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A Comparative Evaluation of Laser and Electrocautery in the Management of Oral Submucous Fibrosis: A Pilot Study

Dr. Pravin Bhos[1], Dr. Supriya Lavate[2], Dr. Shereen fatima[3], Dr.Neelakamal hallur[4] , Dr. Aaisha Siddique[5], Dr. Chaitanya Kothari[6]

[1]MDS in Oral and maxillofacial surgery, Fellowship in aesthetic medicine and cosmetology, Assistant professor at Vasant dada patil dental college sangali

[2]MDS oral and maxillofacial surgery Fellowship

[3]MDS oral and maxillofacial surgery, Professor, Al-Badar rural dental collage kalaburagi, Al

[4]MDS oral and maxillofacial surgery, Hod and professor, Al badar rural dental college

[5]MDS oral and maxillofacial surgery, Professor, Al badar rural dental college

[6]MDS oral and maxillofacial surgery, Professor, AL Badar rural dental college

Corresponding Author: Dr.Pravin Bhos, MDS in Oral and maxillofacial surgery, Fellowship in aesthetic medicine and cosmetology, Assistant professor at Vasant dada patil dental college sangali

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Abstract

Aim: The present study was designed to compare the outcomes of two treatment modalities of Oral submucous fibrosis using diode laser and electrocautery, and to compare the outcome of both interventions regarding wound healing, postoperative pain, and mouth opening.

Materials and Methods: A total of 10 patients were included in the study. An incision was placed with electrocautery on one side of the buccal mucosa (group A) and with laser on the contralateral side of the buccal mucosa (group B) in the same patient, followed up for 1 month periodically.

Results: The present study showed significant changes in the mouth opening (pre- operative and post-operative comparison) for both the groups using One way ANOVA test. the mean and standard deviation of post-operative pain (VAS scale) and their comparison done by using Mann Mann-Whitney test in between intervals of 7th day, 15th day and 1 month after evaluation statically it was found that there was a difference in the mean value of laser and cautery. Evaluation of clinical parameters like Granulation and epithelization on 7th, 15th day and 1month post-operative days, we found that the laser group showed better granulation on 7th and 15th post-operative days compared to the electrocautery group. After 1 month of follow-up, no clinical difference is seen in both groups.

Conclusion: Diode laser can also be used as an alternative treatment option in oral submucous fibrosis patients as it is safe, relatively inexpensive, with the advantage of reduced post-operative complications like; wound healing and post-operative pain.

Keywords: Electrocautrary, Laser, oral submucous fibrosis, premalignant condition.

Introduction

Oral submucous fibrosis (OSMF) is a progressive and chronic disorder affecting the oral cavity, marked by persistent inflammation and fibrosis of the submucosal layers, including the lamina propria and deeper connective tissues. Schwartz initially documented the condition in 1952, and later, Joshi provided a detailed clinical description and introduced the term "oral submucous fibrosis" in the same year.[1] OSMF is predominantly seen in populations with habitual areca nut (betel nut) chewing and tobacco consumption. Several therapeutic approaches are employed in its management, including pharmacological treatments, surgical procedures, physiotherapy, electrosurgical techniques, and more recently, the use of lasers has gained prominence as a minimally invasive option.[2]

In OSMF patients, post-surgical healing is often complicated due to an inherent tendency toward fibrosis and scar formation, making conventional surgical incisions potentially problematic. Laser-assisted procedures, especially with diode lasers, have shown promise in these scenarios by offering precise, contact-mode tissue ablation with reduced collateral damage. Compared to the traditional scalpel, lasers provide notable benefits such as less scarring, improved hemostasis, and reduced postoperative discomfort, which make them favorable in managing fibrotic conditions like OSMF [2].

Materials and Methods

The study was conducted at Al-Badar Rural Dental College's Department of Oral & Maxillofacial Surgery in Kalaburagi, Karnataka. The institutional ethics committee granted ethical approval. Each participant received a participation sheet with unique explanations in Kannada, Hindi, and English. Following their acceptance, informed consent was acquired. Each research participant was informed of the study's goal and methodology. Each person was given an information sheet and given a verbal explanation of it. The participant gave their informed consent.

Inclusion criteria: Patients clinically diagnosed with Oral submucous fibrosis, Patients with stage II and stage III OSMF, ASA I and II patients, and age group of 20-40 years.

