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ORIGINAL ARTICLE

The Role of Diode Laser Assistance in Functional Endoscopic Sinus Surgery (FESS) to Reduce Perioperative Morbidity

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ABSTRACT… Objectives: To compare the mean duration of hospital stay and frequency of postoperative haemorrhage in patients undergoing FESS with or without Diode laser-assistance. **Study Design:** Single-blinded Randomized Controlled Trial. **Setting:** Department of ENT and Head & Neck Surgery, KRL Hospital Islamabad. **Period:** 01.03.2024 to 30.11.2024. **Methods:** No data has been published on the efficacy of Diode lasers as an adjunct to FESS for inflammatory sinonasal disease. Therefore, after Ethical Committee approval, a pilot study was first conducted to evaluate the feasibility of proposed project. Sample size calculated using WHO calculator was sixty. Using simple random sampling technique, thirty patients had laser-assisted surgery and the other thirty did not have laser-assistance employed. The comparative outcome was measured by recording the post-operative duration of hospital stay and the incidence of postoperative haemorrhage in both groups. Comparative data analysis was done using SPSS version 23. **Results:** Regarding postoperative duration of hospital stay, mean±SD compared were significantly different in the Laser-assisted and control groups (1.23±0.43 vs 1.87±0.78 days, p-value=0.0002). The parameter of postoperative haemorrhage, too, showed significant difference between the laser-assisted and control groups i.e. an incidence of 6.67% vs 26.67% respectively, giving p-value=0.04. **Conclusion:** This study revealed that per-operative defocused laser irradiation of the raw cut edges of mucosa following FESS has proven very beneficial as it leads to significant reduction in hospital stay, reduced chance of bleeding, expedited recovery and enhanced patient satisfaction.

Key words: Chronic Rhinosinusitis (CRS), Diode laser, Functional Endoscopic Sinus Surgery (FESS), Haemorrhage.

INTRODUCTION

Haemorrhage is the most common complication of endoscopic sinus surgery.[1] Common techniques for its management, as mentioned in literature, include head end elevation, stringent blood pressure control, use of local vasoconstrictors, occasionally the use of systemic tranexamic acid administration[2], bipolar cauterization and nasal packing. Newer innovations in this area include topical tranexamic acid application[3], preoperative desmopressin injection[4] and application of platelet rich fibrin in the FESS cavity at the end of surgery.[5] The diode laser is a portable, cost-effective and easy to use system. Its flexible fiber has the ability to reach difficult areas through angled handpieces.[6] It is now increasingly employed in rhinology[7] and is particularly useful in turbinate reduction surgery, relatively bloodless excision of vascular lesions, lysis of adhesions, surgery for choanal atresia and primary acquired nasolacrimal duct obstruction (especially when there are contraindications to external or endonasal dacryocytorhinostomy)[8] among many other applications. Its thermal effect has been utilized to reduce nasal swell bodies[9] and its photocoagulation property has also been used in the management of epistaxis in patients of Hereditary Haemorrhagic Telengiactesia.[10]

Till date no data has been published on the use of diode lasers as an adjunct to endoscopic sinus surgery for inflammatory sinonasal disease. In our tertiary care set up we have vast experience in peroperative defocused laser irradiation of the raw cut edges of mucosa following endoscopic sinus surgery over the years and this has proven

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extremely beneficial as it obviates the need for nasal packing and we believe it leads to reduced hospital stay, expedited recovery and an increased level of patient satisfaction.

A pilot study was conducted on 30 patients undergoing FESS at KRL Hospital Islamabad. Diode laser was used in 15 patients but not in the control group. The outcome was measured by recording the duration of hospital stay after surgery and the incidence of postoperative haemorrhage (i.e. any significant bleed requiring attention of the on-call doctor in the first 24 hours after surgery) in both groups. The pilot study result showed that in patients who underwent diode laser-assisted FESS, incidence of postoperative bleed was 6.7% as opposed to 20% in the control group. Moreover, the mean duration of postoperative hospital stay (in days) was 1.27±0.46 and 2.06±0.59 days in the intervention and control groups respectively. It was thus hypothesized that the use of diode laser assistance in endoscopic sinus surgery offers a significant reduction in perioperative morbidity such as postoperative bleed and expedites recovery allowing for earlier discharge from the hospital. Based on this, the sample size was calculated and the main study presented here was conducted.

METHODS

This prospective randomized controlled trial was conducted at the Department of ENT and Head and Neck Surgery, KRL Hospital Islamabad over a period of nine months in 2024. Based on our initial pilot study results, the sample size calculated using WHO calculator was sixty, having 30 patients in each group i.e. those undergoing FESS with or without laser-assistance. The patients were selected by single blinded, simple random sampling technique.

