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Institute of Laser

Research

Effectiveness of Diode Laser (808 nm) for Excisional and Incisional Biopsies of Oral Lesions

A dissertation Submitted for partial fulfillment of the requirement for the Degree of postgraduate Diploma in laser Applications in dentistry.

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DEDICATION

*To my mother (Nassrah
Salamah Hamed), my wife and my sweet daughters*

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ABSTRACT ENGLISH

Introduction: Lasers have made a tremendous progress in the field of dentistry and have turned out to be crucial in oral surgery as collateral approach for soft tissue surgery. This rapid progress can be attributed to the fact that lasers allow efficient execution of soft tissue procedures with excellent hemostasis and field visibility. When comparing to scalpel, electrocautery or high frequency devices, lasers offer maximum postoperative patient comfort.

Methods: Ten patients agreed to undergo surgical removal of oral lesions of 808 nm diode lasers, power of 2 watt were used in continuous wave mode for excisional and incisional biopsies. The specimens were sent for histopathological examination and patients were assessed on intraoperative and postoperative complications.

Results: The obtained results showed that diode laser surgery was rapid, bloodless and well accepted by patients and led to complete resolution of the lesions. The excised specimen proved adequate for histopathological examination. Hemostasis was achieved immediately after the procedure with minimal postoperative problems, discomfort and scarring.

Conclusion: We conclude that diode lasers are rapidly becoming the standard of care in contemporary dental practice and can be employed in procedures requiring excisional biopsy of oral soft tissue lesions with minimal problems in histopathological diagnosis and minimal patient discomfort.

Keywords: Diode laser; Biopsy; Oral lesion

المستخلص

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ABBREVIATIONS

LASER	Light amplification by stimulated emission of radiation
PDT	Photodynamic therapy
LT	Laser therapy
Vs	Versus
SCC	Squamous cell carcinoma
Co2	Carbon dioxide
Nd:YAG	Neodymium: Yttrium aluminum garnet
Er:YAG	Erbium: Yttrium aluminum garnet
Ga	Gallium
Ar	Arsenide
Al	Aluminum
In	Indium
nm	Nanometer
VAS	Visual analog scale
CBC	Complete blood count
PPE	Personal protective equipments

CHAPTER ONE

Introduction

1.1 Overview:

An oral lesion (which includes aphthous ulcers) is an ulcer that occurs on mucous membrane of the oral cavity. They are very common and occurring in association with many diseases and by many different mechanisms. They can be recognized by a break in the skin or mucous membrane with loss of surface tissue and disintegration and necrosis of epithelial tissue (Kani et al 1988). Oral lesions may occasionally be diagnosed correctly, based on a brief history and clinical examination. Therefore, an accurate description is essential for their diagnosis and management. As regards, continuous observation and monitoring of the lesion are required, and acceptable description would be critical for comparison purposes. Biopsy is the removal of tissue from a living person for microscopic examination to confirm or to establish a diagnosis of a disease (Hamid Mortazavi et al 2019).

When biopsy sample is taken, the pathologist needs an accompanying lesion description to reach a definitive diagnosis. Biopsies could be either incisional or excisional. Incisional biopsy is a technique that samples only a particular or representative part of the lesion. This technique usually indicated if the area under investigation appears difficult to excise because of its extensive size (>1cm in diameter) or hazardous location or whenever there is suspicion of malignancy. In contrary, excisional biopsy is the removal of the entire lesion at the time of surgery. A perimeter of normal tissue surrounding the lesion is also excised to ensure total removal (Farun Vyas 2018).

Various techniques are used to take biopsies of patients having benign oral lesions and other lesions that are suspected to be premalignant or malignant. Lesion depending on type, extent, and spread may be biopsied by excision using scalpel, electrosurgery, cryosurgery, and/or chemotherapy. Recently, the use of lasers has become a new technology. Lesions can be removed accurately with lasers, and there is minimal damage to adjacent structures (Ena Mathur

et al 2015), There are many advantages of using lasers over other surgical methods, the primary one being no hemorrhage and no need of suturing that is expected to limit the transplantation of malignant cells into uninvolved healthy tissues. Advantages also include sterile surgical field and accuracy (Vikrant Sharma et al 2021).

Koppolu et al compared the excision of lesions with diode laser and scalpel and concluded that for intraoral soft tissue surgical techniques, laser is a reasonable alternate to the scalpel. Diminished postoperative swelling and pain is a distinctive quality of lasers and facilitates improved safety when performing surgery within the airway (Koppolu P et al 2014). Healing after laser surgery is usually outstanding with negligible scarring and amplified function (Strauss RA 2000).

1.2 Justification

Oral lesions are diagnosed correctly, based on a brief history and clinical examination. Therefore, an accurate description is essential for their diagnosis and management. Recently, clinical experiences showed different advantages in using a laser device rather than a scalpel during oral soft tissue surgery such as excisional biopsies. Laser is a minimally invasive technique with an analgesic and anti-inflammatory properties. Lasers have a great surgical visibility because of laser hemoglobin interaction resulting in a bloodless operative field. This is very important especially with patients with coagulation disorders. Moreover, the transmission of energy makes possible to proceed, in certain cases, with a reduced use of local anesthetics (Gaspare Palaia et al 2019). From the literature very few studies used laser for excisional or excisional biopsy.

1.3 Objectives:

1.3.1 General objective:

- To evaluate the effectiveness of the diode laser (808 nm) in incisional and excisional biopsies of the oral lesions.

1.3.2 Specific objectives:

- To evaluate the intraoperative and postoperative bleeding.
- To assess patient's pain and discomfort during and postoperatively to laser surgical excision of the oral lesion.

