Sudan University of Science and Technology

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Frenectomy using Diode Laser Versus Conventional Scalpel Technique

A Graduation Research Submitted for Requirement of the Degree of Higher Diploma in Laser Applications in Medicine (Dentistry)

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Dedication

To the soul of my dear father

To my dear beloved mother

To my kindly brother

To my helpful sisters

To all my friends and colleagues, who helped and encouraged me to continue.

To all of them, I dedicate this project.

Acknowledgement

Firstly I thank ALLAH for giving me strength to complete this study. I would like to express great thanks to my supervisors Dr. Elhadi Mohieldin Awooda for his support and supervision. Also I would like to thank Dr. Nadir S.E. Osman for his help and guidance. A special thanks to the staff of Institute of Laser at Sudan University of Science and Technology. My thanks extend to the staff of periodontal department in Khartoum Dental Teaching Hospital for their unlimited assistance to complete this study. Also Iwould like to thank all subjects whom participate in the study for their cooperation and patience.

Abstract

The aim of this study is to compare between frenectomy by diode laser versus conventional technique in the degree of postoperative pain expressed by patients, satisfaction of participants and rate of healing after frenectomy.

Fourteen volunteers (10 females and 4 males) with age ranging from 16- 40 years, who required frenectomy were selected for the study, they divided into two groups, A and B. Group A: consists of 7 volunteers were treated with laser technique (one case was lingual frenum and 6 upper labial frena). Group B: consist of 7 volunteers who were treated with conventional scalpel technique. Postoperative pain and functional complication, ranges of each patient were recorded using a visual analogue scale after 3 hours, 3 days and 7 days after frenectomy operation for both groups. Clinical assessment of healing was recorded after 3 days, 7 days and 1 month.

The obtained results indicated that patients treated with the diode laser had less postoperative pain and fewer functional complications and required fewer analgesics compared to patients treated with the conventional scalpel technique (P value = 0.001). Wound healing was delayed in the laser group after 1 month.

Based on the results, it can be concluded that diode laser treatment used for frenectomy operations provides better patient perception in terms of postoperative pain and function than that obtained by the scalpel technique.

الخلاصة

الهدف من هذه الدراسة هو مقارنة درجة الألم ما بعد الجراحة التي أعرب عنها المرضى ، ورضا المشاركين ومعدل الشفاء بعد استئصال طيات الغشاء المخاطي الذي يربط الشفاه ، الخد أو اللسان إلى عظم الفك بعد استخدام تقنية الليزر والمشرط الجراحي.

تم اختيار أربعة عشر متبرع (عشر اناث واربعة دكور , من الأشخاص الذين تتراوح أعمارهم ما بين 16 و 40 سنة ، والذين كانوا بحاجة إلى استئصال الاغشية من أجل الدراسة ، وتم تقسيمهم إلى مجموعتين (أ) و (ب). المجموعة (أ) : تتكون من 7 متبرعين تم علاجهم بالليزر (كانت حالة واحدة غشاء لساني و6 اغشية شفوية . المجموعة (ب): تتكون من 7 متبرعين تم معالجتهم باستخدام تقنية المشرط التقليدية . تم تسجيل الألم بعد العملية الجراحية وتقييمات مضاعفات وظيفية لكل مريض باستخدام مقياس التماثلية البصرية بعد 3 ساعات و 3 أيام و 7 أيام للمجموعتين . التقييم السريري للشفاء المسجل بعد 3 أيام ، 7 أيام و 1 شهر.

أشارت النتائج المكتسبة إلى أن المرضى الذين عولجو بالديود ليزر لديهم آلام أقل بعد العملية ومضاعفات وظيفية أقل واحتاجو مسكنات أقل مقارنة بالمرضى المعالجين بتقنية المشرط بناء علي النتائج أن العلاج بالليزر ديود المستخدم لعمليات استئصال طيات الغشاء يساعد على إدراك أفضل للمرضى من حيث الألم والوظيفة بعد العملية الجراحية من تلك التي يتم الحصول عليها بواسطة تقنية المشرط التقليدية.

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Chapter One

Introduction and Literature Review

1.1 Overview

A frenum is an anatomic structure formed by a fold of mucous membrane, connective tissue, and sometimes muscle fibers. The most important of these are the labial frenae in the mid-line of the upper and lower jaw, the buccal frena in the premolars region and the lingual frenum of the mandible. Embryologically frenum originates as remnant of the central cells of the vestibular lamina at the midsagittal alveolar periosteum of both maxilla and mandible. The size of the frenum varies among individuals as does the location where the frenum inserts into the alveolar mucosa and/ or gingiva. Lingual frenum attaches the tongue to the floor of the mouth or to the alveolar mucosa of mandible. The frena under normal conditions do not have pathological consequences. However, in some cases they can present clinical problems, fundamentally of orthodontic, prosthetic, phonetic or periodontal nature (Hashim and Al-Fatlawi, 2006).

The frena may jeopardize the gingival health by causing a gingival recession when they are attached too closely to the gingival margin, either because of an interference with the proper placement of a toothbrush or through the opening of the gingival crevice because of a muscle pull (Jhaveri, 2006). The presence of an aberrant frenum being one of the aetiological factors for the persistence of a midline diastema between the maxillary central incisors in adults, which considered as an aesthetic problem (Huang and Creath, 1995).

The labial frenal attachments have been classified as follow:

- Gingival: Fibers inserted within attached gingiva.
- Papillary: Fibers extended into interdental papilla.

