

A Comparative Study of Diode Laser and Conventional (Scalpel) Technique for Biopsy of Soft Tissue Oral Lesions

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Abstract:

Background: Biopsy is a critical procedure in the diagnosis and treatment plan of surgical cases and is also highly technique-sensitive. Various biopsy techniques are conventionally used with each technique having its own pros and cons. The aim of this study was to compare clinically and histologically mucosal incisions of oral tissues after surgical procedures with scalpel and diode laser.

Materials and Methods: This cross-sectional study was conducted on 15 patients in the study group (laser) and 15 in the control group (scalpel). Statistical analysis was performed with χ^2 test and t-test for independent samples, values lower than 0.05 were considered as significant.

Results: Laser showing immediate hemostasis thus increased visibility during surgical excision procedure. Incisional margins produced by scalpel were well defined than laser groups both clinically and histologically. During excision, procedure heat was produced by laser so area of charring and lateral heat damage was statistically significant in study groups than scalpel. An area of degeneration was seen more with laser than scalpel.

Conclusion: Laser have upper hand over scalpel in relation to hemostasis, but have demerits such as lateral heat damage, tissue necrosis, delayed wound healing, and high cost. Even with advanced treatment modality, conventional scalpel treatment is better option in terms of precise incision, lower cost and faster reepithelization than laser. Heat generating devices may not allow reliable histological interpretations, particularly when assessing margins of small biopsy specimens or malignant conditions

Key Word: lesions, Laser biopsy, Scalpel biopsy, Histopathology

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I. Introduction

Biopsy is the removal of a tissue sample from a living body with the objective of providing the pathologist with a representative, viable specimen for histopathologic interpretations and diagnosis. This approach is used for all tissues of the body, including those of the oral cavity, where a wide spectrum of disease processes may happen. The dental clinician should be aware of the various biopsy techniques that are available for the oral tissues, as well as the challenges specific to these techniques.¹

Biopsy is essential if there is any clinical suspicion of malignancy, such as an enlarging mass, chronic ulceration, tissue friability, indurations on palpation or persistence of mucosal changes despite removal of local irritants.²⁻⁴ New or enlarging pigmented lesions, especially those with an irregular border and non-homogenous coloration, should be biopsied to exclude mucosal melanoma. Entities that appear to be clinically benign or reactive (e.g., pyogenic granuloma or mucocele) may be excised for esthetic or functional reasons, but the tissues should be submitted for histological analysis to confirm the clinical impression. Lichen planus, mucous

membrane pemphigoid, pemphigus vulgaris and other immune-mediated disorders may present with widespread mucosal erythema and ulceration, and biopsy is essential for definitive diagnosis.

Diode laser surgery is becoming widely used for oral surgical procedures. In the past, there have been few studies reporting beneficial effects of diode laser therapy. As surgical cutting proceeds, the heat generated seals small blood and lymphatic vessels reducing or eliminating bleeding and oedema. Denaturated proteins within tissue and plasma give rise to a surface zone of a tenacious layer, termed "coagulum" or "char" which serves to protect the surgical wound from frictional or bacterial action.⁵ Scalpel wounds do not cause any thermal damage but allow extravasations of blood and lymph, causing a more marked inflammatory response with resultant swelling and formation of a scab.⁶ However, healing mechanisms after laser surgery depend on the laser parameters. Laser efficacy depends among other things on laser wavelength used. Shorter laser wavelengths (diode, 810 nm, 980 nm) transverse the epithelium and penetrate 2-6 mm into tissue, whereas longer wavelengths have minimal penetration into the tissue. Additionally, studies with longer wavelengths show that there is a lack of fibroblast alignment associated with the incision line and consequent reduced tissue shrinkage through scarring.⁷ Irrespective of the laser wavelength all soft tissue healing will be led by secondary intention.

Therefore, the aim of this study was to compare clinically and histologically mucosal incisions of oral tissues after surgical procedures with scalpel and diode laser.