1.4 Literature review

A controversy arise; on whether to excise the lesion first or to confirm the diagnosis by incisional biopsy. Excisional biopsy has been used by some authors for confirmation of the diagnosis and the treatment.

Another controversy is that the use of laser in oral biopsies of suspected dysplastic or neoplastic lesions because of the thermal effects occurring on the edges of the surgical sample that would compromise the infiltrating evaluation which is fundamental for the therapeutical approach. It is essential to keep margins readable and safe, to facilitate the pathologist's examination. So, for this kind of lesion, a scalpel incision is still considered the gold standard technique (Gaspere Palaia et al 2019).

An excisional biopsy should be considered only if lesions are thought to be almost certainly benign. Regarding small lesions (ie, <2 cm), as the medical community moves toward molecular-based and gene-targeted cancer therapies, an excisional biopsy of even small suspected malignancies would preclude the preservation of unfixed tissue samples for molecular pathological/genetic examinations. Thus, even with small lesions it is advisable to obtain the diagnosis first and then plan the definitive therapy (Christopher J Walinski et al 2020).

Suter et al (2010) studied the CO2 and diode laser for excisional biopsies of oral mucosal lesions and the result was that; CO2 laser offers an advantages of smaller thermal damage zones over the diode laser (Suter VG et al 2010).

Munisekhar (2011) studied the conventional scalpel versus laser biopsies and the results revealed that laser biopsies have been more effective by producing less tissue distortion (al., 2011).

Angiero et al (2012) concluded that diode laser is a convincing therapeutic device for excising oral lesion larger than 3 mm in diameter, but can cause serious thermal effects in small lesions. They suggested that specimens should be of at least 5 mm in diameter in order to have a dependable evaluation of the histological sample (Angiero F et al 2012).

Umberto Romeo et al (2014) studied the biopsy of different oral soft tissues lesions by ktp and diode laser; histological evaluation and the study showed that the peri-lesional damage

did not compromise the morphological and structural characteristics of the specimens (Umberto R et al 2014).

A study by Chawla et al (2014) showed that a biopsy may be collected using a diode laser with no alteration in the microanatomy of the sample (Chawla K 2014).

Another study by Ena Mathur in 2015 about the diode laser excision of oral benign lesions revealed that diode laser surgery was rapid, bloodless and well accepted by patients and led to complete resolution of the lesions. The excised specimen proved adequate for histopathological examination. Hemostasis was achieved immediately after the procedure with minimal postoperative problems, discomfort and scarring (Ena Muthyar et al 2015).

Sandeep Kashyap et al (2018) studied the comparison of scalpel versus soft tissue diode laser for biopsy of oral lesions and the study revealed that both techniques seem to be equally effective in performing excisional biopsies of oral lesions. Laser has the advantage of maintaining a bloodless field and avoidance of suturing as well. However, due to the associated thermal damage caused, there may be minor loss of histological architecture (Sandeep Kashyap et al 2018).

A study by Gaspare Palaia et al in 2019 about ex vivo histological analysis of the thermal effects created by a 445-nm diode laser in oral soft tissue biopsy and the result was that a 445-nm diode laser creates a minimum thermal effect that has no implications in the histological evaluation of benign lesions. In suspicious lesions, a safety margin of 1 mm, compared with a scalpel is preferable (Gaspare Palaia et al 2019).

1.4.1 Oral lesions:

Oral mucosal lesions may occasionally be diagnosed correctly, based on history and clinical examination. Therefore, an accurate description is essential for diagnosis and management of oral lesions. A thorough oral lesion description must include the following nine items: size (length, width, and height), number (single, multiple), outline (regular, irregular), surface (smooth, granular, pebbly, cobblestone), base (pedunculated, sessile, nodular, dome-shaped), site (mucosal, intra-bony, dental), color (red, pink, white, red-white combined, blue, purple, gray, yellow, black, or brown according to their prevalence in oral mucosa), consistency (soft, hard, cheesy, firm, rubbery, and fluctuant), origin (acquired, non-acquired), and morphology or clinical appearance (primary lesions, secondary lesions) (Hamed Mortazavi et al 2019).

The description and diagnosis of oral lesions require a basic knowledge about dermatology since, many disorders of the oral mucosa also affect the skin. There are two terms in dermatology glossary for lesion description namely, primary lesions and secondary lesions. The term 'primary' is used to describe a lesion as it first appears, for example a macule. A 'secondary' lesion results from an alteration of primary lesion either in the natural course of disease or as the result of manipulation or treatment, for example, a scar (Bricker SL et al 2002).

The lesion that has undergone change in size or symptomology may be suspected for malignancy. If the management includes a biopsy, the pathologist evaluating the specimen needs an accompanying lesion description to render the definitive diagnosis. Since, questions about the management of the lesion may occur at a later date, documentation of description should be included in the patient record (Ann L et al 1985).

1.4.2 Biopsy:

Biopsy is the removal of tissue from a living person for microscopic examination to confirm or to establish the diagnosis of a disease. The term was coined in 1879 by a French dermatologist, Ernst Henry. This approach is used for all tissues of the body, including those of the oral cavity, where a wide spectrum of disease processes may present. Proper management of an oral mucosal lesion begins with diagnosis, and the gold standard for diagnosing disease, oral or otherwise, is tissue biopsy (R. J. Oliver et al 2004).

Rovin has made several observations on biopsy decisions (Amparo Mota et al 2007).

