



## Treatment of Bilateral Vocal Cord Paralysis by 810 nm Diode Laser

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**Abstract:** This is prospective study began in Jan. 2003 and concluded in April 2004, was undertaken to examine the benefits of 810 nm diode laser in treatment of four patient with bilateral vocal cord paralysis also to compare the results with conventional treatment Material and methods: 810 nm diode laser 15 watts was used in these cases under general anesthesia, and induction of anesthetic drug done through tracheostomy tube in all patients. All patients were decannulated "Tracheostomy tube removed", the voice of all preserved within normal. Laser surgery in this case has more benefit and advantage than conventional methods even if the patient need more than on session of laser operation because of high success rate, less complication and easy technique.

### Introduction

The treatment of vocal cord paralysis remains one of the difficult problems in laryngology. This condition most commonly results from injury to both recurrent laryngeal nerves during thyroid surgery; less frequently it is caused by some other external injury to the larynx or neck, or may be due to neurological disorder. Initially these patients have a fairly

adequate laryngeal airway with a breathy voice. After varying periods of time, while the voice improves, the airway becomes inadequate, leading to dyspnoea and stridor.

They invariably end up with a tracheostomy. Tracheostomy was required in about 51 cent of cases of bilateral paralysis, in a series reported by Holinger et al (1976). Various surgical methods have been used from time to time (Table 1).

Table (1) Bilateral Vocal Cord Paralysis

Surgical procedure	Historical Review
Hoover (1932):	Submucous resection (SMR) of the vocal cord (VC)
Lore (1936):	SMR of V.C. + Arytenoidectomy
Kelly (1941):	Extralaryngeal Arytenoidectomy
Orton (1944):	Modified Arytenoidectomy
Woodman (1946)	Modified Arytenoidectomy +Cord Lateralization
Thornell (1957)	Intralaryngeal Arytenoidectomy +Cord Lateralization
Miehleke (1974)	
Doyle et al. (1967):	Anastomosis of the severed recurrent laryngeal nerve
Tuker (1976)	Nerve-Muscle Pedicle Reinnervation

The main aim of the treatment has been to provide an adequate laryngeal airway so as to get rid of tracheostomy tube. Although woodman's arytenoidectomy (Woodman, 1953) and nerve-muscle pedicle reinnervation (Tucker, 1978) have been reported to yield better results, the failure rates for both procedures have remained significantly high, 20 to 40 per cent for the former and 18 per cent for the latter (Tucker, 1983).

The purpose of this paper is to present a preliminary report on a prospective study on the use of 810nm diode surgical laser in the management of bilateral vocal cord paralysis. Besides being an uncomplicated one, the procedure has so far given high percent success.

The use of laser has its own added advantages: it provides a great degree of precision, an almost completely bloodless field, minimal post-operative oedema, and rapid post-operative healing without the formation of scar tissue.

### **Material and Methods**

Four patients with bilateral vocal cord paralysis on whom tracheostomy had been done, were managed at Al-Yarmouk teaching hospital during a period from January 2003 till April 2004, two of them due to thyroid surgery, the third one is due to head injury and the fourth due to idiopathic cause neurological, i.e., intracranial lesion. Endoscopic laryngeal laser surgery was done under general anesthesia. The type of laser used in my study and instrumentation, dose parameter, safety rules, procedure were applied as follow:

#### ***Surgical Laser system***

The Dio-med surgical laser delivering 15 watts model of continuous wave laser radiation, the laser energy is delivered to the treatment site by means of a flexible optical fibre coupled to the laser aperture. The Dio-med surgical laser incorporate class IV GaAIAs (Gallium Aluminum Arsenide) diode laser with wavelength in the range 790-830 nm and visible (aiming beam) 4 mW class IIIa diode laser with wave length in the range 630-660 nm.

#### ***Procedure***

Two techniques were used in management of BVCP, first technique I apply endoscopic resection of vocal process of arytenoid and

resection of posterior third of ipsilateral vocal cord. This was done in two cases.

The other technique I apply endoscopic Arytenoidectomy with resection of posterior ipsilat vocal cord, this was done in other two cases.

#### ***Instrumentation and Accessory***

To expose the larynx, laryngoscope used which connects with light source for illumination; suspensor use for fixation of laryngoscope in certain position these allow getting two hands free. Microscope 400 lens for magnification was used. Bare fibre of 600  $\mu$ m was used with specific laryngeal hand pieces with channel for suction clearance.

#### ***Dose Parameter***

The power was 5-10 watts, 5 watts were used in resection of vocal process of arytenoid, and 10 watts was used in arytenoidectomy. The laser mode is continuous, controlled by foot piece.

