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Comparison of Intraoperative Bleeding During Excision of Benign Soft Tissue Oral Lesions Using Scalpel and Diode Laser

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ABSTRACT

Objective: To compare the grade of intraoperative bleeding during excision of benign soft tissue oral lesions using scalpel and diode lasers according to Boezart et al bleeding scale.

Methodology: A single blinded randomized comparative trial was conducted over a span of one year at department of Oral and Maxillofacial Surgery, from March 2021 to March 2023 at Shaheed Zulfiqar Ali Bhutto Medical University, PIMS Islamabad. A total of 128 patients with benign oral soft tissue lesions were selected and randomly divided into two groups Group A Scalpel and Group B Diode laser. Relevant history and clinical examination were carried out and recorded. Excision was carried out under Local anesthesia using diode laser and scalpel. The intraoperative bleeding grades were recorded in accordance with the criteria defined by Boezaart et al attached as Annexure A.

Results: The grade of bleeding between both groups was compared. A P value <0.05 was considered significant at 95% confidence level. Data was presented in the form of tables and graphs. The results showed that 66 male and 62 female patients. The average age of patients in group A was 32.38 and group B was 35.19. The most common site of lesion was lower lip in both groups. The average size of lesion in group A was 0.84cm and group B was 0.82cm. There was statistically significant difference in bleeding grade between two groups with group B (Diode laser) showing significantly less intraoperative bleeding compared with group A (Scalpel group).

Conclusion: It was concluded that diode laser effectively reduces intraoperative bleeding during excision of benign oral soft tissue lesions.

Key words: Hemorrhage, Lasers, Semiconductor, Oral Surgical Procedures, Neoplasms

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Introduction

Oral cavity comprises of both soft tissues and hard tissue components. Lesions of the oral cavity may involve both soft and hard tissues.[1] History and clinical examination of oral lesions may indicate towards their benign or malignant nature.[2] Surgical excision of benign oral lesions is a standard curative protocol. Clinically established benign lesion can be excised surgically under local anesthesia using scalpel or a diode laser. Benign soft tissue oral lesions that are non-invasive and show no rapid increase in size are good candidates for excision.[3]

Benign oral soft tissue lesions commonly arise from traumatic, inflammatory, or developmental causes. Hyperplastic lesions often result from habits, infections, or repeated trauma like ill-fitting prostheses. A history of persistent trauma strongly suggests reactive hyperplasia as the underlying diagnosis.

Fibroepithelial polyps and epulides are common fibrous hyperplastic lesions caused by chronic irritation or low-grade infection, often from ill-fitting dentures. Pyogenic granuloma, rich in granulation tissue and endothelial cells, typically appears on the gingiva. Giant cell epulis resembles a giant cell tumor histologically but remains confined to soft tissues, commonly affecting the interdental gingiva.[4,5]

Oral papilloma is a benign lesion linked to HPV, typically appearing as a spiky growth on the gingiva or buccal mucosa. Less common lesions include squamous

papilloma, verruca vulgaris, and verruciform xanthoma.[6] Vascular lesions like hemangiomas and lymphangiomas require careful evaluation due to their bleeding tendency before surgical excision.[7]

Benign lesions are considered for excision when they cause functional and aesthetic problems. There are different techniques available when excision of these benign lesions is indicated. This may be carried out using a conventional scalpel, electrical scalpel, or lasers.[8] With improvement in laser technology and a better knowledge of laser tissue interaction, the scope of laser applications in dentistry is becoming more diverse.