1. Any lesion that persists for more than two weeks with no apparent etiological basis.
2. Any inflammatory lesion that does not respond to local treatment after 10-14 days that is after removing local irritant.
3. Persistent hyperkeratotic changes in surface tissues.
4. Any persistent tumescence either visible or palpable beneath relatively normal tissue.
5. Inflammatory changes of unknown cause, that persists for long periods.
6. Lesions that interfere with local function such as fibroma.
7. Bone lesion not superficially identified by clinical and radiographic findings.
8. Any lesion that has characteristics of malignancy.
9. To establish the diagnosis where there is suspicion of neoplasia.
10. To determine the nature of lesion, this does not readily respond to conservative and simple therapy.
11. To determine the nature of all abnormal tissue removed from the oral cavity including cysts and granulomas.

Various types of biopsies are as follows (Amparo Mota et al 2007):

1. Incisional Biopsy
2. Excisional Biopsy
3. Exploratory Biopsy
4. Punch Biopsy
5. Needle Biopsy
6. Imprint Cytology
7. Shave Biopsy
8. Curettage Biopsy
9. Unplanned Biopsy
10. Fine Needle Cutting Biopsy
11. Exfoliative cytology

An incisional biopsy is a technique that samples only a particular or representative part of the lesion. It is usually indicated if the area under investigation appears difficult to excise because of its extensive size (>1cm in diameter) or hazardous location or whenever there is suspicion of malignancy. While, excisional Biopsy implies removal of the entire lesion at the time the

surgical diagnostic procedure is performed. A 1 mm of normal tissue surrounding the lesion is also excised to ensure total removal (Tarun Vyas 2018).

The center of larger tumors should be avoided as this is often necrotic and will not yield diagnostic material. The excised material needs to be fixed to stop tissue autolysis prior to the sample reaching the pathology laboratory. The solution of choice to do this is 10% neutral buffered formalin fixative (a 4% solution of formaldehyde). This can easily be obtained on request from most pathology laboratories together with a supply of request forms and specimen pots (R. J. Oliver, 2004).

Conventional biopsy by scalpel:

Traditionally, conventional biopsies using scalpel have been used to establish; histological characteristics of suspected lesions, extent and spread, their differentiation and to adopt an adequate treatment strategy (Amparo Motal et al 2007). After the advent of laser, the promotion, the popularity and successful outcome of laser therapy have made patients more inquisitive about the use of laser in dentistry. Lasers are employed for many purposes in various fields of science and the most advantageous is found in medical and dental arena (MS Munisekhar et al 2011).

1.4.3 Diode laser:

An advanced technique is called LASER (Light Amplification by Stimulated Emission of Radiation). Lasers produce light energy that can be absorbed by a target tissue. The absorption process produces a thermal reaction in that tissue. Depending on the instrument's parameters and the optical properties of the tissue, the temperature will rise and various effects will occur (Donald JC 2007).

Although laser was first introduced in 1964, it was not widely used in the mouth until about 1980. Davide Zaffe et al, initially studies were carried out on Ruby laser applicability by Goldman et al, Taylor and Stern et al, followed by studies by different lasers like argon, Co2, neodymium: Yttrium aluminum garnet and erbium: Yttrium aluminum garnet (Davide Zaffe et al 2004).

Dental literature contains many case reports and case controlled studies that reported the use of various laser wavelengths, predominantly Diode, CO2, Nd:YAG, Er:YAG, and Er,Cr :YSGG, for various intraoral soft-tissue procedures (Lee E 2007). Diode laser is a semiconductor laser that generally includes a combination of Gallium (Ga), Arsenide (Ar), and other elements such as Aluminum (Al) and Indium (In) to convert electrical energy into light energy. The wavelength range is about 800–980 nm.

Diode laser does not interact with dental hard tissues making it convenient for soft tissue operations; cutting and coagulating gingiva and oral mucosa, soft tissue curettage, or sulcular debridement. As lasers can achieve excellent tissue ablation with strong bactericidal and detoxification effects, they are one of the most promising new technical modalities for nonsurgical periodontal treatment (Akira A et al 2004).

Diode laser with a wavelength between 655 and 980 nm is able to accelerate wound healing, to promote angiogenesis, augment growth factor release and prevent root surface ablation. Smaller units in size as well as lower financial costs are other advantages of diode laser (Aoki A 2004). Because diode lasers are the most affordable of dental lasers, clinicians may be tended to use them as an applicable instrument for biopsy. However, diode lasers provide a bloodless field and rapid healing, are easy to operate, and, moreover, the bactericidal effects they provide reduce the

risk of bacteremia or infection following treatment (Moritz A 1998). It has been suggested that diode lasers may stimulate clotting factor VII, which seems to enhance hemostasis, as a result of the 'hot tip' effect, causing thermocoagulation (Colenton S 2004). In instances where thermal damage may be a concern, irrigating with saline while operating the laser can help to dissipate thermal energy. The effective penetration depth of a diode laser at 2 W is at least 2 mm. This may be adequate to seal small lymphatic vessels, and to decrease postoperative edema (Pirant S 2007).

Due to absorption characteristics of the various wavelengths of diode lasers, a 980 nm diode laser is able to cut slightly quicker than an 810 nm diode, as the former diode has greater absorption into water, which is the predominant component in most tissues in the oral cavity, than the 810 nm diode, which does not demonstrate much, if any, affinity to water. This difference is most noticeable when ablating tissues with minimal pigmentation (Christopher J Walinski et al 2020).

CHAPTER TWO

Materials and Methods

2.1 Study design: Quasi Experimental Design

2.2 Study area: Al-Abraj Dental Clinic_ Khartoum, Sudan.

2.3 Study duration: Four months study period will be conducted from June to September 2021.

2.4 Study population: Patients with oral lesions indicated for incisional or excisional biopsies.

2.5 Inclusion criteria:

- Willingness of patients to participate in the study.
- Systemically healthy patients

2.6 Exclusion criteria:

- Patients with systemic diseases interfering with surgery.
- Physiological conditions such as pregnancy.