- Papilla penetrating: When the fibers cross the alveolar process and extend up to the Palatine papilla.

  papillary and papilla penetrating frenum are considered as pathological and have been found to be associated with loss of papilla, recession, diastema, and plaque accumulation. In such cases, it is necessary to perform frenectomy for aesthetic and functional reasons.

  Frenotomy is the incision and relocation of the frenal attachment, whereas frenectomy is the complete excision of the frenum along with its attachment to the underlying bone (Butchibabu et al., 2014) Short and tight lingual frenum causes ankyloglossia or tongue -tie that lead to difficulty in breast feeding and speech articulation due to limitation in tongue movement (Chaubal and Dixit, 2011).

  Frenum is shielded by means of stratified layered epithelium which contains vascular structures with thin peripheral nervous ramifications. Hypertrophic, fibrotic, ample, fan-shaped or bifid ending construction are described as an abnormal frenum whose development is not dependent upon its point of insertion (Olivi et al., 2010).

1.2 Statement of the Problem

Highly attach frenum may cause orthodontic problem(mid line diastema), gingival recession , speech problem in lingual frenum and affects stability of the denture.

1.3 Justification

Frenectomy done by conventional scalpel technique carries the risk of bleeding during surgical operation, postoperative discomfort and suturing, diode laser may overcome these disadvantages in term of immediate haemostasis, less discomfort postoperative, less operative time consume and no suture is required.

1.4 Literature Review

Frenectomy can be done by conventional technique, electrosurgery, or soft tissue lasers. The conventional technique comprises excision of the frenumby using a scalpel. However, it carries the routine risks of surgery like bleeding and patient compliance (Kaur et al., 2014).

Since the conventional procedure of frenectomy was first proposed, a number of modifications of the various surgical techniques like the Miller's technique, V-Y plasty and Z-plasty have been developed to solve the problems which are caused by an abnormal labial frenum.

Conventional (Classical) Frenectomy

The classical technique was introduced by Archer (1961) and Kruger (1964). This approach was advocated in the midline diastema cases with an aberrant frenum to ensure the removal of the muscle fibres which were supposedly connecting the orbicularis oris with the palatine papilla. This technique is an excision type frenectomy which includes the interdental tissues and the palatine papilla along with the frenulum (DeviShree and Shubhashini, 2012).

Miller's Technique

This technique introduced by Miller & P.D in 1985. It was proposed for the post-orthodontic diastema cases. The ideal time for performing this surgery is after the orthodontic movement is complete and about 6 weeks before the appliances are removed. Excision of the frenulum and exposure of the labial alveolar bone in the midline. A horizontal incision was made to separate the frenulum from the interdental papilla.

A laterally positioned pedicle graft (split thickness) was obtained and it was sutured across the midline (Miller Jr, 1985).

Z Plasty

This technique is indicated when there is hypertrophy of the frenum with a low insertion, which is associated with an inter-incisor diastema, and when the lateral incisors have appeared without causing the diastema to disappear and also in cases of a short vestibule. The length of the frenum was incised with the scalpel and at each end, limbs at between 60° and 90° angulation, incisions were made in equal length to that of the band. By using fine tissue forceps, with care not to damage the apices of the flaps, the submucosal tissues were dissected beyond the base of each flap, into the loose non-attached tissue planes. The resultant flaps which were created were mobilized and transposed through 90° to close the vertical incisions horizontally (Langdon and Patel, 1998).

V-Y Plasty

V-Y plasty can be used for lengthening the localized area, like the broad frena in the premolar-molar area. This technique was employed in a case of a papilla type of frenal attachment**.** After the area was anaesthetized with a local infiltration , the frenum was held with the haemost and an incision was made in the form of V on the undersurface of the frenal attachment**.** The frenum was relocated at an apical position and the V shaped incision was converted into a Y, while it was suture (Kruger).

Ankyloglossia is an uncommon congenital oral anomaly that can cause difficulty with breast-feeding, speech articulation. The prevalence of ankyloglossia reported in the literature varies from 0.1% to 10.7% (Ballard et al., 2002). The higher prevalence was reported in neonates than in adolescents, or adults. There is some evidence that ankyloglossia can be a genetically transmissible pathology, but the genetic component that regulate the phenotype in affected person is unknown.

Ankyloglossia was also found associated in cases with some rare syndromes such as X- linked cleft palate syndrome(Moore et al., 1987), Kindler syndrome (Hacham-Zadeh S, Garfunkel AA,1985). Speech problems can occur when there is limited mobility of the tongue due to ankyloglossia. The difficulties in articulation are evident for consonants and sounds like " r, s, z, t, d, l, j, zh, ch, th, "(Lalakea and Messner, 2003). The ankyloglossia can be classified into 4 classes based on length of tongue from the insertion of the lingual frenum into the base of the tongue to the tip of the tongue. Clinically acceptable, normal range of free tongue is greater than 16 mm. Kotlow's classification of lingual frenum as follows; Class I: Mild ankyloglossia: 12 to 16 mm length of the free tongue, Class II: Moderate ankyloglossia: 8 to 11 mm, Class III: Severe ankyloglossia: 3 to 7 mm, Class IV: Complete ankyloglossia: Less than 3 mm (Kotlow LA,1999).

1.3 Objectives

1.3.1 General Objective

The aim of this study is to assess the clinical effectiveness of diode laser in frenectomy in comparison to conventional surgical technique.

1.3.2 Specific Objectives

To compare between the effect of diode laser and the conventional technique (scalpel) on the degree of postoperative pain that expressed by patients. The objective extends to assess the satisfaction of participants and rate of healing after frenectomy.

