Section: ENT

Original Research Article

CLINICAL OUTCOME OF CO2 LASER EXCISION OF VARIOUS TYPES OF ORAL LESIONS

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ABSTRACT

Background: LASER (Light Amplification by Stimulated Emission of Radiation) has been widely used in medicine for decades. The CO_2 LASER provides precise tissue excision with excellent haemostasis through absorption of tissue water, making it useful for excision of benign, premalignant, and malignant oral lesions. The aim & objective is to assess the clinical outcomes of CO_2 LASER excision in various oral lesions and evaluate the spectrum of oral lesions presenting to a tertiary care centre in Assam.

Materials and Methods: A prospective observational study conducted over 1 year among 54 patients aged ≥12 years undergoing CO_2 LASER excision for oral lesions. Detailed history, clinical examination, intraoperative findings, postoperative assessment, and follow-up at 1, 3, 12 months were recorded and analysed.

Results: The study showed male preponderance with a mean age of 42.48±18.86 years. Leukoplakia, verrucous carcinoma, papilloma, pyogenic granuloma were the most common lesions. Most procedures (62.96%) were completed within 10 minutes. Intraoperative bleeding was absent in 78% of cases, and only 12.96% required suturing. Mean postoperative pain score was low (VAS 2.4). Postoperatively, 96.3% had no bleeding or oedema & none had scarring or pigmentation. 92.59% patients were discharged on the same day and 91% resumed a routine diet within 1 week. One surgical site infection & two verrucous carcinoma and one leukoplakia recurrence were noted.

Conclusion: CO_2 LASER excision is a safe and effective modality for oral lesions, offering minimal bleeding, less postoperative morbidity, and faster recovery.

Keywords: Oral lesions, CO2 LASER.

INTRODUCTION

LASER meaning Light Amplification by Stimulated Emission of Radiation," has been in use for more than a decade. Carbon dioxide (CO2) laser was the first type that was used in medical treatments. Surgical lasers are instruments that produce continuous "light beams from the infrared to ultraviolet regions of the spectrum by amplifying light.[1] Generating light beams with a wavelength of 10,600 nm that cause haemostasis when absorbed by tissues' water, enabling the removal of varied soft tissue diseases.[2] CO_2 laser excision provides excellent precision and tissue selectivity. The depth of excision can be accurately regulated by modifying the laser power settings and duration of exposure.[3] Clinical and experimental studies have demonstrated that wounds produced by the CO_2 laser differ significantly from those created by conventional scalpel excision, both in their biological response and healing characteristics.[4]

The oral cavity represents the initial portion of the digestive system. Anatomically, it is bounded anteriorly by the vermilion border of the lips, superiorly by the hard and soft palates, laterally by the anterior fauces, and posteriorly by the junction of the anterior two-thirds and posterior one-third of the tongue.

Most oral soft tissue masses are reactive hyperplastic lesions resulting from chronic local trauma or

infection and arise from connective tissue, epithelium, or both.[5]

Oral cancer is the eighth most frequent cancer worldwide, with over 300,000 new cases reported each year.[6].

Laser excision produces a surface coagulum of denatured proteins with minimal collateral tissue damage, allowing wounds to heal by secondary intention without the need for dressings. Additionally, the reduced inflammatory response and lower myofibroblast activity result in minimal postoperative wound contraction.[7]

With scalpel use, there is an increased chance of bleeding causing difficulty identifying tumour margins, increased post-operative edema, increased risk for bacterial contamination of the site with poorly sterilised scalpel, also more thermal damage to nearby area while using diathermy causing inadequate histopathological assessment of the margins of the specimen.