#### ***Safety***

Safety to the surgeon and personnel is mainly for eye protection by wearing goggle of WL 780-830 nm with optic density > 5.

Safety to the patient aiming of protection of eyes and also airway protection eyes covered with wet drapes. Protection of airway either by using anaesthetic tube specialized of laser operation; metallic spiral type. Or wrapping the proper tube with foil Aluminum paper to prevent ignition. In my study induction of anesthesia was done through trcheostomy tube in all patients.

#### ***Evaluation of the Result postoperatively***

Post operatively evaluation depends on successfully closing the tracheostomy which was present preoperatively. Or relieve respiratory distress if there is no tracheostomy. Also keep the speech acceptable.

Another parameter was used for assessment in two patients, which test the pulmonary function preoperatively and postoperatively. An improvement was found in figure preoperatively as it was low to almost near normal postoperatively (normal figure 70-80%).

$$\frac{FEV_1}{FVC} = \frac{\text{Force Expiratory Volume in one sec}}{\text{Force Vital Capacity}}$$

**Results**

Four patients, two of them thyroid surgery was cause of injury to both recurrent laryngeal nerves while in one case it was due head injury and other was due neurological disorder.

All tracheostomised immediately after injury or damaged to the nerve except case No. 1 by which tracheostomy was done two years after injury to nerve (table No.2). All patients presented immediately after injury to the nerve with stridor except the case No. 1 as in Table 3 . All decanulated after diode laser surgery except one case No. 4 decanulation was few days after surgery in cases 1 and 3 in which technique

excision of vocal process arytenoid cartilage and posterior part of vocal cord was done.

While decanulation was late in case (No. 2) and (No. 4) in which technique excision of arytenoid and posterior part of vocal cord was done (Table 4).

Evaluation of patient postoperatively can be considered by pitch of voice, decanulation and pulmonary function test which was done in two cases (No. 1 and 3) as in Table 5.

$$\frac{FEV_1}{FVC} = \frac{\text{Force Expiratory Volume in one sec}}{\text{Force Vital Capacity}}$$

**Table (2)** Patient Summary

Patient	Age	Sex	Duration of BVCP	Tracheostomy	Cause of BVCP
1- BH	24 y	♀	2 y	+ ve	Thyroidectomy
2. AA	50 y	♂	6 m	+ ve	Neurological
3. Km	46 y	♂	7 m	+ ve	Throidectomy
4. SA	15 y	♂	6 m	+ ve	Head Injury

**Table (3)** Presentation of Patients Pre-operatively

Case No.	Speech	Breath
1	Good	Respiratory distress
2	Good	Stridor
3	Good	Stridor
4	Good	Stridor

**Table (4)** Laser techniques used in management of BVCP

Case No.	Laser Technique	Follow Up	Time of Closure
1	Excision of vocal process of arytenoid with posterior part of V.C	Decanulated	After few days
2	Excision of arytenoid and posterior part of vocal cord	Decanulated	After two months
3	Excision of vocal process of arytenoids and posterior part V.C	Decanulated	After few days
4	Excision of Arytenoid and posterior part of vocal cord	Decanulated	After 2 months

**Table (5)** Criteria for evaluation of patients BVCP managed by diode laser post-operatively

Case No.	Speech	Breath	Pulmonary Function test	
			Pre-operative	Post-operative
1	Good	Closure	40% before tracheostomy 10% (tracheostomised)	70%
2	Good	Closure		
3	Good	Closure	10% (tracheostomised)	70%
4	Good	Closure		

### Discussion

BVCP causes sever airway compromise with good voice. The principle goal of the therapy is to improve the airway and at the same time maintain good voice quality traditionally, surgical options have included permanent tracheostomy with speaking valve, cordectomy, vocal cord lateralization and vocal cord reinnervation procedure. These performed endoscopically or through external approach. At present time most commonly practiced procedure are

arytenoidectomy either via external approach (Woodman technique) or via endoscopic technique.

But now with development of CO<sub>2</sub> laser, the procedure of choice in treatment of BVCP is endoscopic arytenoidectomy with or without complete or partial resection of ipsilateral vocal cord with CO<sub>2</sub> laser (Carruth 1987).