Chapter 2

Basic Concepts of Laser

2.1 Laser

LASER is an acronym for 'Light Amplification by the Stimulated Emission of Radiation'. Maiman generated the first laser beam by using a ruby rod. In 1961, the first gas and continuously operating laser was described by Javan et al. The first laser was introduced into the fields of medicine and dentistry during the 1960s by Goldman et al, but the thermal damage was too great to consider this laser as a clinical instrument. Patel produced the first laser with CO_2 in 1964. Stern and Sognnaes in 1964 began looking at the possible uses of the ruby laser in dentistry. In Romania, the first laser with CO_2 and Nd -YAG was produced in 1968. A pioneer in the area of clinical periodontal and oral surgery is Pick, who, along with his colleagues in 1985, reported on laser gingivectomy (Todea, 2004).

2.1.1 Properties of Laser

Light is a form of electromagnetic energy that exists as a particle, and travels in waves, at a constant velocity. The basic unit of this radiant energy is called a photon; the wave of photons travels at the speed of light and it can be defined by two basic properties. The first is amplitude, which is defined as the vertical height of the wave oscillation from the zero axis to its peak. This correlates with the amount of energy in the wave: the larger the amplitude, the greater the amount of energy.

The second property of a wave is wavelength, which is the horizontal distance between any two corresponding points on the wave. These two parameters are very important, both with respect to how the laser light is delivered to the surgical site and to how it reacts with the tissue.

As the waves travel, they oscillate several times per second, and this is termed ‘frequency’. Frequency is inversely proportional to the wavelength: the shorter the wavelength, the higher the frequency and vice versa (Edwards and Reiman, 2008), as illustrated in figure 1.

A laser differs from a conventional light source in four aspects. First, the laser emits radiation in a highly unidirectional (collimation) beam, secondly, the radiation is extremely pure in colour (monochromaticity) , thirdly high degree of coherence , i.e, the degree of correlation between the phase at two different points on beam of light.

The four characteristic of laser radiation is that the intensity can greatly exceed that of conventional light , particularly in pulsed laser (Nityanand and Richa, 2011).

A laser is a device that transforms the light of various frequencies into a chromatic radiation in the visible, infrared, and ultraviolet regions, with all the waves in the phase being capable of mobilizing immense heat and power when they are focused at a close range (Olivi and Genovese, 2011). It emits light through a process called stimulated emission, which features the collimated (parallel) and coherent (temporally and spatially constant) electromagnetic radiation of a single wavelength (Einstein, 1917).

2.1.2 Elements of Laser

Any laser system has three basic components. First component, an optical cavity which is placed at the center of the device. The core of the cavity is comprised of chemical elements, molecules, or compounds and these are called the active medium, which can be a container of gas, a crystal, or a solid-state semi-conductor Surrounding this core is an excitation source (second component), either a flash lamp, an electrical circuit, or an electrical coil, which pumps the energy into the active medium. There are two mirrors (third one), one at each end of the optical cavity, which are placed parallel to each other; or in the case of a semi-conductor, there are two polished surfaces at each end. These mirrors act as resonators and help in collimating and amplifying the developing beam. A cooling system, focusing lenses, and other control complete the mechanical components (Coluzzi and Convissar, 2004).

Stimulated emission is the process which takes place within the active medium due to the pumping mechanism, and it was postulated by Albert Einstein in 1916.

2.1.3 Laser Types

The laser systems which have been developed to date have been classified according to the active medium that is stimulated to emit the photon energy into solid state, gas,liquid or dye and semiconductorlasers

Solid state lasers are high density lasing material in form of crystal of glass like material dopped with chromium, Neodymium, sapphire etc. Solid- stateare pumped with discharge lamps or diode laser. These include ;Ruby ,Nd-YAG, Alexandrite, Er-YAG.

Gas Laser**:** These types of lasers involve gas as a medium when excited by electrical discharge produce light. The gas laser can be characterized as atomic, ionic or molecular depending on the laser material used. Helium-neon, Argon and CO2 lasers are the most common gas lasers having output in visible, UV and far infrared lasers.

Liquid or Dye Lasers**:** These lasers have active medium as colored compounds carried by a solvent. The common materials used in these lasers are copper, chromium, dyes, metallic salts. The major advantage of these ,that can be tuned to broad range of wavelengths. They are useful in isotope separation, measurement and integrated circuit manufacturing.

Semiconductor Laser**:** These lasers are sometimes called as diode lasers. The gain medium is made from a direct band gap semiconductor material based on either gallium arsenide (GaAs) or InP substrates. Unlike other lasers, these devices generally small , use low power and extremely reliable. Lasers may also be classified according to their mode of operation into continuous and pulsed lasers.

Continuous wave (CW) **:** These lasers operate with a stable constant power emitting steady beam of light. A continuous wave lasers usually have the light energy expressed in watts.

Pulsed Laser**:** In these lasers the output of the laser varies with time in form of on off periods. Pulse lasers are characterized by high gain achieved due to a large population inversion for a short time. Their energy is expressed in joule. The main advantages of using pulsed lasers are their ability to provide short duration pulses of very high intensity. The pulsed operation may be single pulse, single pulsed Q switched, repetitively pulsed or mode locked (Nityanand and Richa,2011).