Owing to its precision, excellent hemostatic properties, and favorable wound-healing characteristics, laser surgery has become an established modality for the management of a wide range of oral lesions. It is commonly employed in the treatment of benign conditions such as fibromas, vascular lesions, mucoceles, gingival hyperplasia, as well as premalignant lesions including leukoplakia and erythroplakia, and selected malignant lesions such as squamous cell carcinoma, verrucous carcinoma, and mucosal melanoma. The use of the CO_2 laser offers several advantages, including reduced postoperative pain, edema, bleeding, scarring, and pigmentation changes, while preserving tissue margins and minimizing bacterial contamination of the surgical site.[2]

AIMS & Objectives:

1. To assess the clinical outcome of CO2 Laser in excision of oral lesions.
2. To evaluate the various types of oral lesions attending Department of Otorhinolaryngology, of a Tertiary Health Care Centre of Assam.

MATERIALS AND METHODS

Study Design: Prospective Observational Study

Study Population: Patients with various oral and lip lesions in the age group of more than 12 years, fulfilling the inclusion criteria.

STUDY PERIOD: 1 year, from November 2023-October 2024.

Sample Size: Sample size is calculated by using the following Danial sample size formula.

N= {Z2 X p (1-p)}/d2

Where, N= Sample size

Z= Statistics for a level of confidence (For the level of confidence of 95%, which is convention, Z Value is 1.96)

p= expected prevalence or proportion (Prevalence of Oral mucosal lesions is 16.8%).[8]

d = precision (d is considered 0.1 to produce good precision and smaller error of estimate)

So, the sample size is calculated as 54.

Thus 54 patients was included serially for the study, after fulfilment of inclusion and exclusion criteria.

Inclusion Criteria: All patients of 12 years and above attending department of ENT with oral lesions like fibroma, vascular anomalies, mucoceles, gingival hyperplasia, mucosal frenulas, tongue ties, oral Leukoplakia, Erythroplakia, Papilloma, mucosal melanoma, Verrucous carcinoma etc who gave consent for the study and laser therapy was included in the study.

Exclusion Criteria

1. Patient below 12 years of age.
2. Patients with extensive diseases requiring exploration of other anatomical region other than primary site.
3. Patients with bleeding diathesis, uncontrolled medical illness, anaemia, and acute infection.

Pre-operative evaluation: Informed consent was obtained from all patients included in the study. A detailed history and clinical examination and relevant investigations were recorded as per the proforma. After fulfilment of inclusion and exclusion criteria, all the 54 patients were posted for CO2 LASER excision under local anaesthesia.

The following parameter were assessed and recorded:

Intra-operative assessment of: Pain, hemorrhage, requirement of suturing, duration of surgery, CO2 LASER settings.

Immediate post-operative assessment of: Pain, hemorrhage, pigmentation, charring, edema, duration of hospital stay, days to return to normal diet.

Assessment after 1month, 3 months, 12months for: scarring, pigmentation, surgical site infection, recurrence, final histopathology.

Procedure: Position: Supine with LASER protective eye cover.

Anesthesia: infiltration in and around the lesion with Local anesthetic agent.

Surgical steps: After adequate antiseptic and aseptic dressing and draping, taking care of all LASER safety precautionary, local anaesthesia infiltrated in and around the lesion. CO2 LASER machine was set up accordingly and using the hand piece with precise skill and surgical anatomy knowledge, the lesion was excised and sent for histopathology. After achieving haemostasis, patient sent to post-operative ward.

Intra-operatively, Pain was assessed with Visual Analogue Scale (VAS)[9], presence or absence of intraoperative bleeding noted, duration of surgery was noted from initiation of anaesthesia till achieving haemostasis.

Post operatively, oral cavity was assessed for any bleeding, charring, pigmentation, and oedema. The average post-operative pain of post-operative days 0 & 1 was assessed with VAS score and duration of hospital stay & number of days required to return to normal diet were also recorded. This was calculated based on subjective improvement and initiation of normal regular solid diet by the patient.

The patients were re-assessed of scarring, pigmentation, surgical site infection, recurrence of disease and requirement or reintervention at 1month, 3months and after 12 months post-surgery with their histopathology reports.

Statistical Analysis: This study with 54 patients above 12 years with varied oral and lip lesions who underwent CO2 LASER excision was conducted in the Department of Otorhinolaryngology and Head and Neck surgery for a period of 1 year. The data of all the patients were recorded and analysed accordingly.