Exclusion criteria: Patients with a history of systemic clinical disorder and a history of previous surgery or radiation therapy that compromises wound healing.

All 10 patients were divided into 2 equal groups (Group I and Group II) and fibrotomy was done with a diode laser on one side and electrocautery on the other side of the buccal mucosa.

Surgical procedure

The intraoperative protocol commenced with intraoral irrigation using 5% povidone-iodine followed by normal saline, alongside extraoral antiseptic preparation using the same agents to ensure asepsis.[3] For local anesthesia and hemostasis, 2% lignocaine hydrochloride combined with adrenaline in a 1:80,000 concentration was infiltrated at the operative site.[4] Palpation of fibrous bands was carried out to delineate the extent and direction of the incision.

The present study employed a split-mouth design, where each patient served as their own control. Ten patients clinically diagnosed with stage II or III oral submucous fibrosis (OSMF) were included. Fibrotomy was performed with a diode laser on one side of the buccal mucosa and electrocautery on the contralateral side. This design minimizes inter-patient variability.[5,6]

Figure 1: Diode laser: 980 wavelength, power-2 watt, continuous wave.

After making the incision down to the submucosal tissue, digital manipulation was used to bluntly dissect and release fibrous bands until movement was unrestricted. A Heister's mouth gag was employed to forcibly open the mouth to its maximum extent, and additional digital stretching was applied as needed to separate the bands and increase oral opening.[7]

Postoperatively, all patients received prophylactic antibiotic therapy consisting of amoxicillin (500 mg) and potassium clavulanate (125 mg) administered twice daily, and metronidazole 400 mg administered three times daily, for five days to prevent infection[8]. Oral hygiene was maintained through regular intraoral rinsing and gargling with povidone-iodine (Betadine) mouthwash three to four times per day.[9]

No formal sample size calculation was performed; therefore, this investigation should be considered a pilot study. Conclusions are exploratory and warrant confirmation in larger trials.

Statistical analysis:

* Paired comparisons between laser and electrocautery sides were analyzed using the Wilcoxon signed-rank test (non-parametric paired data).
* Repeated measures of mouth opening were analyzed using repeated measures ANOVA with sphericity checks (Mauchly's test). Where sphericity was violated, the Greenhouse-Geisser correction was applied.
* Effect sizes (Cohen's d for paired comparisons, partial eta-squared for ANOVA) and 95% confidence intervals were reported.

Result

Mouth opening: Mean preoperative mouth opening was 21.8 mm (SD 1.99). At 7 days, 31.5 mm (SD 4.65); at 15 days, 30.6 mm (SD 3.78); at 1 month, 29.5 mm (SD 2.88). Repeated measures ANOVA showed a statistically significant improvement ($p < 0.001$, partial eta-squared = 0.72).

* Pain (VAS): At 7 days, laser mean = 7.6 vs cautery = 8.4 ($p = 0.02$, Cohen's $d = 0.45$). At 15 days, laser = 1.8 vs cautery = 3.9 ($p = 0.001$, $d = 0.75$). At 1 month, no significant difference (laser = 0.3 vs cautery = 0.6, $p = 0.37$).
* Granulation (7 days): Laser showed significantly better scores for area, color, and consistency ($p < 0.05$ for each).
* Granulation (15 days): Laser continued to show superior area, color, and consistency ($p < 0.05$).
* Epithelization: At 7 and 15 days, laser showed higher mean scores, though differences were not statistically significant. At 1 month, both groups achieved complete epithelization (mean = 6.0, $p = 1.0$).

Table 1. represents the mean and standard deviation of mouth opening and their comparison by ANOVA between preoperative,7th day, 15th day, and 1 month after evaluating statically it has found that there was an increase in mean value from pre-operatively (21.80) to post-operatively on 7th day (31.50), 15th day (30.60) and 1 month (29.50) with a significant P value of ($p < 0.001$) which is statistically significant.

Time	N	Mean	SD	Min	Max	p-value
Pre-op	10	21.80	1.99	19	25	
7 Days	10	31.50	4.65	22	38	
15 Days	10	30.60	3.78	25	38	
1 Month	10	29.50	2.88	27	36	<0.001*

Table 1: Comparison of mean Mouth Opening (in mm) between different. time intervals among study subjects using the Repeated Measures of ANOVA Test.