2.7 Sample size:

Sample size was calculated using openepi.com, using the equation for quasi experimental design.

Repeated measures ANOVA and *Independent sample's T test* were used for association.

Significant level= 0.05

Following simplified and approximate formula can be used for sample size calculation:

$$n_1 = \frac{(\sigma_1^2 + \sigma_2^2 / \kappa)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

$$n_2 = \frac{(\kappa * \sigma_1^2 + \sigma_2^2)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

According to this formula, the sample size was 10 patients.

Power.t.test (power= 0.8, delta=0.4, SD=0.28, type="two.sample")

2.8 Sample technique:

Non-probability sample purposeful technique

2.9 Data Collection Tools:

Data were collected using a check list as followed:

- Principle investigator took demographic data, History chief complaint, PMH, PDH, oral hygiene status, soft tissue and hard tissues examination.
- **Investigations:** X-rays, CBC, cytology if needed.
- Any diagnosed gingival/ periodontal or caries teeth were treated at least one week before surgery. At the day of the surgery the participant was requested to rinse with normal saline. Then oral lesion prescribed using the eight steps for documenting oral lesions; the check list of data sheet (Clarie Jeong 2019).
- Every patient was treated following phases of periodontal therapy;
- Phase I (Nonsurgical phase), every patient was received oral hygiene instructions and full mouth scaling and root planing using hand instruments (Gracey Curettes,) and ultrasonic devices (SATELEC, France).
- Phase II (Surgical phase), excisional biopsy by 808 nm diode laser (Chinese, Solase®)
- Parameters:
 - Power: 2 W
 - Emission mode of laser light: Continuous mode
 - Optical diameter fiber and tips: 400 µm.
- Evaluation of intraoperative and postoperative bleeding
- Evaluation of patient's pain and discomfort during and postoperatively were based on the subjective answer of the patient, scores from 0 to 10 were attributed, these values were registered on a filling card which had the Visual Analogue Scale (VAS) , suggested by Plagmann et al. (Plagmann HC, 1997) Appendix

2.10 Materials needed for the Procedure:

- Universal measures of Infection control were taken; face mask and a pair of examination gloves were used for each participant.
- Personal protective equipments (PPE) and protocol of minor surgery practice post-COVID 19 Pandemic (Yilmaz S etal 2002).
- Dental chair, examination set consisting of a mouth mirror, explorer, tweezers and sterile cotton rolls.
- Hand instruments scalers (Gracey Curettes) and Ultrasonic device (SATELEC, France).
- Local anesthesia (lidocaine 2%), needles and syringes.
- Normal saline, disposable syringes for irrigation.
- 808 nm diode laser (Chinese, Solase®)
- Safety glasses were worn by the patient, the operator and the assisting staff all through surgery.

2.11 Ethical approval and informed consent:

Approval letter from the Ethical Committee of the University of Sudan was obtained prior to the condition of the study. Patients indicated for biopsy were given the different option of surgery and were requested to participate voluntary on taken their biopsies by laser. The laser technique and how it interacts with tissue to have an effect was explained to the patient. Those who agreed to participate signed an informed written consent. Data were kept confidentially and only used for the purposes of the study.

2.12 Data analysis:

The data were analyzed using Statistical Package for the Social Science (SPSS) version 21 with assistance of a professional biostatistician. P value less than 0.05 is statistically significant.

Repeated measures ANOVA and *Independent sample's T test* were used for association.

CHAPTER THREE

RESULTS AND DISCUSSION

3.1 Frequencies

3.1.1 Gender and age:

Our study was started with 10 patients (5 males and 5 females) and they all completed the follow-up with the mean age of 34.4 years. Among patients, there was a patient with a medical history of a migraine and another patient with a family history of a systemic lupus erythematosus. **(Table 3.1.1) (Figure 3.1.1)**

3.1.2 Habit and Oral hygiene activity:

Patients were non-smokers and there was no reported case of alcoholism. Among patients, only a 4.5 year old patient who did not exhibit a toothbrush activity due to age.

(Tables 3.1.3 and 3.1.4)

3.1.3 Diagnosis and Location:

Then oral lesion were prescribed using the eight steps for documenting oral lesions; the check list of data sheet (Clarie Jeong 2019). /30% of cases were diagnosed as a fibromas and the dominant location were anterior mouth. There was a case of squamous cell carcinoma (SCC) on the lateral border of the tongue. **(Tables 3.1.5) (Figure 3.1.2)**

3.1.4 Anesthesia

Anesthesia (Lidocaine HCL 2% - 1.8 ml) was administrated to 5 patients (50% of patients) with the amount of one ampule. **(Table: 3.1.7)**

3.1.5 Suturing and Bleeding:

Only one patient (10% of patients) underwent postoperative suturing. Regarding the bleeding, only one patient (10% of patients) had intraoperative and postoperative bleeding. **(Table 3.1.8)**

3.1.6 Pain measured with visual analog scale (VAS):

Regarding the patient's pain and discomfort, the mean of visual analog scale (VAS) during, immediately postoperative, after 3 hours, after 3 days and after one week are 3.2, 2.7, 1.8, 0.7 and 0.3 respectively. **(Table 3.1.9)**

3.2 Association

3.2.1 Comparison of the pain level in the different levels of time:

Using *repeated measures ANOVA*, there was a statistically significant Difference in VAS between during and after one week ($P= 0.001^{**}$). (Table 3.2.1) (Figure 3.2.1)

