



Gingival Enlargement Management using Diode Laser 940 nm and Conventional Scalpel Technique (A Comparative Study)

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Abstract: Background: Diode lasers are becoming popular in periodontal surgery due to their highly absorption by pigments such as melanin and hemoglobin their weak absorption by water and hydroxyapatite makes them safe to be used around dental hard tissues. **Objective:** The aim of the present study was to evaluate the efficiency of diode laser in performing gingivectomy in comparison to conventional scalpel technique in patients with chronic inflammatory enlargement. **Materials and methods:** Thirty patients were selected for this study. All of them required surgical treatment of gingival enlargements and were randomly divided into two groups: Control group (treated by scalpel and include sixteen patients) and study group (treated with diode laser 940nm and include fourteen patients). Data collected during and after surgery were compared and statically analyzed. **Results:** Fifteen male and fifteen female were included in this study with age mean of 26.2. Significant differences were observed in the Gingival Index and bleeding scores in laser group compared to the scalpel group, while no significant differences were found in swelling score and plaque index, The level of significance was set at $P \leq 0.05$. **Conclusion:** Diode laser 940nm are beneficial in achieving hemostasis with the improvement of gingival health compared to the scalpel technique.

Keywords: gingival enlargement, diode laser, scalpel gingivectomy.

Introduction

Gingival enlargement or sometimes called gingival overgrowth is an increase in the size of the gingiva. It is common feature of gingival inflammation. These are accurately descriptive clinical terms to avoid incorrect pathological connotation of terms used in the past like "gingival hyperplasia" or "gingival hypertrophy" (Newman, 2012). Gingival enlargement is multifactorial condition that causes aesthetic, functional and masticatory problems (Devi et al., 2013). The first line in the management of gingival overgrowth is oral hygiene control (To TN, et al., 2012; Yeung et al., 1989; Lindhe, J, 2003; Caccianiga et al., 2012; Gama et al., 2012). Another approach to the management

is using the mouth rinses but there is a side effect with long term use (Mavrogiannis et al., 2006). Effective oral hygiene control along with scaling and root planning with using of mouth rinse is the non-surgical management approach for the gingival enlargement but when the self-care is compromised and the enlargement is extensive, then surgical approach is planned (Gama et al., 2012; De Oliveira et al., 2010). Gingivectomy defined as the surgical excision of the gingiva by removing the pocket wall provides accessibility and visibility for complete removal of the calculus and thorough smoothing of the root creating a favorable environment for gingival healing and restoration of a physiological gingival contour¹.

Gingivectomy can be performed using scalpel chemosurgery, electrosurgery and laser (Fornaini et al., 2007; Sobouti et al., 2014). Conventional gingivectomy performed using scalpel tills is now the most common method which has advantage of low cost and durability of the instrument; however hemostasis may be difficult to obtain (Fornaini et al., 2007; Sobouti et al., 2014; Matthews, 2010; Ize-Iyamu et al, 2013; Amaral et al.2015). Excellent hemostasis can be provided by using electrocautery by sealing blood vessel and cutting simultaneously but excessive heat generation leads to thermal damage which can cause delayed healing compared to the scalpel surgery (Kumar et al, 2015; Amaral et al.2015).

Considerable attention in the recent decade focused on using lasers as adjunctive approach in the periodontal surgery as they provide less invasive approach (Fornaini et al., 2007; Kravitz et al, 2008; Mavrogiannis et al, 2006). Since the development of ruby laser by Maiman (Maiman, 1960) researchers have investigated laser application in dentistry for both hard and soft tissue applications.

The action mechanism of the laser on the tissue depends on different factors like laser parameters and the tissue properties. Different types of lasers have been used in the periodontal surgery like Nd:YAG laser, diode ,CO₂ and Erbium laser family .

Robert, (2011) reported that diode lasers have several advantages in soft tissue surgery with benefit of less bleeding , pain ,infection and scar formation. Diode laser was effective in the reduction of microbial population and it is safe to use near the hard tissue as it is absorbed by pigments in soft tissue only (Fontana et al, 2004).