The study included adult patients of both genders who underwent FESS for chronic rhinosinusitis refractory to standard medical therapy or initially presented with extensive allergic or mycotic polyposis. Known hypertensive patients and those with vascular lesions e.g. haemangioma or other benign or malignant tumours were excluded from the study.

The study was conducted after obtaining the ethical approval of ethical research committee of KRL Hospital Islamabad vide Reference Number: KRL-HI-ERC/Dec22/25 Dated 16th December 2022.

Patients presenting in the OPD of ENT Department, KRL Hospital were listed for FESS if history, clinical examination (zero degree endoscopy) and radiological investigations (CT scan nose and paranasal sinuses, coronal cuts) suggested a diagnosis of chronic rhinosinusitis refractory to medical therapy or disease with extensive polyposis. Informed consent was taken for the surgery (written) however the patients were unaware as to whether or not diode 980 nm laser (Biolitec, Germany) will be used in their case as an adjunct to FESS. After baseline investigations and general anesthesia evaluation, once the patient was in the operating room the experienced surgeon ensured elimination of disease from the remote canaries of the sinuses and their adequate ventilation. Thirty patients underwent 980 nm Diode laser-assisted defocused irradiation of the raw cut edges of mucosa at 5 watts in continuous mode, particularly in the sphenopalatine region, while control group patients did not. The effect of defocused laser irradiation can be seen in Figure-1 below.

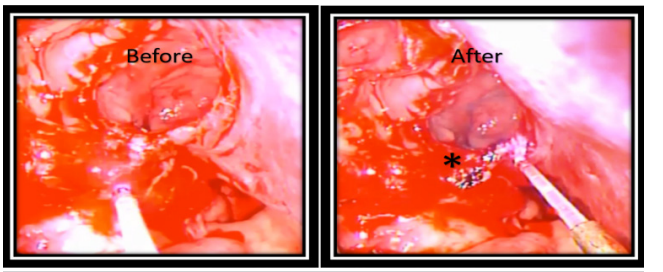

Figure-1. The asterisk marks the effect of diffuse Diode laser irradiation in a FESS cavity

Postoperatively patients were observed for any significant haemorrhage that required the attention of the on-call doctor during the first 24 hours of surgery. Furthermore, the length of hospital stay was noted in both groups for purpose of comparison. The data was entered, tabulated and analyzed using the Statistical Package for the Social Sciences (SPSS) Version-23. Descriptive statistics were evaluated for both quantitative and qualitative variables. Qualitative variables

like gender and postoperative haemorrhage were presented as frequency and percentage. Quantitative variables i.e age and length of hospital stay were presented as mean and standard deviation. For postoperative haemorrhage, Chi Square test was applied to determine any significant difference between groups, taking p value ≤ 0.05 as statistically significant. For duration of hospital stay, T-test statistics were utilized to determine any significant difference. Again, p value≤0.05 was considered significant.

RESULTS

This current study with an overall sample size of N=60 FESS candidates revealed 31(51.7%) males and 29(48.3%) females between the ages of 13 and 49 years (Mean=33.43±10.45).

Regarding postoperative duration of hospital stay, there was a statistically significant difference between the two groups, i.e. p value ≤ 0.05. All the statistics are given in tabulated form (Table-I)

Patients from the laser-assisted group suffered postoperative complication of haemorrhage much less than the group where this innovative intervention was not used. Chi Square test was applied to compare the significance of the results which came out to be statistically significant, with a p value ≤ 0.05 as shown in Table-II.

DISCUSSION

Our tertiary care referral center excels in the management of diverse pathologies in the field of Otolaryngology using innovative techniques. One of the main surgical tools used is the Diode 980 nm laser owing to its remarkable blend of both cutting and coagulating properties depending upon the pruning of its fiber, the parameters set e.g. power in watts, etc. and the whether it is used in contact or non-contact mode to exert required dispersion of energy. Various combinations of the aforementioned factors are used to achieve desired goals tailored to the surgery being performed.

Some recent case reports we have published elaborate the usefulness of this equipment include case reports on apnoeic phase surgery for the transoral endoscopic management of acquired supracarinal tracheal stenosis[11] and the almost bloodless transoral excision of a sizeable tongue base schwannoma.[12] Coming to Rhinology in specific, besides basic surgeries like laser turbinoplasties, we also employ this to manage a variety of benign and malignant neoplasms like the endonasal endoscopic laser-assisted resection of septal glomangiopericytoma.[13]

Francesco et al have conducted a study on CO_2 laser in resection of sinonasal neoplasms but suggested that other studies are needed to compare its effectiveness over other lasers.[14] We believe that Diode lasers are superior to CO_2 lasers in the management of nasal pathologies as its hand-held fiber facilitates disease eradication from the nooks and canaries of the nose and sinuses effectively.