3.2.2 Comparison of pain level between patients took preoperative anesthesia and patient who didn't:

Using *Independent sample's T test*, statistically no significant difference was observed between patients took preoperative anesthesia and patient who didn't at different time intervals ($P>0.05$) (Table 3.2.2)

Section (1): Frequencies

Table: 3.1.1 Age of the participants

	Mean	SD	Minimum	Maximum
	34.4	18.5	4.5	62

Table: 3.1.2 Medical history

		Frequency	Percent
Medical condition	No abnormality detected	9	90
	Migraine/ neuralgia	1	10
Medication	No abnormality mentioned	9	90
	Tegritol	1	10
Family history	No abnormality mentioned	7	70
	Systemic lupus erythematosus	1	10
	Migraine	1	10
	Diabetes mellitus, Hypertension	1	10
Total		10	100

Table: 3.1.3 Habits

		Frequency	Percent
Tobacco	No	10	100
Alcohol	No	10	100
Total		10	100

Table: 3.1.4 Oral hygiene habits

		Frequency	Percent
Tooth brushing	Yes	9	90
	No	1	10
Brushing Frequency	Once	2	22
	Twice	7	78
Mouth Wash	No	10	100
Total		10	100

Table: 3.1.5 Diagnosis

	Frequency	Percent
Fibroma	3	30
Hemangioma	1	10
Impacted tooth	1	10
Inflammatory gingival enlargement	1	10
Mucous membrane pemphigoid	1	10
Mucocele	1	10
Squamous cell carcinoma	1	10
Wart	1	10
Total	10	100

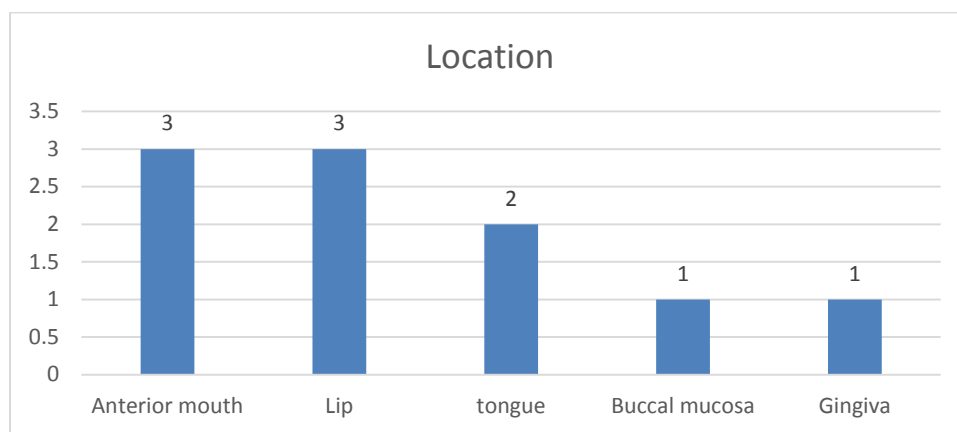


Figure 3.1.1

Table: 3.1.6 Operation done

	Frequency	Percent
Excisional biopsy	9	70
incisional biopsy	1	10
Total	10	100

Table: 3.1.7 Anesthesia

		Frequency	Percent
Pre-Operative anesthesia	Yes	5	50
	No	5	50
Amount	One Ampule	5	100
type	Lidocaine HCL 2% - 1.8 ml	5	100
Total		10	100

Table: 3.1.8 Suturing and bleeding

		Frequency	Percent
Post-operative suturing	Yes	1	10
	No	9	90
Intra- operative bleeding	Yes	1	10
	No	9	90
Post-operative bleeding	No	10	100
	Total	10	100

Table: 3.1.9 Pain measured with visual analog scale (VAS)

	Mean	SD	Minimum	Maximum
During	3.2	1.0	2	5
Immediately Postoperative	2.7	0.7	2	4
After 3 hours	1.8	1.3	0	4
After 3 days	0.7	0.9	0	3
After One week	0.3	0.5	0	1

Section (2): Associations

Table: 3.2.1 Comparison of the pain level in the different levels of time

	Mean	SD	P value
During	3.2	1.0	0.001**
Immediately Postoperative	2.7	0.7	
After 3 hours	1.8	1.3	
After 3 days	0.7	0.9	
After One week	0.3	0.5	

Repeated Measures ANOVA, P value is significant

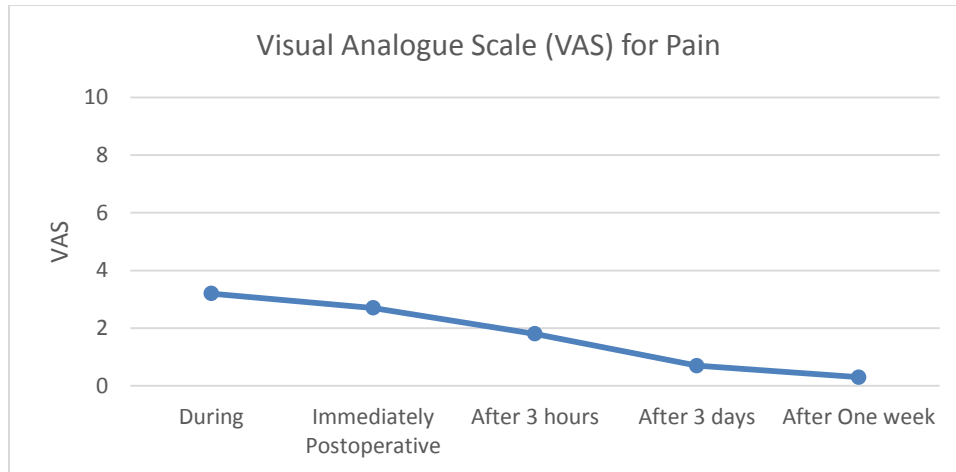


Figure 3.2.1

Table: 3.2.2 Comparison of pain level between patients took preoperative anesthesia and patient who didn't

