

Role of CO₂ laser and Diode laser in ENT diseases

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Abstract :

Laser is known as light amplification by stimulated emission of radiation. ENT surgeons use laser to improve care of patient in many ways. Due to evolution of laser surgical approach has been revolutionized by the ability to perform minimally invasive, highly precise surgery, suitable for a wide range of treatment for ENT diseases. Total 83 patients of various age groups were included in our study for treating various ENT diseases using CO₂ and diode laser. CO₂ laser is most commonly used laser due to its precision, minimal charring, less bleeding where as diode laser is used in "contact" mode for deeper tissue planes (intranasal, oral and micro-laryngeal) due to its special wavelength. Diode laser offer delicacy in contact mode or good coagulation in non-contact mode. Laser have ability to stop bleeding simultaneously with cutting action, allowing rapid bloodless surgery, reducing anaesthetic time, quick recovery and little pain in postoperative period. This study was undertaken to determine usefulness and effectiveness of lasers.

Key words : CO₂ laser, Diode Laser

Introduction:

State of the art of electronics and advanced technologies are new to medicine. Machines have aided man throughout the ages. The perception of the laser has moved from the laboratory into everyday conventional surgery. The introduction of laser into routine ear, nose and throat surgery has gradually given way to a more balanced and realistic attitude to its uses and limitations. The major advantage of laser is its precise incision, bloodless surgery, and reduced postoperative troubles. Due to their unique properties, lasers have certain advantages over conventional methods. Their surgical application can be enhanced by in depth appraisal of these properties and how they react with biological tissues. The delivery of the laser energy to the surgical site in dark and narrow passages poses a challenge.

The purpose of choosing this topic is to know what the potential lasers users need to acquire as new surgical skills and, in order to achieve an anticipated surgical outcome, to understand the performance of each laser in a systematic manner.

Aims and objective:

1. To study the various types of laser and their application in otorhinolaryngology.

2. To study the indication and complications of various types of lasers in otolaryngology.
3. To study effectiveness of lasers and their efficacy.

Methods:

The present study involves the review of 74 patients, who were treated with the CO₂ laser and retrospective study of 9 patients in whom diode laser was used.

Table 1. : Comparative properties of CO₂ laser & diode laser.

Properties	CO ₂ Laser	Diode Laser
Type of Material	Gas	Semiconductor
Wavelength	10,600	840
Tissue Absorption	High	High
Tissue Penetration	0.1	0.3-0.6
Coagulation	Low	Medium
Cutting Effect	High	Medium

Most of the patients were operated under general anaesthesia and others in local anaesthesia. When an oral endotracheal tube was used for intubation, it was wrapped with aluminium foil or laser protective metallic tube with two bulbs was used. Bulb was inflated with methylene blue. For additional protection, the surrounding area was covered with moist gauze and eyes protected with pad or moistened gauze. A catheter is passed through nose to the pharynx to evacuate laser fumes.

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All patients undergoing laser surgery with Diode laser system were performed in “contact” mode using a flexible silica fibre(400 or 600 micromm core diameter) that was fixed into a specially designed for precise fibre guidance system. In contact mode tip of the laser is placed directly on the surface of tissue and used for photocoagulation (low and medium) and vaporization (high power). The CO₂ laser excision was done with or without the use of operating microscope (Zeiss microscope) with a micromanipulator and the mode of laser was adjusted according to the site of lesion and amount of action required. For microscope CO₂ laser surgery micromanipulator with 300 micron spot size at 400mm working distance is used. For premalignant lesions, the limits were first marked and then vaporization or excision was performed. Healing following laser surgery generally progressed well. Re-epithelisation was complete after 4-6 weeks and the newly formed epithelium appeared healthy in most patients. There was little postoperative scarring and tissues were soft on palpation.

Complications were noted immediately and subsequently when they developed. Postoperatively patients were examined at 3 days, 1 week, 1 month and 6 months thereafter.

Results:

A total of 83 patients are included in this study out of which 55 were male and 28 females giving male:female ratio of 1.96:1.

Table 2: Distribution of the patients as per anatomical site involved

Part involved	No. of patients	Percentage
Larynx	42	50.60%
Oral Cavity	23	27.71%
Face(Cosmetic)	11	13.25%
Ear	4	4.82%
Nose	3	3.61%
Total	83	100%

Table 3: Cases operated with diode laser

Site	Diagnosis	No. of cases
Larynx	Supraglottic and Glottic Stenosis	4
Oral Cavity	OSMF	2
Larynx	Recurrent Papilloma	1
Larynx	B/L Abductor Palsy	1
Nose	Choanal Atresia	1
Total		9

As shown in Table 2, total 9 cases were operated with diode laser, of which majority, i.e., 4 cases had Supraglottic and Glottic Stenosis and 2 cases were of Oral Submucous Fibrosis (OSMF).

As shown in table 3, total 74 cases were operated with CO₂. Out of total 74, 36 cases had laryngeal lesion, 21 had lesions in oral cavity, 4 patients had ear pathology, 2 cases had nasal lesion and 11 patients had pathology involving facial region.

As shown in table 4, total 61 patients had one or other complications after laser surgery. Most common complication was late granulations followed by immediate oedema, bleeding and recurrence were there.

Discussion:

In last few years, the availability of many different laser wavelengths has expanded the application of laser technology to include laryngology, bronchology, rhinology, otology, general otolaryngology. Co₂ laser is known for its precision, particularly when coupled with microscope for delicate a traumatic surgery.