Although there are several surgical lasers that have been tested for oral surgical and dental procedures, the most popular lasers are the CO_2 laser, the erbium family lasers, the Neodymium laser, and the diode laser.[9] These lasers have shown superior results and therefore are recommended for dental use. The CO_2 was the pioneer laser employed in dentistry due to its superior tissue cutting capability. This efficacy and accuracy of this laser in oral surgery proved to be a significant improvement in the development of surgical lasers. Presently this laser is employed in oral surgery.[10]

The development of diode laser revolutionized the use of laser in dentistry. It became widely accepted for minor soft tissue surgeries due to its portable design and ease of use. This laser produces photothermal interaction with oral soft tissues and is used for excision of such lesions.[11]

Intraoperative bleeding during excision procedure hampers the visibility of the operative field and produces swelling and necessitates the use of sutures to achieve hemostasis.[12] Traditionally, excisions are carried out using a scalpel, which is an accurate, quick, and cost-effective tool. It causes excessive blood loss, delayed wound healing, and increased intraoperative time. Furthermore, scalpel blade is to be used carefully by a skilled surgeon to avoid the risk of damaging important anatomical structures at the surgical site.[13]

Diode lasers (810–980 nm) are highly effective for soft tissue excision due to strong absorption and coagulation capabilities. They allow simultaneous cutting and hemostasis through thermal interaction with tissues.[14] These lasers are increasingly used as alternatives to scalpel surgery. Applications include biopsy, lesion removal, and various aesthetic or functional oral procedures.[15]

Diode laser provides benefits of minimal bleeding and excellent hemostasis during the procedure. The diode laser system has an edge over other lasers due to small compact size, portable design while providing efficient and reliable surgical results comparable to these systems. Low power diode laser in the visible range is used as an aiming beam instead of the helium-neon lasers in these systems.[16]

The diode laser has high affinity for hemoglobin and is a good option for soft tissue surgical procedures. Owing to the thermal interaction at the target site, smaller blood vessels of 0.5 mm diameter get sealed spontaneously, thereby providing a good visibility of the field. Precise cutting of tissues is possible and minimal damage is imparted to cells adjacent to incision site. This leads to rapid healing with good quality of reparative tissue and the specimen is obtained with little tissue destruction helping in accurate diagnosis by the pathologist. [17]The rationale of this study is to decrease the extent of intraoperative bleeding and to achieve excellent hemostasis during surgical excision of soft tissue oral lesions.

Methodology

This study was designed as a randomized controlled trial and conducted in the Department of Oral and Maxillofacial Surgery at Shaheed Zulfiqar Ali Bhutto Medical University, PIMS Islamabad from March 2021 to March 2023.

The study was approved by Ethical review board and Advanced study and review board, SZABMU Ref No F.1-1/2025/ERB/SZABMU/396. It was carried out over the span of one year following the approval of the synopsis. A sample size of 128 patients was calculated using the WHO sample size calculator, with a level of significance set at 5%, power of test at 90%, a population standard deviation of 35, a test value of population (mean value of intraoperative bleeding in the scalpel group) as 83.6, and an anticipated population mean value for the diode laser group as 63.5. This resulted in 64 patients per group. A two-stage sampling technique was used: first, 128 patients were selected through non-probability consecutive sampling; then, these patients were randomly assigned into two equal groups, Group A (scalpel) and Group B (diode laser), using the lottery method. The inclusion criteria comprised patients with individual and well-demarcated soft tissue oral lesions, good surgical and visual access, no prior surgical scars at the lesion site, no history of impaired wound healing, and no current medications that could affect blood circulation or cause bleeding disorders. Patients were excluded if they were

on medications for systemic diseases, had drug-induced lesions, were pregnant, had blood dyscrasias, biopsy-proven malignant lesions, or arteriovenous malformations like hemangiomas. Data was collected using the Boezart et al. bleeding scale (Annexure A). A total of 128 patients presenting with oral soft tissue lesions were assessed according to the inclusion and exclusion criteria. The study protocol and risk-benefit ratio were explained to each patient, and written informed consent was obtained. Patients were then divided into the two study groups. A complete history of the lesion was recorded, and clinical findings were documented on a structured proforma. Lab investigations were conducted, including complete blood count (CBC), prothrombin time (PT), activated partial thromboplastin time (APTT), international normalized ratio (INR), bleeding time (BT), clotting time (CT), and Hepatitis B and C screening. All patients were administered local anesthesia with 2% lignocaine containing adrenaline (1:100,000). Excision for Group A was performed using a No. 15 surgical blade, while a 980 nm diode laser with a 400 µm initiated fiber was used for Group B. The degree of intraoperative bleeding was recorded for each patient using the Boezart et al. bleeding scale. Sutures were placed only if necessary due to bleeding. The excised tissue specimens were then submitted for histopathological analysis. All collected data were entered and analyzed using SPSS version 23. Means and standard deviations were calculated for numerical variables such as age, lesion size, and bleeding grade. Frequencies and percentages were calculated for categorical variables such as gender and lesion site. The Chi-square test was applied to compare the bleeding grades between the two groups, and a p-value of less than 0.05 was considered statistically significant. The results were compiled and presented using tables and graphs. The laser machine used for this study was Medelux D-10, a 10Watts 980nm diode laser, in contact mode with a 400 µm initiated fiber.