Aoki (2008) reported that after diode laser surgery, the wound heals without the need to cover the surgical site with surgical pack. Only few studies compared diode laser 940 nm to the scalpel gingivectomies. This study was conducted to compare these two surgical modalities depending on clinical observation and patient outcome.

Materials and Methods

Thirty patients, sixteen males and fourteen females, whose age ranged between 17-34 years were selected for this study. All

required surgical treatment of gingival enlargements. Only patients with chronic inflammatory enlargement were included. All patients were systemically healthy and had no history of pervious surgical treatment of gingival enlargement. Patients excluded from this study if they were taking a medications that might cause gingival overgrowth or medically comprised patients as well as pregnant women. Patients that attended teaching hospital, periodontics Department, College of Dentistry/Al-Mustansirya University were treated by scalpel method while the patients attended Dental Clinic of Laser Medicine Research Clinics/Biomedical Applications Department at Institute of Laser for Postgraduate Studies were treated with diode laser 940nm(Epic™ 10, BIOLASE Inc., USA) .

Prior to the surgery, all patients received full mouth scaling and polishing in addition to the oral hygiene instructions. The gingival and plaque scores were evaluated before surgery and during the follow up visits.

Surgical Procedure

Control group (scalpel gingivectomy) included 16 patients. The procedure is done under local anesthesia (lidocaine 2% and 1:80000 epinephrine, Lignospan special, septodont ,France). The bleeding points were demarcated using pocket depth marker. Then the primary incision was done by Kirkland knife (beveled incision at 45°). The secondary releasing incision was performed using surgical blade No.15 . The remaining of granulation tissue was removed using curette and blade no.12 . Irrigation with normal saline and chlorhexidine rinse was used thorough the whole surgery. Scaling and root planning were done to leave the root surface clean and smooth. The surgical site was covered by periodontal pack (septo-pack, septodont, France).

The test group (diode laser gingivectomy) included 14 patients. The procedure was done under local anesthesia (lidocaine 2% and 1:80000 epinephrine, Lignospan special, septodont, France). Bleeding points were demarcated by using pocket depth marker. Beveled tissue cutting was done using fiber tip in contact mode with sweeping brushing stroke motions. Tissue

remnants were removed with wet gauze and final reshaping was done to retain the normal contour of the gingiva. High-volume suction was used to evacuate the laser

plume. Irrigation of the surgical site was done with normal saline and the subgingival calculus was removed by curette. The surgical site was left without coverage.



Fig (1): Laser gingivectomy, A, Before treatment. B, Immediately after Laser surgery. C, One week after surgery. D, Two weeks after surgery



Fig (2): Scalpel gingivectomy, A. Before treatment, B. Immediately after scalpel surgery, C. Placement of periodontal pack, D. One week after surgery (Immediately after removal of pack). E. Two weeks after surgery

Laser Parameters

Laser irradiation was performed using a 940nm diode laser (Epic™ 10, BIOLASE Inc., USA), with optical fiber diameter of 400µm and at energy output of 60 mJ (peak power 3W and average power 1.5 W), P₃ mode with pulse duration of 20 msec.

Clinical Assessments

The following parameters were assessed for both surgical techniques: patient satisfaction, gingival index (GI) (Löe, 1967), Plaque index (PI) (Löe, 1967), swelling (Rosa et al, 2007; Ishii et al, 2004; Kawashima et al., 2003) and bleeding (Kumar et al, 2015).