II. Material And Methods

Study Design & Study Area: This was Hospital based Cross-sectional study, conducted in the Department of Oral Pathology and Microbiology, RUHS College of Dental Sciences, Jaipur from April-19 to June-19. Informed consent was taken from patients. The procedure was performed by a single surgeon. Ethical clearance was obtained from institutional ethics committee.

Sample Size & Sampling methods: Patients presenting with benign intraoral lesions requiring biopsy were selected for the study by Simple random sampling. 30 participants with oral lesions (either on the buccal or labial mucosa) were involved in the study.

Inclusion criteria

1. Patient with evident oral soft tissue lesion.

Exclusion criteria:

1. Medically compromised patients.
2. With any active other dental/oral infections.

Methods- The diagnosis was established based on clinical appearance of the lesion and confirmed by histopathological evaluation. Oral lesions in the study group were treated with high power diode laser, (LITEMEDICS[®] Diode Dental laser) layer of (Al-In-Ga-As-P) on a (Ga-As) substrate, using wavelength of 975 nm, and power of 5W, continuous mode with the spot size of 0.1-0.5 mm. All lesions in the control group were treated with conventional scalpel (**Scalpel blade of 15 no.**) double elliptic-shape excision and silk sutures. Local anesthetic (UbistesinTM[®], 3M ESPE, Espe Plazt, D-82229 Seefeld, Germany) was administered to all patients before the procedure. Three days after the surgical procedure oedema, haematoma, postoperative pain and patient's satisfaction rate were assessed by the single examiner.(Figure 3) After three weeks patients were recalled again to evaluate delayed postoperative complications. Oedema was assessed as the presence of swollen tissue around incision line and was measured in millimeters using digital caliper. Haematoma was defined as the presence of blood extravasation around the incision line and was measured in millimeters as well. Both oedema and haematoma were measured by the same digital caliper. Post-operative pain was assessed by the patients on 10 cm visual analogue scale (VAS, 0 – no pain at all; 10 worst possible pain). Patient's satisfaction after the procedure was assessed on VAS as well (0 – not satisfied at all; 10 fully satisfied).

Data analysis- Data was recorded on a Performa. The data analysis was computer based; SPSS-22 will be used for analysis. For categorical variables chi-square test was used. For continuous variables independent samples' *t*-test will be used. *p*-value <0.05 was considered as significant.

III. Result

Patients in the study group had significantly lower oedema and haematoma scores compared to the patients in the control group (1.32±0.4 vs. 3.24±1.14 for oedema, 1.22±0.28 vs. 2.18±0.98 for haematoma). Also there is significantly lower pain and higher satisfaction rate compared to the patients in the control group (0.81±0.28 vs. 3.15±1.08; 8.52±0.58 vs. 7.08 ± 1.08)

Table no 1 : Outcome of both techniques

Outcome	Laser	Scalpel	P-value
Oedema(mm)	1.32±0.4	3.24±1.14	<0.05
Haematoma (mm)	1.22±0.28	2.18±0.98	<0.05
VAS	0.81±0.28	3.15±1.08	<0.05
Satisfaction rate	8.52±0.58	7.08 ± 1.08	<0.05

Scalpel and laser techniques were comparable regarding ease of use. Laser was shown immediate hemostasis thus increased visibility during surgical excision procedure. Both clinically and histologically, Incisions' margins produced by scalpel were well defined than laser groups. During excision, procedure heat was produced by laser so area of charring and lateral heat damage was statistically significant in study groups than scalpel. An area of degeneration was seen more with laser than scalpel.