Results

The results of the study revealed that in Group A (scalpel group), the mean age of patients was 32.38 years, with an age range of 15 to 54 years and a standard deviation of 10.165. In Group B (diode laser group), the mean age was slightly higher at 35.19 years, with a range of 17 to 65 years and a standard deviation of 11.721, as shown in Table 4.1. The overall gender distribution in the study showed a slight male predominance, with 66 patients (51.56%) being male and 62 (48.43%) being female, as illustrated in Table I.

Table I: Descriptive statistics of Age and Gender distribution in study groups.

Variable		Group A	Group B
Age (Years)	Minimum	15	17
	Maximum	64	64
	Mean	32.38	35.19
	St. Deviation	10.165	11.721
Gender	Male	30 (46.9%)	36 (56.2%)
	Female	34 (53.1%)	28 (43.7%)
	Total	64 (100%)	64 (100%)
Size of Lesion (**mm)**	Minimum	0.50	0.50
	Maximum	1.30	1.20
	Mean	0.8438	0.8266
	St. deviation	0.19426	0.18016

Regarding the site distribution of the soft tissue lesions, the lower lip was found to be the most common site of involvement in both groups. In Group A, 28 patients (43.8%) had lesions on the lower lip, followed by gingiva in 18 patients (28.1%) and cheek in 14 patients (21.9%). Similarly, in Group B, the lower lip was involved in 26 patients (40.6%), followed by cheek and gingiva in 16 patients each (25.0%), as shown in Table II. Analysis of the side of lesion presentation showed that in the scalpel group (Group A), 39 lesions (60.9%) were on the left side and 25 lesions (39.1%) on the right side of the oral cavity. In contrast, Group B (diode laser) had equal distribution with 32 lesions (50%) on each side.

Table II: Frequency and Percentages of Site of lesion in both Groups A and Group B The values are in "mm".

Technique	Site	Frequency	Percent
Scalpel excision (Group A)	Lower Lip	28	43.8
	Cheek	14	21.9
	Tongue	4	6.3
	Gingiva	18	28.1
	Total	**64**	**100.0**
Diode laser excision (Group B)	Upper Lip	2	3.1
	Lower Lip	26	40.6
	Cheek	16	25.0
	Tongue	4	6.3
	Gingiva	16	25.0
	Total	**64**	**100.0**

In terms of lesion size, Group A had a mean lesion size of 0.8438 cm, with a range from 0.50 to 1.30 cm and a standard deviation of 0.19426. In Group B, the mean lesion size was 0.8266 cm, with a range from 0.50 to 1.20 cm and a standard deviation of 0.18016. Bleeding grades were evaluated according to the Boezart et al. bleeding scale. The diode laser group (Group B) demonstrated significantly better hemostasis compared to the scalpel group (Group A). In Group A, 40 patients (62.5%) exhibited bleeding grade 3 and 24 patients (37.5%) showed bleeding grade 2. Conversely, in Group B, 17

patients (26.6%) had grade 0 bleeding, 40 patients (62.5%) had grade 1 bleeding, and only 7 patients (10.9%) had grade 2 bleeding, as shown in Table III

When comparing intraoperative bleeding between both groups, the Chi-square test revealed a statistically significant difference ($p < 0.05$). In Group B (diode laser), 17 patients had bleeding grade 0, 40 patients had grade 1, and 7 had grade 2. In contrast, Group A (scalpel) had no patients with bleeding grades 0 or 1; instead, 24 patients had grade 2 and 40 had grade 3 bleeding. The statistically significant p-value confirmed that Group B achieved superior intraoperative bleeding control compared to Group A, as presented in Table III

Table III: Chi-square test showing statistically significant differences (p<0.05) between two groups.