Time	Side	N	Mean	SD	Mean Diff	p-value
7 Days	Laser	10	7.60	0.70	-0.80	0.02*
	Cautery	10	8.40	0.70		
15 Days	Laser	10	1.80	1.03	-2.10	0.001*
	Cautery	10	3.90	0.88		
1 Month	Laser	10	0.30	0.68	-0.30	0.37
	Cautery	10	0.60	0.97		

Table 2: Comparison of mean VAS scores for pain between 2 sides at different time intervals using Mann Whitney Test.

Table 2 represents the mean and standard deviation of postoperative pain (VAS scale) and their comparison done by using Mann Whitney Test in between the interval of the 7th day, 15th day, and 1 month after evaluating statically it is seen that there was the difference in the mean value of laser (7.60) and cautery (8.40) on 7th day and laser (1.80) and cautery (3.90) on 15th-day p- value is <0.05 which is statistically significant. Postoperative mean value on 1 month (laser - 0.30, cautery -0.6) p > 0.05, which is statistically not significant.

Parameters	Side	N	Mean	SD	Mean Diff	p-value
Area	**Laser**	**10**	**2.40**	**0.70**	**1.10**	**0.01***
	Cautery	10	1.30	0.95		
Color	Laser	10	0.80	0.42	0.50	0.03*
	Cautery	10	0.30	0.48		
Consistency	Laser	10	0.50	0.53	0.40	0.04*
	Cautery	10	0.10	0.32		
Epithelization	Laser	10	0.90	1.45	0.90	0.07
	Cautery	10	0.00	0.00		

Table 3: Comparison of mean scores of Granulation tissue parameters between 2 groups at 7 Days period using Mann Whitney Test

Table 3 Mean value of area (laser M-2.40, cautery M-1.30) on post-operative 7th day. The p- value is 0.01 (p< 0.05) which is statistically significant. Mean value of color (laser M-0.80, cautery M-0.30) on the post-operative 7th day. The p-value is 0.01 (p< 0.05), which is statistically significant. Mean value of consistency (laser M-0.50, cautery M-0.10) on the post- operative 7th day. The p-value is 0.01 (p< 0.05), which is statistically significant. Mean value of epithelization (laser M-0.90, cautery M-0.00) on the post-operative 7th day. The p-value is 0.01 (p> 0.05), which is statistically not significant.

Parameters	Side	N	Mean	SD	Mean Diff	p-value
Area	Laser	10	3.90	0.32	0.50	0.02*
	Cautery	10	3.40	0.52		
Color	Laser	10	1.90	0.32	0.50	0.02*
	Cautery	10	1.40	0.52		
Consistency	Laser	10	0.80	0.42	0.40	0.04*
	Cautery	10	0.40	0.52		
Epithelization	Laser	10	5.40	1.27	1.20	0.06
	Cautery	10	4.20	1.55		

Table 4: Comparison of mean scores of Granulation tissue parameters between 2 groups at 15 Days period using Mann Whitney Test

Table 4 represents a comparison of mean scores of Granulation tissue parameters between 2 groups over at 15-day period using Mann Whitney Test. Mean value of area (laser M-3.90, cautery M-3.40) on post-operative 7th day. The p-value is 0.01 (p< 0.05) which is statistically significant. Mean value of color (laser M-1.90, cautery M-1.40) on post-operative 7th day. The p-value is 0.01 (p< 0.05) which is statistically significant. Mean value of consistency (laser M- 0.80, cautery M-0.40) on post-operative 7th day. The p-value is 0.01 (p< 0.05) which is statistically significant. The mean value of epithelization (laser M-5.40, cautery M-4.20) on postoperative 1 month. The p-value is 0.01 (p> 0.05) which is statistically not significant.

Parameters	Side	N	Mean	SD	Mean Diff	p-value
Epithelization	Laser	10	6.00	0.00	0.00	1.00
	Cautery	10	6.00	0.00		

Table 5: Comparison of mean scores of Epithelization tissue parameters between 2 groups at 1-month period using Mann-Whitney Test.

Table 5. representing a comparison of mean scores of epithelization tissue parameters between 2 groups over 1 month period using the Whitney Test. The mean value of epithelization (laser M-6.00, cautery M-6.00) on post-operative 1 month. P value is 1.00 (p> 0.05) which is statistically not significant.