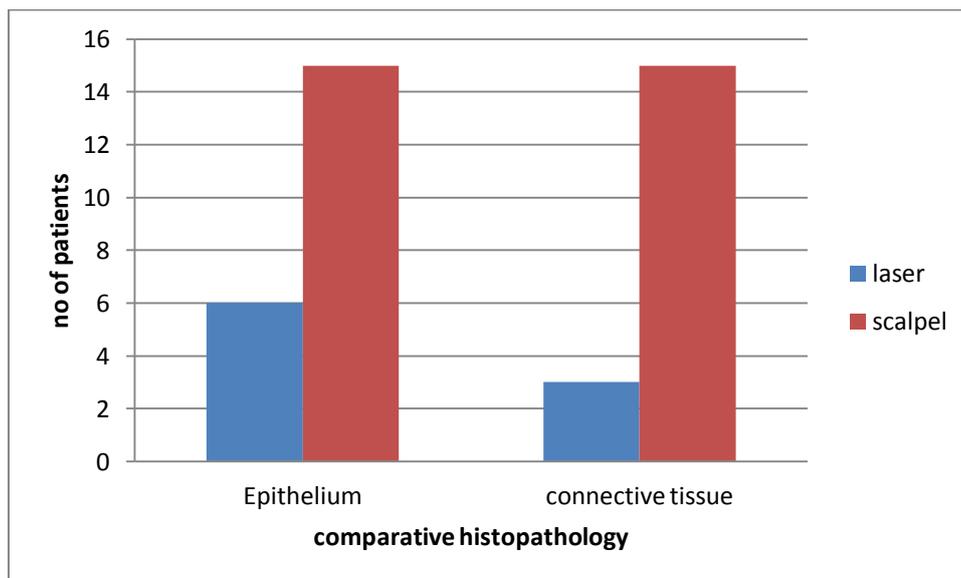
Table no 2 :Comparison of Scalpel and Diode Laser for cutting soft tissue

	Scalpel	Laser
Easy to use	Yes	Yes
Cost effective	Yes	No
Hemostasis	Delayed	Immediately
Incision margin	Well defined	Ill defined
Visibility	Less	More
Heat production	No	Yes
Duration	Less	More
Healing	Best	Better
Post operative pain	More	Less
Degeneration	No	Present
Lateral heat damage	No	Present

Table no 3 : Comparative histopathology

Techniques	Epithelium	Connective tissue
Laser(n=15)	6 (40%)	3 (20%)
Scalpel(n=15)	15 (100%)	15 (100%)

$\chi^2 = 0.24$, $df=1$; P value>0.05, there is statistically no significant difference between two methods. It may be due to our small sample size

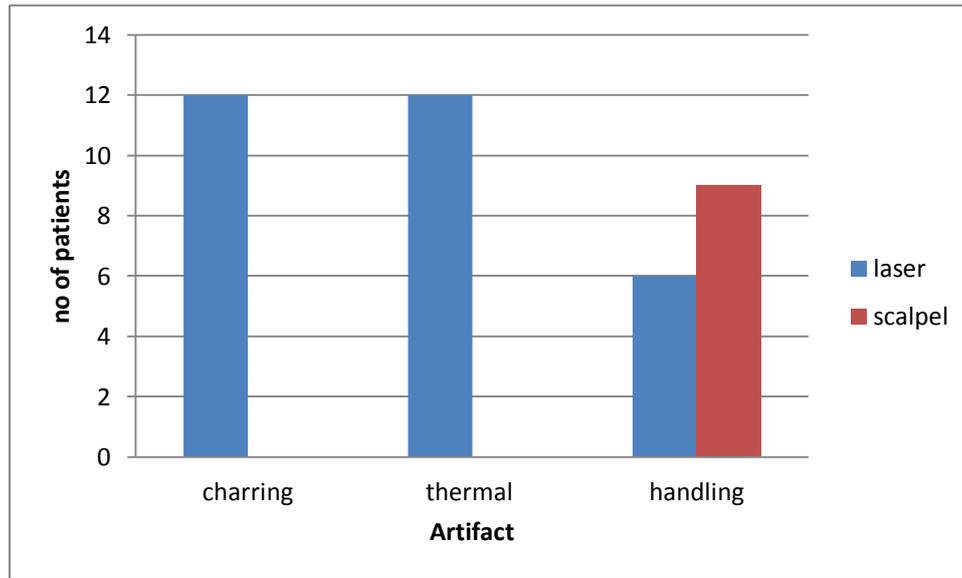


Healing is best with scalpel, whereas satisfactory results can be achieved with laser