2.1.4 Laser Applications

Laser radiation has various applications in many fields. As a device, it is now used in medicine, astronomy, geodesy, metrology, chemistry, biology, spectroscopy, holography, power engineering, in various processes in engineering, as well as in communication technology, automation and remote control, in military technology, entertainment industry, art restorations, industrial applications include many procedures, such as laser welding, drilling, cutting (e.g., glass decoration, trimming, milling) , laser microelectronics, in computer science semiconductors or He-Ne low- power lasers seem to be the best. The laser printer used in computer science, has become standard equipment of computer centers (Jelínková, 2013).

2.1.4.1 Medical Applications of Lasers

The laser is applied to almost all disciplines of medicine for therapeutic and diagnostic purposes including dermatology, ophthalmology, dentistry, otolaryngology, gastroenterology, urology, gynaecology, cardiovascular system, neurosurgery and orthopaedics (Steiner, 2003).

2.2 Laser Tissue Interaction

When biological tissue is irradiated by laser light four phenomena exist which govern on undistributed propagation of light in tissue: reflection, scattering, absorption and fluorescence.

The penetration of laser light in biological tissue depends on optical properties of biological tissue, such as index of refraction, scattering and, and also the absorption of laser light in tissue.

These optical properties determine the mechanism of laser-tissue interaction in that special case (Ansari and Mohajerani, 2011) laser radiation can interact with biological tissue in six ways:

2.2.1 The electromechanical (photomechanical or photodisruptive mode)

This mode requires nano second or shorter pulses with extremely high spatial density of photons. The main area of application photomechanical mode is ophthalmology (Geerling et al., 1998).

2.2.2 Ablasion

Ablation is evaporation followed by expulsion of evaporated material. The absorption of strong laser pulses causes small explosions. The kinetic energy of molecules and molecular fragments is provided by the excess energy of the pulse after evaporation and/or fragmentation has been caused**.** The process is dependent on absorptive and elastic properties of tissue and on its viscosity.

Ablation is an important mode of action in caries removal and cavity preparation without significant thermal effects, collateral damage to tooth structure and patient discomfort (Hibst and Keller 1989), ophthalmology (Pallikaris et al., 2003), surgery of joints, angioplasty (Köster et al., 2002) and lithotripsy (Welch et al., 2004).

2.2.3 Photothermal (coagulative and vaporization) Processes

A typical example is photothermolysis of ectatic vessels in port-wine stain. The wavelength is selected for high absorption in blood,e.g. 585 or 595 nm. The pulse duration is chosen long enough to allow heat to diffuse into the vessel wall from the site of absorption within the erythrocytes, but small enough to prevent heating of perivascular tissue.

Thus the vessel wall can be selectively heated to 70 ◦C, which is required for thermal necrosis (Tanzi et al., 2003).

2.2.4 Photochemical (photodynamic) Reactions

Fluence rates below the hyperthermia threshold can be used for Photodynamic therapy (PDT), a two-step modality in which the delivery of a light activated and lesion-localizing photosensitizer is followed by a low, non-thermal dose of light irradiation. Photochemical reactions of biological relevance are dependent on generation of reactive oxygen species (ROS) (Halliwell, 1991).

2.2.5 Biostimulation and wound healing

lower CW light fluence rates and doses than those used in PDT are used. Laser penetration into tissues is a few tenths of a millimetre, and the treatments are often termed ‘low laser level therapies’,

LLLTs, also known as photobiomodulation, cold laser therapy and laser biostimulation. The following applications have been proposed: tumour treatment, treatment of tinnitus, epilepsy, pain, thrombosis, reduction of the recovery time after traumas or surgery, treatment of hyperlipidemia and strengthening of the immune system (Navratil and Kymplova, 2002).

The chromophores for possible biostimulative effects are unknown, and so are the cell reactions.

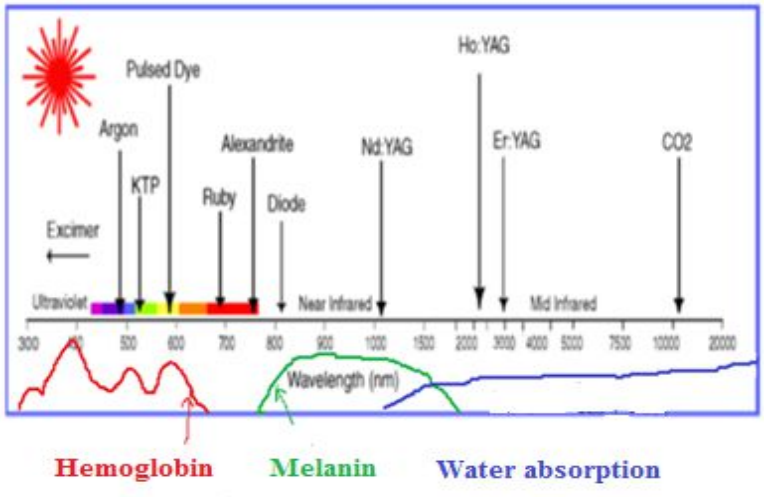

Figure 2.2 Wavelengths of common medical lasers and it's peak absorption of chromophores in the tissues (courtesy of Dr Albert Poet, Shore Laser Center).

Chapter 3

Materials and Methods

This was an experimental clinical study used to compare between the degree of postoperative pain such as discomfort and functional complications experienced by patients after two frenectomy techniques. It was be carried out between December 2017 and February 2018 in Kharoum Dental Teaching Hospital and Davinchi center. All participants received written consent before the operation.

3.1 Inclusion Criteria

- Willingness of patients to participate in the study.
- Good oral hygiene of the participants.
- Highly attached frena.
- Systemically healthy subjects.