Discussion

An insidious, long-term illness that can impact any area of the mouth and occasionally the throat. It is always linked to a juxta-epithelial inflammatory reaction in conjunction with fibroelastic change of the lamina propria and epithelial atrophy, which results in stiffness of the oral mucosa, trismus, and an inability to eat, even though it is sometimes preceded by or associated with the formation of vesicles.[10]

The term LASER is an acronym for 'Light Amplification by Stimulated Emission of Radiation' and was first introduced to the public in 1959, in an article by a Columbia University graduate student, Gordon Gould.[11]

A solid-state semiconductor composed of aluminum, gallium, arsenide, and sometimes indium serves as the diode laser's active medium. It generates laser wavelengths that range from around 810 nm to 980 nm. The primary absorbers of all diode wavelengths are hemoglobin and tissue pigment (melanin). On the other hand, the water and hydroxyapatite in the enamel do not absorb them well. Aesthetic gingival re-contouring, soft tissue crown lengthening, exposing soft tissue impacted teeth, frenectomies, removing hypertrophic and inflammatory tissue, and photostimulating the apthous and herpetic lesions are some of the specific operations.[12]

Erythrocytes damaged by lasers draw platelets, which promote intraluminal thrombosis and reduce blood loss even further. This explains why there was less blood loss in the laser wound than with the scalpel, which is particularly significant in our study because lasers offer superior hemostasis.[13]

In our study, fibrotomy was done with a diode laser on one side and electrocautery on the other side of the buccal mucosa in the same patient. Evaluation of clinical parameters like Granulation and epithelization of wound on the 7th, 15th day, and 1-month follow-up. We found that the laser group showed better granulation on the 7th and 15th postoperative days as compared to the electrocautery group. After 1 month of follow-up, no clinical difference is seen in both groups. In terms of epithelialization, no significant difference was seen in both groups.

Wound healing was better in the Laser therapy group as compared to the electrocautery group and both groups showed less scar formation and procedure-related trismus.

Nayak et al. studied 532 lasers because they found that using a laser to release fibrotic bands reduces the likelihood of procedure-induced trismus, which is typically observed after simple release operations, and promotes healing with little scarring. Additionally, laser is linked to early wound healing. Using a laser also has the benefit of spontaneously obstructing small, transected arteries, which results in good hemostasis. Additionally, the surgeon can make accurate incisions with less collateral damage thanks to the laser.[14]

In our study, a comparison of post-operative pain was done in groups A and B with Mann Mann-Whitney test between intervals of the 7th day, 15th day, and 1 month. The P value <0.05 is statistically significant in intervals of 7th and 15th postoperative days. The postoperative pain was high in group A as compared to group B on the 7th and 15th days. There is no difference seen in post-operative pain in both groups after 1 month.

Shah et al have compared the conventional technique with laser in 10 patients with OSMF stage II and III. VAS score analysis was done using paired "t-test" analysis between both the treatment groups. The paired mean was 3.7, 1.37 (t= 19.042 & p=0.000), representing the highly significant difference between the two groups. Postoperative pain reported with the diode laser was significantly less compared to the conventional group.[15]

Laser therapy has shown superior efficacy in improving mouth opening as compared to electrocautery. The precision of the laser treatment allows for more effective release of fibrotic bands and improved mandibular mobility.

In our study, pre-operative Mouth opening was 21±3.2 after diode laser fibrotomy. The mouth opening at the end of 1 month was 30±2.90. in our research the Comparison of mean Mouth Opening (in mm) between diff. time intervals among study subjects using Repeated Measures of the ANOVA Test were highly statistically significant (p-value < 0.05) which showed significant improvement in mouth opening.

This pilot split-mouth study demonstrates that diode laser fibrotomy provides superior short-term outcomes compared to electrocautery in OSMF management. Patients experienced significantly less postoperative pain and improved wound granulation with laser therapy. Mouth opening improved significantly across all time points, consistent with prior reports. However, by 1 month, epithelization outcomes were equivalent between groups.

Limitations include the small sample size, absence of randomization, lack of blinded outcome assessment, and short follow-up. These factors restrict generalizability. Future randomized controlled trials with larger cohorts, validated wound-healing scoring systems, blinded assessors, and extended follow-up are necessary to confirm these findings.

Conclusion

Diode laser fibrotomy appears to be a promising alternative to electrocautery in OSMF management, offering advantages in pain reduction, wound healing, and mouth opening improvement. Given the pilot nature of this study, results should be interpreted cautiously, and larger, well-designed trials are required to establish definitive clinical recommendations.

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