Table no4: Artifact seen in Epithelium and Connective tissue

	Charring	Thermal	Handling
Laser(n=15)	12(80%)	12(80%)	6(40%)
Scalpel(n=15)	0	0	9(60%)

P value >0.05, there is statistically no significant difference between two methods. It may be due to our small sample size.



IV. Discussion

Several studies are present in the literature about ⁸⁻¹¹ the use of laser in oral soft tissue biopsy, but only few of them focus on the damage caused by this device at periincisional margins of tissue fragments. Every type of laser can create thermal damage to the target tissues because of the photothermal effect. While lasers work, they heat tissues, causing a temperature increase, at the point of incidence, of more than 100 degrees. Surrounding tissues can be involved in the increase of temperature and so they are permanently or reversibly damaged. Furthermore, the histological exam is linked to the integrity of peri-incisional margins, and this is a basic requirement for a tool employed in biopsies.

Fig.1: Clinical image shows pre operative, intra operative and post-operative conditions of patient



Fig.2: Histopathological image shows tissue excised with scalpel H& E stain, x100

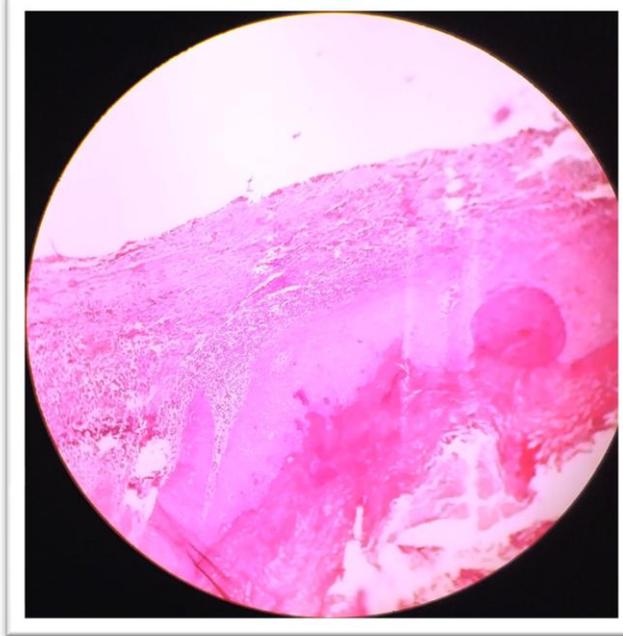
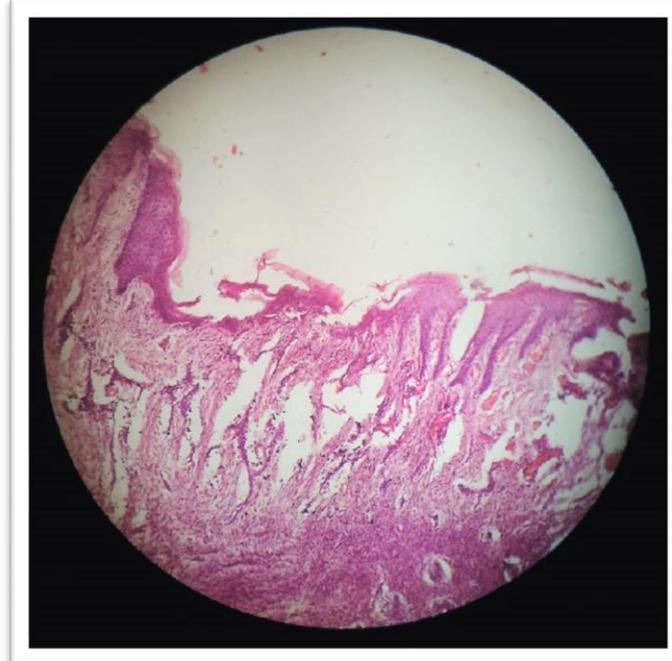


Fig.3: Histopathological image shows tissue excised with laser H& E stain, x100.