Intraoperative bleeding was assessed according to the following grades: 1. None, 2. Self-limiting, 3. Requiring light pressure, 4. Requiring coagulation, 5. Requiring ligation or Hemoclip. Swelling was assessed according to the following grade: 1. None, 2. Slight, 3. Moderate, 4. severe. GI&PI were evaluated before, one and two weeks after surgery. GI (Löe and Silness, 1967) was used for assessment of gingival condition. It scored from 0-3 as follows: 0. Normal, 1. Mild: slight change in color, no bleeding on probing, 2. Moderate: redness, edema and bleeding on probing, 3. Severe:

redness, edema and spontaneous bleeding. PI (Löe and Silness, 1967) was scored as follows: 0. No plaque, 1. Plaque removed with probe, 2. Visible plaque, 3. Plaque covering the whole crown.

Statistical Analysis

All data were tabulated and subjected to statistical analysis. Data analysis was performed using SPSS, version 21.0 France. This analysis included descriptive statistics and association tests for comparisons between the two surgical techniques. The Mann-Whitney U-test was used to compare numerical variables. The level of significance was set at $P \leq 0.05$.

Results

Bleeding

In the laser group, no bleeding was encountered intraoperatively in (11) patients, while the bleeding was self-limiting in (2) patients and only in one patient, the pressure was required to stop the bleeding. In the conventional group, pressure was required to stop bleeding for all patients as shown in the Table (1)

Table (1): Percentage distribution of bleeding score

Techniques	Bleeding score					Total
	None	Self-limiting	Required pressure	Requiring coagulation	Requiring ligation or hemoclip	
Conventional Patients No. (16)	0 (0)	0 (0)	16 (100)	0 (0)	0 (0)	16 (100)
Laser Patients No. (14)	11 (78.6)	2 (14.3)	1 (7.1)	0 (0)	0 (0)	14 (100)

Swelling

No swelling was observed in laser group; only slight swelling in conventional group was seen in (3) patients as shown in Table (2).

Table (2): Percentage distribution of swelling score

Techniques	Swelling score				Total
	none	slight	Moderate	Sever	
Conventional Patients No. (16)	13(81.25)	3(18.75)	0(0)	0(0)	16(100)
Laser Patients No. (14)	14(100)	0(0)	0(0)	0(0)	14(100)

Gingival Index

Gingival Index was evaluated before the surgery and during recall visits; there was highly significant difference in the 1st and

2nd weeks bet ween two groups with less gingival index score in the laser group as shown in Table (3)

Table (3): Statistical analysis of Gingival Index (GI)

Techniques		Gingival index Mean $\pm$SD			
		Before	1st week	2nd week	LSD
Conventional Patients No. (16)		0.85 $\pm$ 0.12 b	1.45 $\pm$ 0.29 C	0.68 $\pm$ 0.25 a	0.18
Laser Patients No. (14)		0.72 $\pm$ 0.23 c	0.55 $\pm$ 0.29 B	0.29 $\pm$ 0.32 a	0.21
P- Value	Mann-Whitney U-test.	0.1	0.001	0.001	

Plaque Index

No significant difference in (PI) between the two techniques is shown as in the table (1-4).

Table (4): Mean and Standard Deviation of PI

Techniques		Plaque index			
		Mean $\pm$SD			
		Before	1 st week	2 nd week	LSD
Conventional Patients No. (16)		0.46 $\pm$ 0.33 b	0.37 $\pm$ 0.3 a	0.38 $\pm$ 0.24 a	0.06
Laser Patients No. (14)		0.51 $\pm$ 0.37 b	0.38 $\pm$ 0.4 a	0.28 $\pm$ 0.47 a	0.13
P- Value	Mann–Whitney U-test.	0.96	0.94	0.51	

Discussion

Dental lasers have been used in oral and periodontal surgery due to their intraoperative and postoperative advantages. This study aimed to investigate if the diode laser has got advantage over the conventional scalpel technique in the treatment of gingival overgrowth.

Excellent hemostasis and clear vision of the surgical field was obtained in this study during diode laser surgery in comparison to the scalpel. These results agree with the results reported by Amaral et al, (2015) and Asnaashari et al, (2013). One of the characteristic differences between laser and the scalpel is the generation of coagulated tissue layer along the incision line (Watanabe et al, 2006).