With precision, great ease and in blood less field. The CO<sub>2</sub> laser has been the most frequently used laser in the larynx. In my study I

used diode laser in management of BVCP and I used two technique, the first technique applied on case No. 1,3 in which excision of vocal process of arytenoid and posterior part of vocal cord was done and patients get benefit from operation as they were decanulated few days postoperatively with good voice. So diode laser by this technique provides a great degree of precision, an almost completely bloodless field, minimal postoperative oedema, and rapid postoperative healing without the formation of scar tissue and in comparison with CO<sub>2</sub> laser the advantage is the same except that the use of CO<sub>2</sub> laser allows the otolaryngologist surgeon to perform a precise operation through the relatively narrow field of the laryngoscope without the need for tissue manipulation (hands-off surgery).

Other technique used in cases 2 and 4 in which excision of the arytenoid and posterior part of ipsilateral vocal cord was done. I faced difficulty peroperatively like time consuming on cutting the arytenoid with more bleeding, also postoperatively decanulation was late as in 2nd case and 4<sup>th</sup> cases. The time measured from starting cutting by laser till the end of operation by the first technique, it was a few minutes, while the second technique it was about one hour duration. Delayed decanulation in the second technique was due to odema of posterior laryngeal region. There are, however, other different techniques to perform laser endoscopic operation one of these techniques was first introduced by Strong et al. in 1976 and Groft in 1984 in which wide resection of the true vocal cord with good result in a short series (Carruth 1987). Shaheen in 1988 preferred to do posterior wedge excision of one vocal cord in conjunction with laser ablation of homolateral arytenoid. Ossoff et. al in 1984 reported success in 10 of 11 patients by laser arytenoidectomy in which the cartilage was exposed and vaporized with laser. Prasad (1985) also reported successful outcome in short series of 6 patients who had been subjected to CO<sub>2</sub> laser vaporization of the part of the cord and vocal process of arytenoid rather than whole arytenoid cartilage. Dennes et. al 1989 reported a successful and good result in these series of 6 patients who had been subjected to posterior partial cordectomy. Szmaja-Z 1993 used a technique of arytenoidectomy and ipsilateral posterior part cordectomy by CO<sub>2</sub> Laser. The use of this method gave good result in preserving breathing and phonation, it was also emphasized that the fast process of healing

and lack of granulation in operated field allow for the quick recovering patient. Remacle-M 1996 reported subtotal CO<sub>2</sub> laser arytenoidectomy, the principle modification involve preservation of thin posterior shell providing good postoperative fixation of arytenoid region, the risk of aspiration is thus averted. Also Izquierdo-Luzon-J 2001<sup>(10)</sup> reported the same procedure subtotal arytenoidectomy and posterior cordectomy with the CO<sub>2</sub> laser in treatment of bilateral vocal cord paralysis.

### Conclusion

Four patients with bilateral vocal cord paralysis who had worn tracheotomy tube for varying periods of time were treated by diode laser by using the technique excision of vocal process of arytenoid and posterior part of ipsilateral vocal cord give the same advantage of the CO<sub>2</sub> laser as bloodless field and ease procedure, the two patients operated on by this technique have been successfully decanulated.

In spite of problem of the other technique (excision of arytenoid and posterior part of ipsilateral vocal cord), it has an advantage over traditional surgical methods, as less instrumentation, less manipulation, less time consuming and easy technique.

Further studies are needed because the number of cases is low.

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## علاج شلل ثنائي الأوتار الصوتية بوساطة ليزر الدايبود 810 نانومتر

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**الخلاصة** تضمن هذا البحث دراسة سريرية لاستخدام ليزر الدايبود 810 نانومتر في علاج شلل ثنائي الأوتار الصوتية أجريت لاربعة حالات في مركز مستشفى اليرموك التعليمي من الفترة كانون الثاني 2003 إلى نيسان 2004. الاسباب التي تؤدي الى شلل الاوتار الصوتية والاكثر شيوعاً هي الضرر الذي يصيب العصب المغذي لعضلات الحبال الصوتية خلال عمليات الغدة الدرقية وكذلك اسباب اخرى منها الشدة الخارجية واصابات الحنجرة وكذلك اسباب عصبية نتيجة تآثر تجويف الجمجمة باصابات الشدة الخارجية أو امراض اخرى كالنزف والاورام. الشكوى أو الاعراض التي تظهر على المريض هو انسداد الحنجرة وبالتالي ضيق التنفس الخانق والتي تستوجب عملية الفتحة الرغامية وهي عملية طارئة ومنقذة للحياة لغرض تامين التنفس . وقد استخدمت أكثر من طريقة في المعالجة بالليزر وكانت النتائج جيدة ومثيرة للاهتمام قياساً بالمعالجة بالطرق التقليدية وتظهر النتائج برفع الأنبوب الرغامى والإمكان من التنفس من خلال المجرى التنفسي الطبيعي وكذلك المحافظة على نوعية الصوت بالحدود الطبيعية .