The data are tabulated in Microsoft excel and analysed with SPSS V.24 software. The continuous variables are presented with mean and standard deviation. The categorical variables are presented with frequency and percentage. Chi square test is used for the statistical analysis. The p value ≤0.05 is considered statistically significant.

RESULTS

Table 1: Demographic characteristics

Demographic characteristics		Values	
		Mean	SD
Age (in years)		42.48	18.86
Sex	Female	19	35.2%
	Male	35	64.8%

The study show a Male: Female ratio of 1.84:1. Most of the patients were aged between 40-60 years, with the mean age of presentation being 44.48±18.86 years.

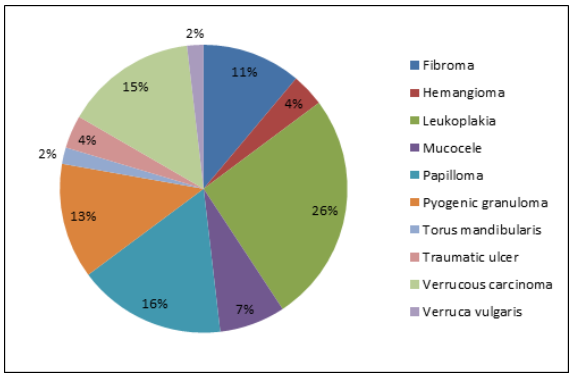


Figure 1: Distribution of various oral lesions

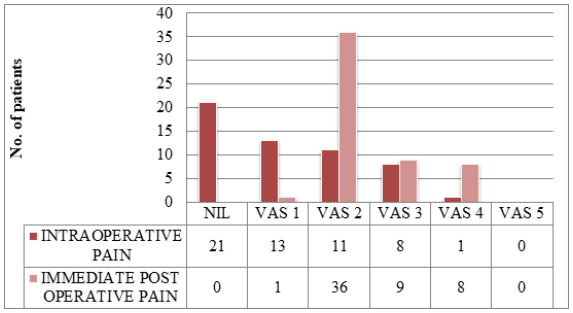


Figure 2: Assessment of pain

(Intra operative & immediate Post operative)

The mean VAS score for intra operative & immediate post operative calculated is 1.16 & 2.4 respectively.

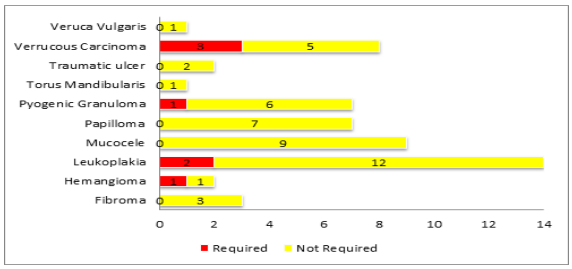


Figure 3: Requirement of intraoperative suturing

Only 7 (12.96%) patients required intraoperative suturing, out of which, 3 was for Verrucous carcinoma, 2 for Leukoplakia involving angle of mouth reconstruction. 1 each for Pyogenic granuloma & Hemangioma having bleeding.

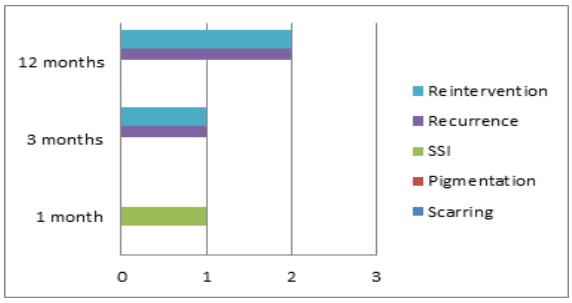


Figure 4: Assessments at 1 month and 3 months & 12months post-surgery.

There was 1 (1.85%) case of Surgical site infection in traumatic ulcer at 1month which recovered by 3months. There was 1 (1.85%) recurrence of Leukoplakia at 3 months whereas 2 (3.7%) recurrences of Verrucous carcinoma at 12 months.