3.2 Exclusion Criteria

- Pregnancy.
- Smoking.
- Any systemic disease.

Fourteen volunteers with age ranging from 16- 40 years, who required frenectomy were selected for the study, and divided into two groups, Group A and Group B.

Group A : consist of 7 volunteers who were treated with laser surgical technique. (one case was lingual frenum and 6 upper labial frena).

Group B: consist of 7 volunteers who were treated with conventional surgical technique.

For the laser technique the area was anaesthetized with few drops 2% lignocaine with 1:80,000 adrenaline on both side of the frenum. Laser safety precautions by worn of eye wear by patient , assistant and operator and high volume suction was used to evacuate the smoke from tissue ablation. Elexxion Pico (Germany) with:

- Wavelength 808 nm.
- Power used between 1.5- 2 W. Maximum power 5 W.
- 400 micrometer fiber tip diameter.
- Pulse duration 26 micro second.
- Pulsed rate 20.000 Hz.

400 micrometer fiber tip dimeter. fiber tip was used in a contact mode and moved in a paint brush stroke began at the coronal attachment and moves the laser tip unidirectionally, pulling of the upper lip for tension, to sever all fibers including that over periosteum. The tip of the laser fiber and the ablated remnant tissue was cleaned with gauze soaked in saline, continue all fibers are removed resulting in a diamond shaped wound .

While for laser assisted lingual frenectomy; the tongue was retracted upwards and posteriorly The tip of fiber optic was hold in perpendicular or slightly oblique to the frenum in contact mode between the laser tip and tissue surface. The procedure Started by cutting from above moving downward avoiding the vessels and glands in the floor of the mouth. The surgical site and the tip of the laser fiber was maintained clean from remnants of the tissues with gauze wetted by normal saline.

Upon completion of the frenectomy , the subjects were instructed to avoid spicy food and acidic fluids, freezies , ice , cold fluids could be used.

Soft tooth brush should be used carefully around the wound. ,and tonguge exercise for lingual frenectomy after 24 hour.

For the conventional classical technique, the area was anesthetized with 2% lignocaine with 1:80,000 adrenaline . The frenum was held with a hemostat, and the whole band of tissue together with its alveolar attachment was be excised with a #15 blade. After freeing any remaining fibrous adhesions to the underlying periosteum, the wound was be sutured with 4‑0 silk. The subjects were instructed to maintain good oral hygiene and keep the wound clean. After one week sutures are removed. Both groups were advice to use analgesic(paracetamol) if needed and reappointed after one week and one month to evaluate healing.

3.2 Method of Scoring

The subjects were asked to rate the degree of pain after 3 hours, 3days and 7 days on a 10‑cm horizontal visual analog scale (VAS) (Haytac et al, 2006) by placing a vertical mark to assess position between the two endpoints. The left end point was nominated as “no pain,” and the right end point was nominated as severe pain.

VAS

0: No pain

1-3: Mild pain

3-6: Moderate pain

6-10: Severe pain

Satisfaction is one of the outcome measure used in this study Satisfaction of the subjects about the procedure was assessed using Likert-Type Scale(Vagias and Wade 2006).

Level of Satisfaction

A. Not at all satisfied.
B. Slight satisfied.

C. Moderate satisfied.

D. Very satisfied.

E. Extremely satisfied.

Rate of wound healing was performed after one week and one month using the same index for both groups (A: complete epithelialization B: Incomplete epithelialization C: Ulcer D:Tissue defect or necrosis (Ishii et al., 2002).

3.3 Statistical Analysis

A statistical analysis was performed using a Statistical Package for Social Sciences (SPSS) software version 22. Pearson Chi- square test was used to compare visaual analogue scale of patient perception between laser and scalpel group.

Chapter Four

Results and Discussion

4.1 Introduction

Abnormal frenal insertion can distend and retract the marginal gingiva or papilla away from the tooth when the lip is stretched. A frenum that encroaches on the margin of the gingiva may interfere with plaque removal, and tension on this frenum may tend to open the sulcus (Haytac and Ozcelik, 2006). More conservative and precise techniques are being adopted to create more functional and aesthetic results in periodontal plastic surgery. The presence of an aberrant frenum being one of the etiological factors for the persistence of a midline diastema, the focus on the frenum has become essential. The aberrant frenum can be treated by frenectomy or by frenotomy procedures (Fiorotti et al., 2004).

Diode lasers present a solid semiconductor as an active medium, with wavelengths varying between 800 and 980 nm. As its wavelength is poorly absorbed by the hard dental tissue, the diode laser is safe and well indicated for soft oral tissue surgeries in regions near the dental structures (Gontijo et al., 2005).

Diode lasers is absorbed not only by water (although less so than the carbon dioxide laser wavelength), but also by other chromophores, such as melanin, and oxyhemoglobin. Moreover, the exclusive use of this laser by contact or at an extremely close distance avoids damage, due to ‘beam escape,’ in an open field, which makes it much safer than other laser sources.

In addition, diode lasers have the ability to cut the tissue to perform coagulation and hemostasis, and have a higher tissue ablation capacity and enough bleeding hemostatic properties compared to most laser systems (Desiate et al., 2009).