Regarding use of lasers in management of inflammatory sinonasal disease, after thorough literature review, we believe that this very article is the first of its kind.

Diode Laser Assistance in FESS	Postoperative Duration of Hospital Stay			Mean ± SD	Independent Samples T- test	
	1 day	2 days	3 days		95% CI	P-Value
Laser-Assisted Cases	23	7	0	1.23±0.43	(1.07-1.39)	0.0002
Control Group	11	12	7	1.87±0.78	(1.57-2.15)	

Table-I. Postoperative duration of hospital stay (n=60)

Diode Laser Assistance in FESS	Postoperative Haemorrhage		Incidence	Chi Square Test
	Yes	No		
Laser-Assisted Cases	2	28	6.67%	p value=0.04
Control Group	8	22	26.67%	

Table-II. Postoperative haemorrhage (n=60)

The project was undertaken based on years of observation of the therapeutic role of defocused coagulation of the FESS cavity with diode laser after completing surgery for inflammatory sinonasal polyposis with cold steel instruments.

Mihai et al in a recent review (i.e. in 2023) on laser nasal surgery considered its use for nasal polyposis treatment based on other studies. In those studies, however, the type of laser used was Nd:YAG/KTP and not Diode laser. They concluded that the dispersed beam of a laser can quickly cauterize and remove the mucosa while letting it redevelop later which is the principle of our study as well. They however said it is not currently in use and has the 'potential' of becoming a good surgical option for nasal polyposis.[15] In our study, however, we had started observing the positive outcome of the use of lasers in FESS for sinonasal polyposis management for years before undertaking this formal study.

The diode laser has remarkable photocoagulation properties sealing off vessels less than 0.9 mm during its use. We utilize this ability to decrease chances of postoperative bleed as we rarely, if ever, use merocel packs after FESS for mere inflammatory disease in otherwise healthy individuals. This characteristic has also been proven by its preferred use over other lasers for the treatment of recurrent epistaxis in Shuyue et al[16] and Marietta et al's studies. The latter describes the diode 940 nm laser to have a somewhat lower potential risk of wound healing impairment as compared to Argon or Nd:YAG lasers when used for this purpose due to its relatively lower optical penetration.[17]

Wen-Sen et al conducted a study to compare 940 nm Diode laser-assisted versus cold steel vidian neurectomy for treating refractory rhinitis and concluded that the laser-assisted group not only had better surgical field but also lesser incidence of post-operative haemorrhage.[18] This is exactly in line with the results of our study regarding laser-assistance for treating inflammatory disease.

In the past decade, various studies have suggested that diode laser irradiation alters cellular response by modulating mitochondrial respiratory chain or behaviour of the membrane calcium channels. Furthermore, it can facilitate collagen synthesis, angiogenesis and cause release of growth factors which ultimately accelerates wound healing.[19]

Reham et al studied the anti-inflammatory and antibacterial effects of diode laser for management of sufferers of chronic maxillary sinusitis and concluded that it increases the efficacy when used as an adjunct to standard medical treatment.[20] So laser-assistance in FESS is not only improving surgical outcomes in terms of reducing hospitalization and reduced chances of bleed, it is also positively modulating the nasal biofilms which certainly brings to light their potential for decreasing chances of recurrence of disease.

The current limitation of this intervention is that laser-assisted surgery demands very specific and dedicated training of surgeons in specialized centers to acquire high skill levels and precision in this evolving field. This ensures patient safety by achieving the desired outcome while avoiding collateral damage that can lead to complications. Furthermore, besides high surgical expertise, it is important to have competent and trained operating room personnel to avoid any hazard of laser surgery.

CONCLUSION

This unique study reveals that defocused laser irradiation of the cut edges of mucosa following FESS has proven extremely beneficial as it leads to significant reduction in hospital stay, lesser chances of bleed, expedited recovery and an increased level of patient satisfaction.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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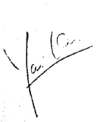
AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Mavra Sarwar	Literature review, data collection, statistical analysis, interpretation of results, drafting of the article.	
2	Zahra Sarwar	Data collection, statistical analysis, interpretation of results, helped with drafting the article.	
3	Muhammad Sarwar Khan	Primary surgeon of all patients in the study, The surgical intervention, presented is his original idea that was found beneficial for patients over many years from a clinical perspective before this formal research project was undertaken. He also gave final approval of the manuscript before submission.	
4	Muhammad Jamil	Contributed towards the surgical work done, advised throughout the course of the study and contributed towards ensuring integrity of this research project.	
5	Muhammad Yasir Khan	Contributed towards the surgical work done, advised throughout the course of the study and contributed towards ensuring integrity of this research project.	
6	Saifullah Khan	Contributed towards the surgical work done, advised throughout the course of the study and contributed towards ensuring integrity of this research project.