Table 2: CO2 Laser settings

CO2 LASER settings	Values	
	Mean	SD
Power (in Watt)	6.94	0.77
Aiming (in percentage)	20.37	20.09
Total energy (in Joules)	222.28	133.41
Total time (in seconds)	31.11	16.8
Emission (pulsatile) (N, %)	54	100.0%

All the excision was performed in Pulsed mode, with a Power ranging from 6 to 8 watts, with mean expenditure of 222.28±133.41 joules of energy. The average aiming beam is 20.37%.

Table 3: Immediate post-operative haemorrhage, charring &oedema

Parameters	Present	Percentage	Absent	Percentage	P value
Haemorrhage	2	3.7	52	96.3	0.039
Charring	8	14.8	46	85.2	
Oedema	2	3.7	52	96.3	

Only 3.7% had immediate post-operative bleeding and oedema, and 8 (14.8%) had charring over the wound immediate post-surgery which was found significant.

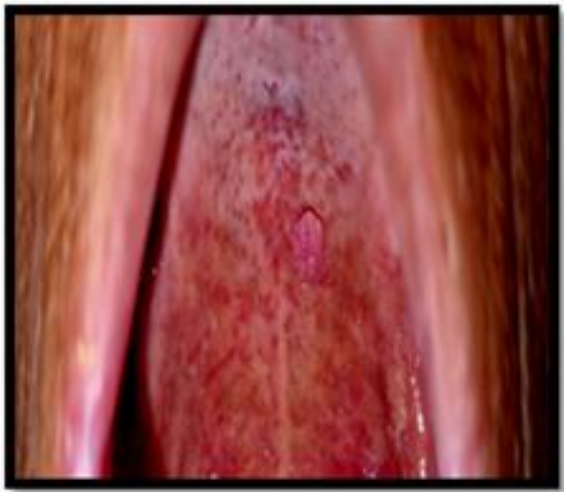


Illustration 1: Preoperative image of papilloma over hard palate.



Illustration 2: Immediate post operative image of CO2 Laser excision of papilloma over hard palate.

DISCUSSION

In this study of 54 patients with varied oral pathologies undergoing CO2 Laser excision under local anaesthesia at Department of Otorhinolaryngology & Head and Neck Surgery from November 2023 to October 2024 were recorded and analysed.

Detailed analysis was done and compared with several similar studies by varied authors all over the world.

In the present study, patients aged ≥12 years were included, with a mean age of 42.48±18.86 years. Similar findings were reported by Torres-Domingo et al., who observed a mean age of 50.5±18.67 years among patients with benign oral lesions.[10] Other authors such as Chang F. et al., Lawoyin et al., and Muench et al. also documented mean ages ranging from 30–50 years.[11-13]

The present study showed a male predominance with a male:female ratio of 1.84:1. This differs from studies by Lee KW et al., Keer DA et al., and Al Khateeb et al., which reported a slight female predominance.[14-17] In the present study, pyogenic granuloma and papilloma showed female predominance, corresponding to studies by Vilman et al, Al Khateeb et al., and Neville et al., who suggested hormonal influences as a contributing factor.[18-19]

Premalignant and malignant lesions such as leukoplakia and verrucous carcinoma were more common in males, consistent with studies by Silverman et al. and Bouquot et al.[20-21]

Among benign lesions, papilloma (16.6%) was the most common pathology treated with CO_2 laser excision, followed by pyogenic granuloma (12.96%), fibroma (11.11%), mucocele (7.4%), hemangioma (4%), and traumatic ulcer (4%). Leukoplakia was the most common premalignant lesion (26%), while verrucous carcinoma accounted for 15% of cases. Saibene et al. similarly reported fibroma, papilloma, leukoplakia, and verrucous lesions as common pathologies managed with CO_2 laser surgery.[22] However, Torres-Domingo et al. observed fibroma as the most common lesion.[10]