	Anesthetized Pt		None anesthetized Pt		P value
	Mean	SD	Mean	SD	
During	3.6	1.3	2.8	0.4	0.263
Immediately Postoperative	2.8	0.8	2.6	0.5	0.667
After 3 hours	2.4	1.5	1.2	0.8	0.160
After 3 days	0.8	1.3	0.6	0.5	0.760
After One week	0.4	0.5	0.2	0.4	0.545

Independent sample's T test

Discussion

After the advent of laser, the promotion, the popularity and successful outcome of laser therapy have made patients more inquisitive about the use of laser in dentistry. Lasers are employed for many purposes in various fields of science and the most advantageous is found in medical and dental arena (MS Muniskhar et al 2011). Diode laser does not interact with dental hard tissues making it convenient for soft tissue operations; cutting and coagulating gingiva and oral mucosa, soft tissue curettage, or sulcular debridement. As lasers can achieve excellent tissue ablation with strong bactericidal and detoxification effects, they are one of the most promising new technical modalities for nonsurgical periodontal treatment (Akira.A 2004). Diode laser with a wavelength between 655 and 980 nm is able to accelerate wound healing, to promote angiogenesis, augment growth factor release and prevent root surface ablation. Smaller units in size as well as lower financial costs are other advantages of diode laser (Aoki A 2004).

Our study was started with 10 patients (5 males and 5 females) and they all completed the follow up with the mean age of 34.4 years. Among patients, there was a patient with medical history of migraine and another patient with family history of systemic lupus erythematosus.

In the present study, anesthesia (Lidocaine HCL 2% - 1.8 ml) was administered to 5 patients (50% of patients) with the amount of one ampule. Statistically no significant difference was observed between patients took preoperative anesthesia and patient who didn't at different time intervals ($P>0.05$). Patients who didn't take anesthesia showed slightly lower VAS**.

This study in agreement with Chang Kai Chen et al (2013), for removal of keratosis by laser using only topical anesthesia and the results were satisfactory, only slight pain and bleeding occurred, eliminating the need for suturing (Chang Kai Chen et al 2013).

In the current study, only one patient (10% of patients) underwent postoperative suturing. Regarding the bleeding, only one patient (10% of patients) had intraoperative and postoperative bleeding. A study by Ena Mathur in 2015 about the diode laser excision of oral benign lesions revealed that diode laser surgery was rapid, bloodless and well accepted by patients and led to complete resolution of the lesions. The excised specimen proved adequate for histopathological examination. Hemostasis was achieved immediately after the procedure with minimal postoperative problems, discomfort and scarring (Ena Muthar et al 2015).

Sandeep Kashyap et al (2018) studied the comparison of scalpel versus soft tissue diode laser for biopsy of oral lesions and the study revealed that both techniques seem to be equally effective in performing excisional biopsies of oral lesions. Laser has the advantage of maintaining a bloodless field and avoidance of suturing as well (Sandeep Kashyap et al 2018).

Regarding the patient's pain and discomfort, the mean of visual analog scale (VAS) during, immediately postoperative, after 3 hours, after 3 days and after one week are 3.2, 2.7, 1.8, 0.7 and 0.3 respectively. There was a statistically significant Difference in VAS between during and after one week ($P= 0.001^{**}$).

Robert A. Strauss (2006) stated that no statistically significant difference in frequency and intensity of pain or temporal distribution of pain with laser biopsy vs scalpel biopsy (al., 2006). Sandeep Kashyap et al (2018), a study compared the scalpel to diode laser for biopsy of oral lesions. The study showed that the mean time taken for excision was statistically similar in both the groups. Distribution of patient comfort and pain was statistically not significant.

Pía López-Jornet and Fabio Camacho-Alonso (2013) found that pain and swelling reported by the patients was greater with the conventional cold knife than with the laser, statistically significant differences for pain and swelling were observed between the two techniques during the first three days after surgery.

Our study is in agreement with a study by Margherita Gobbo et al in 2017 about the comparison between blue diode laser versus traditional infrared diode laser and quantic molecular resonance scalpel. The study showed that the referred pain was lowest in the BLUE group and reported minimum bleeding and necessity of sutures. The scalpel group showed the highest bleeding during surgery. The lowest thermal damage ($p < 0.000$) was found in the BLUE group ($71.3 \pm 51.8 \mu\text{m}$), whereas the IR group proved the highest ($186.8 \pm 82.7 \mu\text{m}$) compared both with the BLUE and scalpel ($111.4 \pm 55.4 \mu\text{m}$) groups (Margherita Gobba et al 2017).

The current study revealed that excisional and incisional biopsies of the oral lesions using diode laser are a valid techniques and they have no implications on the histopathological assay. This is in agreement with Valérie G. A. Suter et al (2010), MS Munisekhar (2011), Angiero et al

(2012), Umberto Romeo et al (2014), Ena Mathur (2015), Sandeep Kashyap et al (2018) and Gaspare Palaia et al (2019).

Valérie G. A. Suter et al (2010) studied the CO₂ and diode laser for excisional biopsies of oral mucosal lesions and the result was that; CO₂ laser offers an advantages of smaller thermal damage zones over the diode laser.