4.2 Results & Discussion

Fourteen volunteers, 10 were females and 4 were males with mean age 24.07 Comparison of VAS of patients perception of pain after 3 hours between group (A) laser and group (B) surgical groups. The analysis showed that 2 cases (28.6 %) of laser group revealed no pain and 5 (71.4%) had mild pain, while 7 (100 %) of surgical group expressed moderate pain. After 3days VAS of pain between both groups showed that all laser group had no pain, while all cases in scalpel group had mild pain. VAS after 7 days between 2 groups showed that all cases in both groups had no pain. One case of laser group used analgesic while 5 cases in scalpel group.

In this study subjects treated with the diode laser had significantly less postoperative pain both after 3 hours and 3 days as compared to scalpel technique (P- value = 0.001 and 0.000) (Table 4.1and Table 4.2), as well as number of analgesics used were lower in the laser group. These results were in accordance with the studies carried out by Haytac *et al*. (Haytac et al ,2006) and Butchibabu *et al*. (Butchibabu et al 2014) wherein they suggested that soft tissue laser treatment used for frenectomy operations provides better patient perception in terms of postoperative pain and function than that obtained by the scalpel technique. It is theorized that decreased pain perception after the use of laser may be due to the protein coagulum that is formed on the wound surface, thereby acting as abiologic dressing and sealing the ends of the sensory nerves (Fisher et al., 1983), (Fenner et al., 1992).

The increased pain perception associated with the scalpel frenectomy might be attributed to the fact that it is a more intrusive surgical procedure involving blood loss, wide surgical wound and suturing. The sutures also contribute to the discomfort postoperatively since they interfere with regular functions such as speech and intake of food (Butchibabu et al, 2014), (Fiorotti et al, 2004).

Although all laser wavelengths can be used successfully to perform maxillary and mandibular frenectomies, patients with bleeding disorders who require hemostasis

during soft tissue surgery benefit from the diode, CO_2, or Nd:YAG lasers.

These three lasers are much better than erbium lasers at creating excellent hemostasis immediately after frenum revision (Kotlow et al., 2011). Other wavelengths such as Er:YAG lasers may ablate frenums faster, and can be used in non-contact mode, but the drawback compared to diode lasers is an increased risk of bleeding (Bjordal et al., 2007).

Table 4.1 Visual Analogue Scale (VAS) after 3 hours for Laser and Scalpel groups**.**

Groups	No pain	Mild pain	Moderate pain	P-value
Laser (n=7)	2 (28.6%)	5 (71.4%)	-	
				0.001
Scalpel (n=7)	-	-	7 (100%)	

Table 4.2 Visual Analogue Scale (VAS) after 3 days for laser and Scalpel groups.

VAS	Group A Laser	Group B Scalpel	P-value
No pain	7(100%)	-	
Mild pain	-	7(100%)	0.000

Patient satisfaction was carried out for both groups. For Group (A) laser 3 of cases (42.9%) were extremely satisfied, very satisfaction was expressed by 3 cases (42.9%) , while one case (14.3%) revealed moderate satisfaction as in (Figure 4.1).

Group (B) scalpel 5 (71.4%) expressed moderate satisfaction , while 2 cases (28.6%) showed slight satisfaction (figure 4.2).

Patient satisfaction in this study was higher in laser group than in scalpel group , this result was in agreement with study done by Tahrir N and Ali S, in Iraq who found that patient acceptance with respect to patient perceptions after laser frenectomy was superior to conventional technique (Aldelaimi and Mahmood, 2014). This might be to short duration of surgery, no bleeding during and after laser treatment and less pain expression.

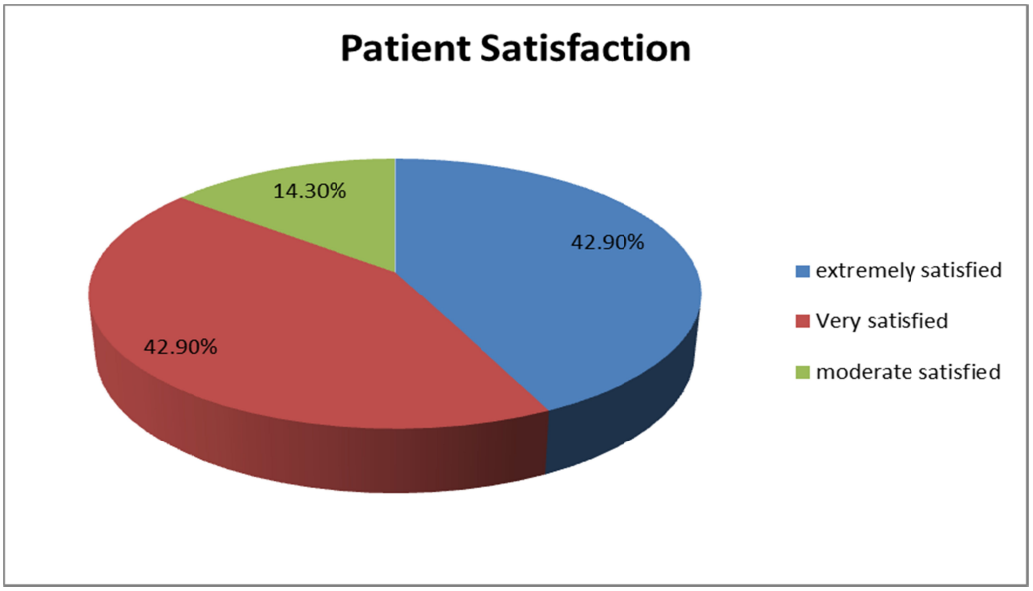

Figure 4.1 Patient satisfaction for Group A (laser).