	Bleeding grade				Total	P-value
	Grade 0	Grade 1	Grade 2	Grade3		
Group A: (Scalpel)	0	0	24	40	64	0.000
Group B: (Diode Laser)	17	40	7	0	64	

Discussion

Benign oral mucosal lesions encompass a wide range of conditions, often resembling each other clinically, making accurate diagnosis essential to distinguish them from malignant lesions and determine those requiring excision.[18] These lesions raise concerns due to possible malignancy, aesthetic issues, functional impairment, or discomfort. In this study, lesions appeared across a wide age range 15 to 54 years in Group A and 17 to 64 years in Group B—with mean ages of 32.38 and 35.19 years respectively, aligning with findings by Allon I et al. and Kilinc A et al. The male-to-female ratio was 1.06:1, consistent with prior literature, including Reddy V et al. reporting a 1.5:1 ratio. Common sites included lips and cheeks, with lower lips being the most frequent for mucoceles, while buccal mucosa and tongue had more fibrous and lipomatous lesions, as noted by Gobbo M et al. and Cecconi DR et al. Most lesions were slow-growing and asymptomatic, with sizes ranging from 5 to 13 mm (Group A) and 5 to 12 mm (Group B), and met the inclusion criteria for surgical excision.[19]

In this study, benign tumours showed a nearly equal gender distribution (male-to-female ratio 1.06:1), with a slight male predominance, consistent with Reddy V et al. (1.5:1).[20] Certain lesions show gender-specific patterns, aiding diagnosis. Common sites included lips, buccal mucosa, gingiva, tongue, and palate, with lips and cheeks being most frequent. Lower lips had the highest incidence of mucoceles, while fibrous and lipomatous lesions were more common on the tongue and buccal mucosa, as supported by MA Kumar and V Ebenezer.[21] Most lesions were slow-growing and asymptomatic, ranging from 5–13 mm in Group A and 5–12 mm in Group B, meeting criteria for surgical excision.

Excision of benign oral lesions is necessary when they cause functional or esthetic issues.[22] Injection of local anesthetic with adrenaline reduces bleeding, but scalpel excision still requires sutures. Newer tools like lasers offer better hemostasis with less pain and quicker recovery.[23] While scalpel excision is standard, it has limitations such as bleeding and the need for sutures. Innovations like lasers offer better hemostasis, reduced pain, and faster recovery. Diode lasers, operating at 800–980nm, are highly absorbed by pigments like hemoglobin and melanin. This makes them ideal and safer for soft tissue procedures near calcified structures.[24]

Laser treatment offers multiple intraoperative and postoperative benefits, including better visibility, minimal bleeding, rapid healing, and a bactericidal effect.[25] Diode lasers are cost-effective, easy to use, and well-suited for routine dental practice. Their hemostatic properties shorten surgical time and reduce the need for postoperative bleeding control. Lesions can be treated without dressing, with minimal functional limitations. Compared to scalpel excision, laser ablation results in significantly less pain and discomfort during the initial recovery period.[26]

According to Campos WG et al [27], laser ablation of oral soft tissue lesions like leukoplakia offers precise removal with less postoperative discomfort, aligning with our findings. Using pulsed mode minimized thermal damage, as supported by Rolf Borchers. Diode laser showed marked clinical improvement and high patient acceptance compared to scalpel. Using pulsed mode minimized thermal damage, as supported by Rolf Borchers. Diode laser showed marked clinical improvement and high patient acceptance compared to scalpel. Nilesh et al. also reported fewer complications, and studies by Hirano et al. and Ortega-Ishii et al. confirmed its safety and effectiveness without the need for sutures.[28,29,.30]