MS Munisekhar (2011) studied the conventional scalpel versus laser biopsies and the results revealed that laser biopsies have been more effective by producing less tissue distortion.

Angiero et al (2012) concluded that diode laser is a convincing therapeutic device for excising oral lesion larger than 3 mm in diameter, but can cause serious thermal effects in small lesions. They suggested that specimens should be of at least 5 mm in diameter in order to have a dependable evaluation of the histological sample.

Umberto Romeo et al (2014) studied the biopsy of different oral soft tissues lesions by ktp and diode laser; histological evaluation and the study showed that the peri-lesional damage did not compromise the morphological and structural characteristics of the specimens.

Research by Chawla et al (2014) showed that a biopsy may be collected using a diode laser with no alteration in the microanatomy of the sample.

Another study by Ena Mathur in 2015 about the diode laser excision of oral benign lesions revealed that diode laser surgery was rapid, bloodless and well accepted by patients and led to complete resolution of the lesions. The excised specimen proved adequate for histopathological examination. Hemostasis was achieved immediately after the procedure with minimal postoperative problems, discomfort and scarring.

Sandeep Kashyap et al (2018) studied the comparison of scalpel versus soft tissue diode laser for biopsy of oral lesions and the study revealed that both techniques seem to be equally effective in performing excisional biopsies of oral lesions. Laser has the advantage of maintaining a bloodless field and avoidance of suturing as well. However, due to the associated thermal damage caused, there may be minor loss of histological architecture.

A study by Gaspare Palaia et al in 2019 about ex vivo histological analysis of the thermal effects created by a 445-nm diode laser in oral soft tissue biopsy and the result was that a 445-nm diode laser creates a minimum thermal effect that has no implications in the histological evaluation of benign lesions. In suspicious lesions, a safety margin of 1 mm, compared with a scalpel is preferable.

Conclusions:

The results of our study support the concept of introducing this new technology in the clinical practice on a daily basis; this could largely change and ameliorate the quality of surgical procedures. The hemostatic effect is a major advantage, since it allows optimal visibility and reduces the need for sutures. These advantages lead to good compliance of the patient and excellent healing results. This technique offers minimal patient pain and discomfort.

Finally, excisional and incisional biopsies of the oral lesions using diode laser 808 nm allows great advantages for the reduced risk of artefacts and damages of the sample for histopathological examination.

Recommendations

Further evaluation on the optimization of both dosimetric values in larger sample size and in varying simulations should be carried out in future for corroboration of results

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ANNEXES

Data sheet

Sudan University of Science and Technology

Institute of Laser

Date: / /2021 case No:

Name: Age: Gender:

Occupation: Address: Phone no:

1. History of current illness

- Onset, location, intensity, frequency, duration

- Aggravating and/or relieving variables

- Better, unchanged or worse over time

2. Medical, tobacco and alcohol history

- Medical conditions

3. Medications and allergies

4. Tobacco and alcohol (type, frequency, duration)

5. Family history

6. Oral hygiene habit

- Tooth brushing: Yes___ No___
- Frequency of brushing___ times/day___
- Mouth wash: No___ Warm saline___ Chlorhexidine___

7. Clinical examination

- Extraoral examination

- Intraoral examination

- Lesion inspection (adjunctive visual tools such as toluidine blue and direct fluorescence)

Lesion description*:

Location	
Distribution and definition	
Size	
Shape	
Color	
Consistency	
Texture	
History	

8. Differential diagnosis

9. Diagnostic tests

- **Biopsy**

10. Definitive diagnosis

11. Suggested management

Preoperative local anesthesia:

Yes: ___ No: ___

Amount: _____

Type: _____

Postoperative suturing:

Yes: ___ No: ___

Intraoperative bleeding:

Bleeding

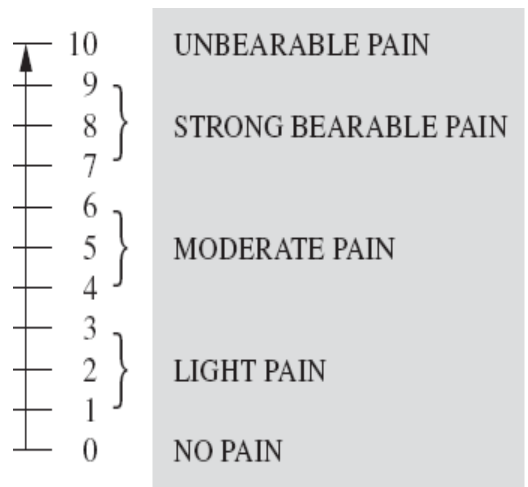
No bleeding

Postoperative bleeding:

Bleeding

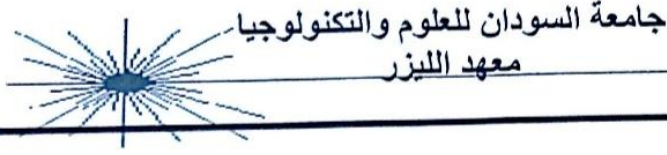
No bleeding

Visual Analogue Scale (VAS) _For pain*



	During	Immediately postoperative	After three hours	After three days	After one week
VAS					

بسم الله الرحمن الرحيم



جامعة السودان للعلوم والتكنولوجيا
معهد الليزر

التاريخ: 2021/11/01م

السيد/ المؤسسات العلاجية الخاصة

المحترم
السلام عليكم ورحمة الله وبركاته

الموضوع: الدارس/ لؤي أحمد عبد الله

بالإشارة للموضوع أعلاه ، نفيدكم بأن الدارس المذكور ضمن طلاب الدبلوم فوق الجامعي في تطبيقات الليزر في الطب الدفعة الثامنة (أسنان) وهو بصدد إجراء بحث تخرج، عليه نرجو منكم التكرم بالسماح له باستخدام جهاز الليزر الخاص به في عيادته الخاصة.