In our study patients in the study group had significantly lower oedema and haematoma scores compared to the patients in the control group (1.32 ± 0.4 vs. 3.24 ± 1.14 for oedema, 1.22 ± 0.28 vs. 2.18 ± 0.98 for haematoma). Significantly lower pain and higher satisfaction rate compared to the patients in the control group (0.81 ± 0.28 vs. 3.15 ± 1.08 ; 8.52 ± 0.58 vs. 7.08 ± 1.08).

D'Arcangelo et al.¹² reported that diode laser tends to produce more changes than scalpel with regard to the degree of inflammatory response and delay in tissue organization only at the initial stage. However, long term results of the diode laser on the tissue histology are not known. Histological analysis on rats performed by D'Arcangelo et al.¹² showed that healing after laser surgery is not compromised but rather slower and satisfactory when higher output power (6W) is used. Therefore, they concluded that lasers at lower output power (4W) reduce the effectiveness of the incision, but also minimize thermal damage of the tissue and that use of diode lasers should be further investigated as they are good alternative to scalpel incision and suture repair.

Bryant et al.¹³ evaluated wound healing of soft oral tissues after diode irradiation and concluded that the clinical application in oral surgical procedures had beneficial effect. Results are consistent with that of our study. The absence of bleeding significantly reduces postoperative swelling and discomfort and the absence of sutures can minimize the risk of distortion of anatomy. There are only two studies in humans so far in the published literature which compare healing effects after carbon dioxide (CO₂) laser surgery and scalpel surgery.^{14,15} Jin et al.¹⁶ reported that diode laser is a good cutting device for oral mucosa, however, more tissue damage occurs than with the use of a scalpel or an Er, Cr:YSGG laser. Due to thermal-induced damage, laser as compared to the scalpel, tends to produce more pronounced tissue change. Such changes are associated with an increased inflammatory response and an initial delay in healing response.

The histological observations in the present study suggest that scalpel incisions create the least amount of collateral tissue damage and heal more rapidly than the incisions made by diode laser. Delayed healing can be attributed to damage produced by lateral heat. Lateral heat damage is the area of coagulation necrosis produced around the incision line due to unwanted heat production. Decrease in lateral heat production will improve the healing.¹⁷ Laser produced more degenerative changes in epithelium as compared to scalpel.

The degree of carbonization noted in laser specimens in Kumar et al.¹⁹ (2015) study appears to be in accordance with our study. Filmar *et al*¹⁸. who found comparatively more charring in electrosurgery specimens as compared to our study. Laser techniques produce thermal artifacts that may hamper histological interpretation; accordingly, these methods should be used with caution for diagnostic biopsy or when information from the margins is required. Histologically, laser produced smaller thermal coagulation zone than electrosurgery.¹⁹ The extent of lateral tissue damage is particularly important for incisions in proximity to bone or, in the case of biopsy of pathologic tissue like malignant conditions or small biopsy specimens; extensive thermal damage may compromise histological examination and diagnosis.²⁰

V. Conclusion

Laser have upper hand over scalpel in relation to hemostasis, but have demerits such as lateral heat damage, tissue necrosis, delayed wound healing, and high cost. Even with advanced treatment modality, conventional scalpel treatment is better option in terms of precise incision, lower cost and faster re-epithelization than laser. Heat generating devices may not allow reliable histological interpretations, particularly assessing margins of small biopsy specimens or malignant conditions. Therefore, Still scalpel is considered the gold standard for taking biopsy in the present scenario.

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