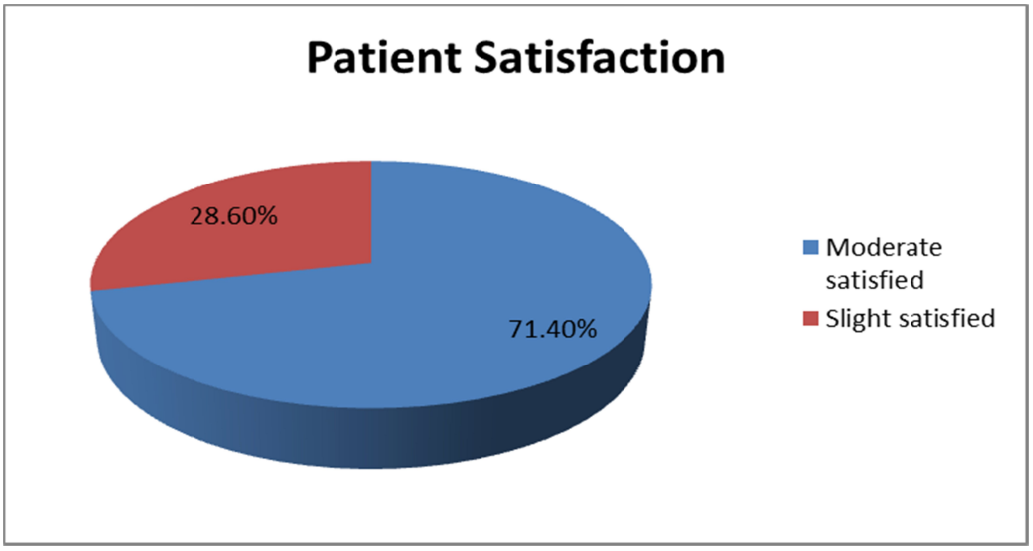

Figure 4.2 Patient Satisfaction for Group B (Scalpel).

Clinical assessment of the postoperative edema using the scale of (0 = no edema; 1 = mild edema; 2 = moderate edema; and 3 = severe edema), there was mild intraoral edema that noticed in one case of laser group during first three days; then it subsided gradually, otherwise no patient showed edema during one week. Assessment of wound healing after 7 days and after one month was done for both groups. There were no signs of swelling or necrosis noted between laser and scalpel groups. Postoperative Functional abilities were within normal limit except in case of lingual frenectomy who was speaking with mild limitation in functional abilities with the first three days postoperatively; e.g. painful eating, soreness during brushing, swallowing, while no patient revealed limited or disturbed functional abilities during one week, and four weeks postoperatively.

After one month there were complete epithelialization in 4 cases (57.1%) of laser group and 3 cases (42.9%) revealed incomplete epithelialization (figure 4.3). For scalpel group 6 cases (85.7%) expressed complete epithelialization, while one case (14.3%) (figure 4.4).

The healing pattern of laser wounds after the seventh day and 1 month was found to be delayed as compared to scalpel wound. Delayed healing can be attributed to distribution of the heat laterally (Meenawat et al., 2013). These results were similar to the studies carried out by Frame *et al*. (Frame, 1985) and Buell *et al*.(Buell and Schuller, 1983) and contrary study carried out by Fisher *et al*.(Fisher et al.1983) suggested that laser‐created wounds heal more quickly and produce less scar tissue than conventional scalpel surgery.