Diode laser can be effectively used for larger surface lesions via vaporization, eliminating the need for dressing

and preserving postoperative function. Compared to scalpel and electric knife, which are common techniques, diode laser offers advantages in cases with high vascularity. Ize-Iyamu et al. demonstrated that 810nm diode laser significantly reduced bleeding and the need for sutures during soft tissue excision.[31] It also minimized swelling, pain, and accelerated healing. These findings support the diode laser as a minimally invasive and safe approach for oral surgeries.[32] Tachmatzidis T. et al. also noted reduced postoperative bleeding, edema, and pain with improved healing by secondary intention, especially in esthetic zones like the lips.[33] Patients on anticoagulant therapy who cannot afford to stop medications due their systemic condition, can safely undergo surgery with diode laser. [34] Its secondary healing benefits are valuable in hard-to-access areas such as the soft palate and retromolar region. In such cases, diode laser prevents the need for invasive flaps or grafts. Its minimally invasive nature also allows procedures under local rather than general anesthesia.[35] Conventional surgical procedures often lead to complications such as intra- and postoperative bleeding, prolonged healing, need for more anesthesia, swelling, scarring, and pain. In contrast, diode lasers provide enhanced patient comfort with minimal bleeding, owing to their superior coagulative ability. In our study, 980nm diode laser resulted in no bleeding in 26% of cases and only minimal bleeding in the rest, requiring no suctioning. Postoperative edema and discomfort were also significantly reduced compared to scalpel excision.[36]

The laser's mechanism—photochemical, thermal, or plasma-mediated—enables precise tissue ablation without affecting surrounding areas. Absorption in hemoglobin leads to sealing of blood vessels and stimulation of clotting factor VII, improving field visibility. Laser energy promotes coagulation and minimizes lymphatic leakage, thus reducing edema. Additionally, laser wounds show fewer myofibroblasts histologically, leading to reduced contraction and scarring. These features support faster healing and superior surgical outcomes. The findings reinforce diode laser's role as a highly effective and minimally invasive surgical tool.[37]

Studies have shown that lasers, in both pulsed and continuous modes, create sterile surgical fields by reducing viable bacteria and inhibiting inflammatory responses. Diode lasers also aid in coagulating blood vessels and sealing lymphatics, minimizing intraoperative bleeding.[38] n our study, only 10.9% of laser cases needed occasional suctioning, compared to 62.5% of scalpel cases showing Grade 3 bleeding. Scalpel excision resulted in more bleeding, suturing needs, and postoperative discomfort. These limitations are effectively addressed by diode lasers. Gabric et al. also confirmed lower edema, bleeding, and healing time with lasers over scalpels in oral surgeries.[39] This study demonstrated that the 980nm diode laser significantly reduced intraoperative bleeding during oral lesion excisions, enhancing surgical field visibility. Using the Boezaart et al. scale, the diode laser showed superior hemostasis compared to scalpel techniques. Thus, it is a highly effective and preferred alternative for soft tissue surgeries.

Conclusion

The present study concludes that 980nm diode laser can be used as an effective tool for surgical procedures of oral soft tissues and provides superior results intraoperatively as well as postoperatively. There was very good control of intraoperative bleeding thereby providing improved quality of surgical field compared with the conventional scalpel surgery. Therefore, 980nm diode laser proved to be a successful alternative for surgical excision of benign oral lesions and should be considered as a substitute to the scalpel technique.

Limitations and Recommendations: The present study was designed to include benign oral lesions of size upto 1 centimeter (10mm), however lesions greater than this size also occur in the oral cavity. The diode laser can be used for excision of any size of soft tissue lesion. It is recommended that further studies should be conducted on even larger oral lesions and standard power settings should be identified for different types of lesions. The present study was conducted at only one center, future studies with multicenter involvement and greater sample size would further strengthen the study.

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