Our study of 83 patients showed that, CO₂ laser was successfully used in treating soft tissue pathology in 74 patients while diode laser was successfully used in 9 patients. It has been reported in the literature for treating a wide range of lesions from benign conditions to premalignant lesions.⁽¹⁾

In our study 3 cases of bleeding were observed due to the fact that CO₂ laser beam closes disrupted arteries, veins and lymphatic vessels of up to 500micromm.^(2,3) while 96.39% cases had no bleeding as laser has a

Table 4: Cases operated with CO₂ laser

Sr.no	Type of laryngeal case	No. of patients
1	Post corrosive laryngeal stenosis	15
2	Post traumatic stenosis	6
3	B/L abductor palsy	4
4	Ca larynx	4
5	Laryngeal papilloma	3
6	Vocal cord polyp	2
7	Saccular subglottic cyst	1
8	Vocal nodule	1
	Total	36
Sr.no	Type of oral cavity lesions	No. of patients
1	Tongue tie	6
2	Carcinoma tongue	4
3	OSMF	3
4	Leukoplakia	3
5	Cyst	2
6	Tonsillectomy	1
7	Papilloma	1
8	Microstomia	1
	Total	21
Sr.no	Type of ear pathology	No. of patient
1	Keloid excision	2
2	Hemangioma	1
3	stapedotomy	1
	Total	4
Sr.no	Type of nasal cases	No of patients
1	Skin tag on vestibule	1
2	B/L choanal atresia	1
	Total	2
Sr.no	Type of nasal cases	No of patients
1	Basal cell carcinoma	1
2	Mole on face	10
	Total	11

haemostatic effect. ⁽²⁻⁵⁾ Hemostasis results in an increased visibility of the surgical site. ^(6,7,8) As a result we observed reduction in surgery time, particularly in cases of larynx and oral cavity where achieving hemostasis and good visibility is an issue. ^(8,9)

In our study postoperative edema was noted in 6 cases. The reduced inflammation is accompanied by reduced postoperative pain, edema and swelling.

As laser doesn't crush, tear and bruise the tissue, wound didn't require suturing ^(6, 7) dressing and healed by second intention in our study. ⁽⁵⁾

No patient in our study complained of severe pain. The pain was found to be significantly lower after a laser resection as it cuts nerve endings compared to a scalpel resection with conventional wound care. No case of infection or cross infection was seen in laser wound in our study as no direct contact was required with the tissue and the tip of the probe in contact mode is at very high temperature. ⁽¹⁰⁾

No accident involving the use of CO₂ or diode laser was found in the study. 9 cases of carcinoma were treated in our study. Out of which 1 case of Ca larynx developed recurrence and required tracheostomy. He was referred for radiotherapy. Thus results of laser surgery in early carcinoma are equal to that achieved in radiotherapy with no dissemination of cancer cells.

In our study inflammatory edema is noted in 6 cases as laser surgery is represented by the histological evidence of a thermal alteration around the zone of laser tissue ablation.

In our study slough was present in patients with minimal granulations in laryngeal cases due to the thermal damage around the laser incision/ablation. This mainly applies to the first 7 days of wound healing regard to histological and biochemical parameters ⁽¹¹⁻¹²⁾ and coincides with delayed inflammation. ⁽¹³⁾ With the use of laser the number of patients operated under local anaesthesia and on OPD basis has increased.

One major drawback is that the surgeon receives no information about the actual ablation depth or information about the ablated tissue at the bottom of the cut when operating deep to superficial layer.

For patients is advantageous in form of 1) less postoperative pain, less apparent bleeding and

Table 5: Complications of laser surgery.

Sr. No	Type of Complication	Larynx	Oral Cavity	Facial	Ear	Nose	Total No. of Cases
1	Immediate edema	4	2	-	-	-	6
2	Bleeding	1	2	-	-	-	3
3	Subcutaneous emphysema	-	-	-	-	-	-
4	Late granulations	17	2	-	-	-	19
5	Recurrence	3	-	-	-	-	3
6	Infection	-	-	-	-	-	-
7	Numbness	-	-	-	-	-	-
8	None	25	19	11	4	2	61

Table 6: Distribution of patients as per type of admission and average time for discharge

Type of admission	Number of patient	Discharged		
		After 2-3 hrs	After 24 hrs	After 2-3 hrs
O.P.D	15	15	-	-
Admission	68	-	43	25

Table 7: Occurrence of complication and requirement of regular follow up

Type of cases	No complications and follow up uneventful	No complications but required observation	Complication and required regular follow up
O.P.D	15	-	-
Admission	5	44	19

swelling 2) reduced surgical time 3) reduced cost of surgery as it becomes a day care procedure 4) earlier return to work.

Conclusion:

The CO₂ laser is widely used in E.N.T speciality because of its precise and predictable soft tissue interaction, minimal damage to surrounding normal tissue and minimal formation of char. Diode laser is ideally suited for intranasal, oral and micro-laryngeal use as it is used in “contact” mode for deeper tissue planes. CO₂ laser requires minimal instrumentation with bloodless dissection that leads less post-operative troubles, quicker recovery and shorter hospital stay. CO₂ laser is highly effective to cure early stage of cancer (T1 and T2) in E.N.T. The cost of laser surgery is more due to

stringent theatre protocols and high cost of purchasing laser machine but diode laser is economical as compared to CO₂ laser.

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