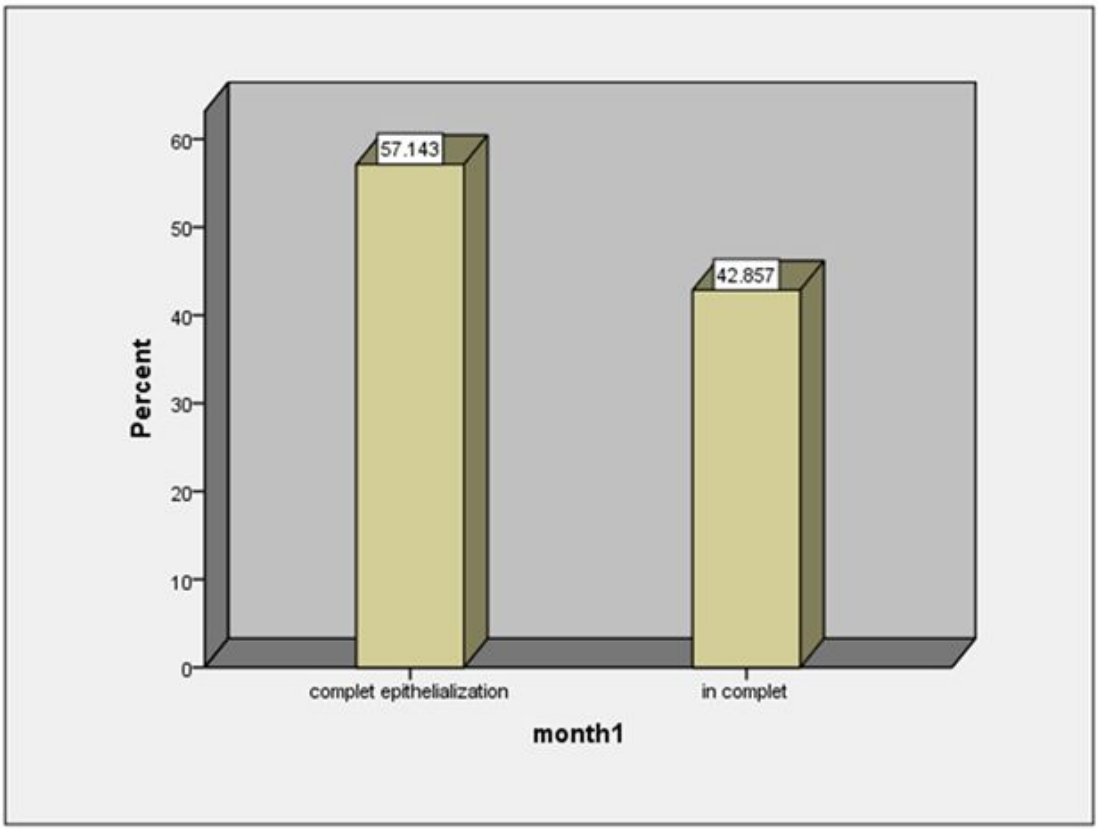

Figure 4. 3 Wound healing for group A after one month.

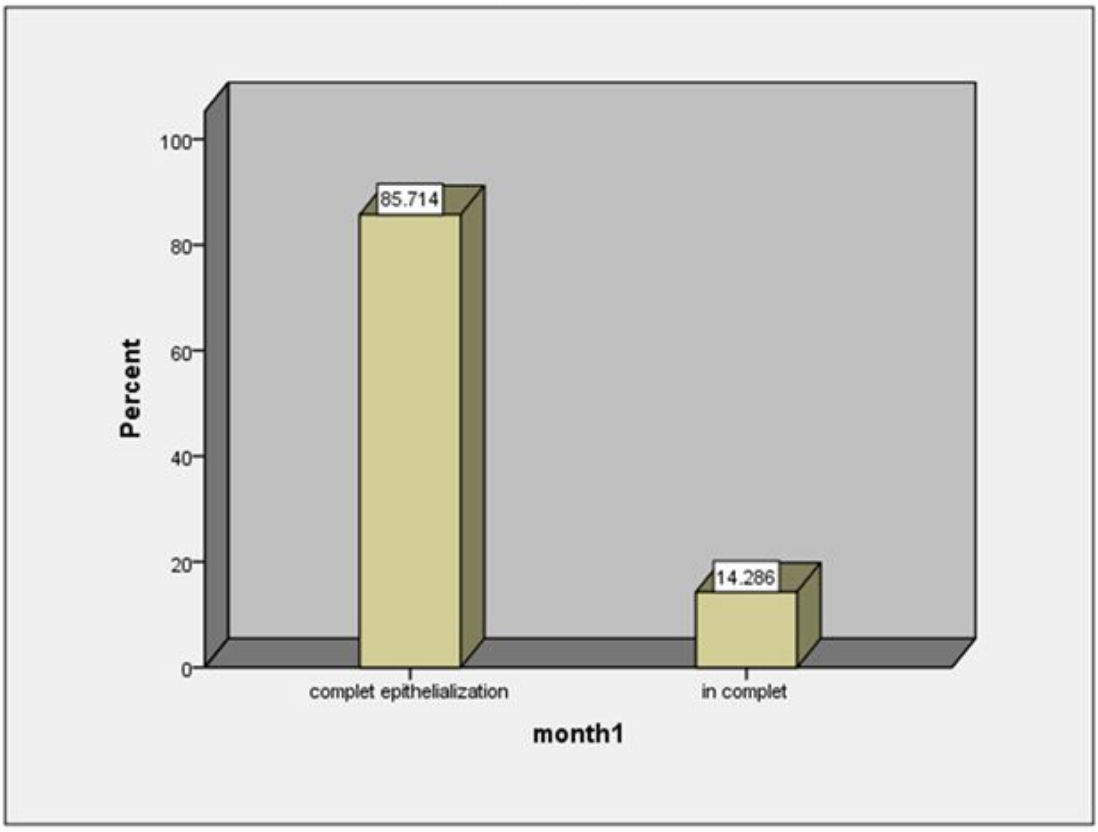

Figure 4.4 Wound healing for Group B after one month.

4.3 Conclusion

This an experimental study demonstrated that diode laser frenectomy provided better patient perception and satisfaction in term of postoperative pain, bloodless field and short operative time than encountered by the scalpel technique. Wound healing was delayed in the laser group in comparison to the scalpel group.

4.4 Recommendations

More longitudinal studies with larger sample size are required to confirm the exact efficacy of diode laser over the conventional scalpel technique for frenectomy procedure.

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Appendices

Appendix 1

Questionaire Form

Personal Data

Name: …….. Sex.…… :

Age: ……, Occupation…… :

Address: …… Tel.…… :

Clinical Examination

Types of frenum.…… :

Clinical assessment after laser/surgery

Pain perception: using Visual Analogue Scale

0: No pain

1-3: Mild pain

3-6: Moderate pain

6- 10: Severe pain

Patient Satisfaction

A. Extremely satisfied

B. Very satisfied

C. Moderate satisfied

D. Slight satisfied

E. Not at all satisfied

Assessment of wound healing

After 3 days Postoperative Edema Scale

0 = no edema

1 = mild edema

2 = moderate edema

3 = severe edema

After 1 month :rate of wound healing

A: complete epithelialization

B: Incomplete epithelialization

C: Ulcer

D:Tissue defect or necrosis

Class IV tongue –tie preoperative

During laser frenectomy

Immediately after completion of the frenectomy

After one week

Upon Completion of Laser and Scalpel Frenectomy

After one week Scalpel Frenectomy

After one month Scalpel frenectomy

After one month Laser frenectomy