Local anaesthesia provided satisfactory intraoperative pain control, with a mean intraoperative VAS score of 1.16. Most patients experienced either no pain or minimal discomfort. Similar findings were reported by Bornstein et al., where topical anaesthesia alone was adequate in many cases undergoing laser treatment.[23] Postoperative pain was also minimal, with a mean VAS score of 2.4 on postoperative day 1, relieved effectively with analgesics. Saibene et al. & López-Jornet et al. similarly reported low postoperative pain scores following CO_2 laser surgery.[22,24]

Intraoperative bleeding was absent in 78% of patients, and only 12.96% required suturing. Postoperative bleeding occurred in only 3.7% of cases. Tambuwal et al. also demonstrated superior haemostasis with CO_2 laser compared with scalpel excision.[25] Saibene et al. and Goodson et al. similarly reported low postoperative bleeding rates.[22,26] Carruth et al. and Strong et al. highlighted

the precision and bloodless surgical field provided by the CO_2 laser in oral cavity surgeries.[27-28]

Most procedures (62.96%) were completed within 10 minutes, corresponding to findings by Saibene et al., where no surgery exceeded 10 minutes.[22] Postoperative oedema was minimal, occurring in only 3.7% of patients and resolving within 2 days. Charring was observed in 14.81% immediately after surgery but healed spontaneously within 3 days. No scarring or pigmentation was noted in the present study. Similar observations were made by López-Jornet et al. and Natekar et al., who reported reduced pain, swelling, and scarring with laser procedures compared with conventional techniques.[24,29]

Only one patient developed surgical site infection, which resolved with antibiotics and dental management. The antimicrobial effect of laser energy and the formation of a coagulated protein layer over the wound surface may reduce bacterial contamination and postoperative infection risk

Most patients (92.59%) were discharged within one week, and 91% resumed normal diet and routine activities within 1 week, indicating faster recovery and reduced morbidity.

Recurrence was observed in two cases of verrucous carcinoma and one case of leukoplakia during follow-up. Similar recurrence patterns have been reported by Saibene et al., Thompson PJ et al., and Jerjes et al., particularly in verrucous leukoplakia and dysplastic lesions treated with laser excision.[22,30-31] Chainani et al. suggested that lesion size, accessibility, and margin clearance significantly influence recurrence following CO_2 laser surgery.[32]

Regarding laser parameters, the mean power used was 6.94±0.76 W, with settings ranging from 6–8 W according to lesion characteristics. Energy expenditure and operative duration increased proportionately with lesion size, showing statistical significance. Saibene et al. emphasized that laser settings remain an underreported aspect in literature and highlighted the importance of standardizing surgical parameters for better reproducibility and comparison of outcomes.[22]

CONCLUSION

This prospective observational study on Clinical outcome of CO2 LASER excision for various oral lesions, reveal that, there are various oral lesions ranging from benign like Papilloma, Fibroma, Granuloma, Mucoceles to premalignant like Leukoplakia and malignant conditions like Verrucous carcinoma prevailing in the population. Usage of CO2 LASER excision for oral pathologies is found to be less painful as well as with lower amount of haemorrhage both intra & post operatively. CO2 Laser itself can be used for both cutting as well as haemostasis, as requirement of suturing & bipolar cauterisation for haemostasis is very low with usage of CO2 laser. With CO2 Laser, surgical duration is also quite low and thus there is increased satisfaction of both patients & surgeon. CO2 laser does not cause any pigmentation, scarring or Edema in and around the wound after surgery. Recovery time is fast and thus patients can resume their daily activities, diet & duties quickly after surgery. Wound healing is faster with CO2 laser as suggested in various literatures but could not be assessed via my study considering it to be a limitation of my study. Margins of lesion sent for histopathology was not assessed in my study, thus generating a limitation of my study on assessing the thermal damage property of CO2 Laser. With diseases like Leukoplakia & Verrucous carcinoma, recurrence rates are more and thus reintervention is necessary irrespective of CO2 laser usage. There is still more to learn and gather knowledge regarding the minimal CO2 laser settings required to excise or vaporise different patterns of oral pathologies, and thus this remains as an area of interest for further deeper studies in future.

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