ولكم الشكر والتقدير

د. نادر شمس الدين عثمان

رئيس قسم تطبيقات الليزر الطبية والبيولوجية



إقرار المشارك

يقوم الطبيب **لؤي احمد عبدالله** بأجراء بحث علميا لتقييم _____ إسهاما منكم في دعم البحوث العلمية نرجو من سيادتكم التكرم بالموافقة على المشاركة في هذا البحث علما بان بيانات المستخدمة بغرض البحث العلمي في مجال الأسنان و العلاج بالليزر و ليس هنالك أي اثار جانبية مترتبة على ذلك وسوف لن تستخدم هذه البيانات لغير أغراض البحث مع الاحتفاظ بسرية المعلومات وحفظها.

إقرار المشارك

لقد اطلعت على المعلومات الحالية والتي تم شرحها لي وأتيح لي طرح الأسئلة عنها، وقد تلقيت الإجابات الوافية عن كل الأسئلة، وانا اقر بالموافقة على المشاركة طواعية في هذه الدراسة واعلم بحقي في التوقف عن المشاركة في أي وقت دون أن يؤثر ذلك على حقوقي في تلقي العناية الطبية اللازمة في أي وقت.

رمز المشارك

توقيع المشارك.....

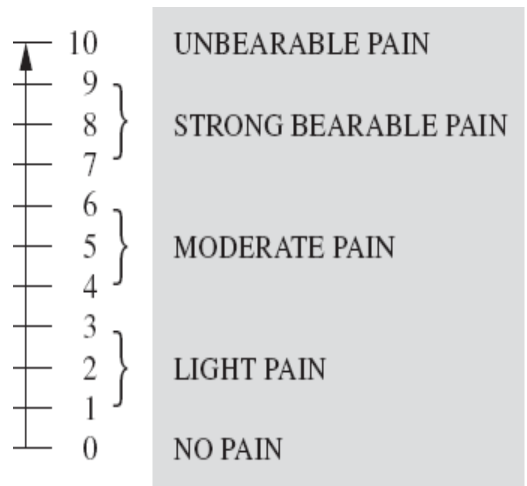
توقيع من ينوب عن المشارك.....

في حالة عدم قدرة المشارك على قراءة الإقرار ويحتاج إلى من يقرأ له أو يترجم له

توقيع القارئ أو المترجم.....

توقيع الباحث.....

التاريخ / / ٢٠٢١



Visual analog scale

:

Figure: 3.1.1

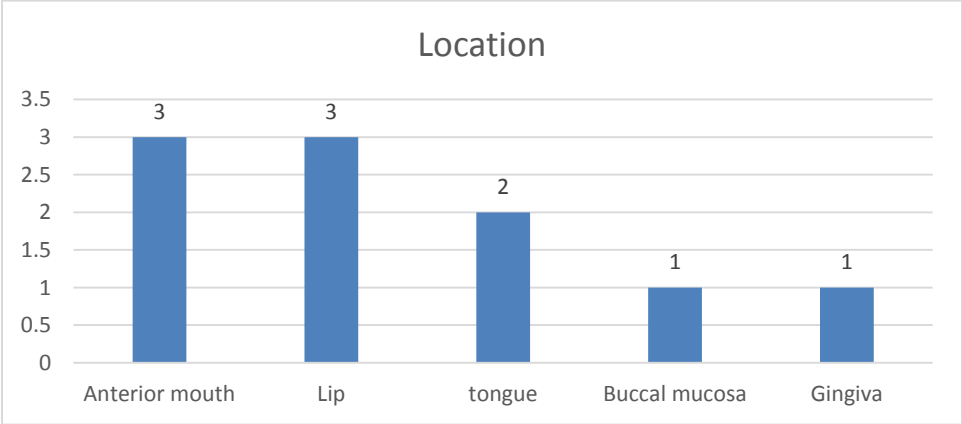


Figure 3.1.2

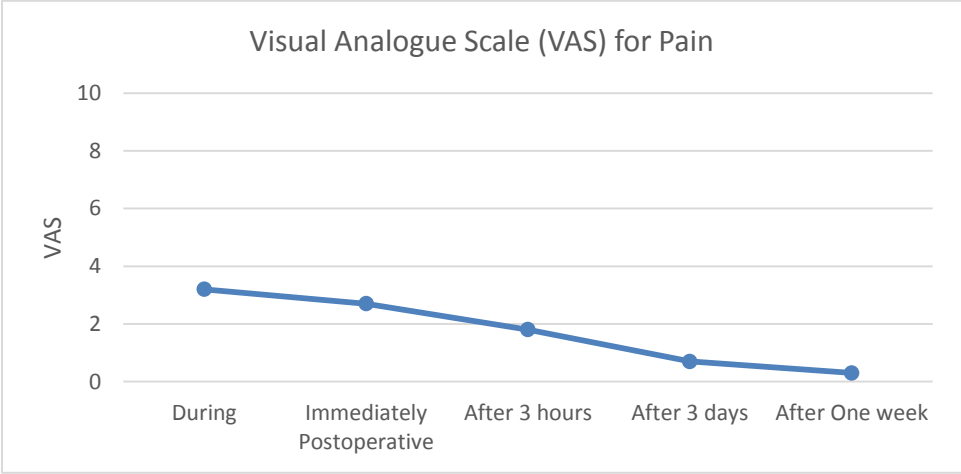


Figure 3.2.1