After absorption of laser light by biological tissue, the tissue temperature was increased. When it reaches 60°C the coagulation occurred. This phenomenon is of great importance in the surgical application of lasers. As a result of photo-coagulation, protein, enzyme and other bioactive molecules undergo instant denaturation.

Alteration in the molecular structures of tissue collagen is the basic physical event that will lead to shrinkage of the collagen fibers. The irradiated tissue constricts against the proximal vasculature and the shrinkage of the collagen in the walls of blood vessels will improve hemostasis. Laser damage to erythrocytes enhanced

aggregation of platelets which encourage intraluminal thrombosis, further decrease in the blood loss (Aoki et al, 2003) and this explains why the laser group had minimal blood loss in comparison to the scalpel group. As bleeding criteria within the focus of this study diode laser 940nm had been chosen. Diode are lasers highly absorbed by hemoglobin and melanin. This allows precise cutting of soft tissue with excellent homeostasis and deep penetration in comparison to other types of lasers such as CO₂ laser which consequently reduce the operation time and postoperative bleeding without the need to surgical pack or suture (Amaral et al, 2015).

This study shows significant difference in GI between laser group and conventional group with lower degree of inflammation seen in patients treated with diode laser 940nm. This result agrees with result reported by (Evans et al., 2008) who used three different wavelength for evaluation of wound healing in vitro study and the result reported by Elanchezhian et al. (2013) when comparing diode laser to the conventional surgery in the treatment of hereditary ankyloglossia.

Wound healing after laser gingivectomy is greatly affected by laser setting parameters such as power, pulse duration, frequency and exposure time as reported by White et al. (1991). This result could be explained by increased production of collagen fiber with less number of myofibroblast which result

in less wound contraction and less scar formation along with sealing of lymphatic vessels which reduced inflammation. The decontamination ability of lasers allows the surgeon to work in almost sterilized surgical field that reduced the possibility of postoperative infection (Fisher,1984). There is no significant difference in plaque index between two groups as the plaque control depending on patient's oral hygiene controls. This result agrees with Aboelsaad (2013) who reported that no significant differences in plaque index when using diode laser gingivectomy as an adjunct to nonsurgical periodontal treatment in patients with fixed orthodontic appliances and persistent gingival enlargements.

Conclusion

In conclusion, diode laser940nm surgery proved to be effective as an alternative technique in the management of gingival enlargement with excellent hemostasis and reduced postoperative inflammation when comparing it to the scalpel surgery.

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معالجة تضخم اللثة باستخدام الدايدود ليزر 940 نانومتر وتقنية المشرط التقليدية (دراسة مقارنة)

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الخلاصة : الهدف من هذه الدراسة هو لتقييم كفاءة الدايدود الليزر 940 نانومتر في أداء عملية قطع اللثة بالمقارنة مع تقنية مشرط التقليدية للمرضى الذين يعانون من تضخم التهابي مزمن في اللثة **المقدمة:** ليزر الدايدود أصبح ذا شعبية في جراحة اللثة نظرا لامتناس الكبير من قبل الأصباغ مثل الميلانين والهيموجلوبين مع قابلية امتصاص ضعيفة عن طريق الماء وهيدروكسي اباتيت مما جعلها آمنة للاستخدام في جميع أنحاء الأنسجة الصلبة للأسنان. **المواد والطرق:** تم اختيار ثلاثين مريضا لهذه الدراسة، عن العلاج الجراحي المطلوب من التوسعات اللثة، قسمت عشوائيا إلى مجموعتين. وتمت مقارنة مجموعة المراقبة (يعامل من قبل مشرط) ومجموعة الدراسة (تعامل مع دايدود ليزر 940 نانومتر)، البيانات التي تم جمعها أثناء وبعد الجراحة وتحليلها بشكل ثابت. **النتائج:** أدرجت خمسة عشر ذكرا وخمسة عشر الأنثى في هذه الدراسة بمتوسط عمر 26.2 وقد لوحظت فروق ذات دلالة إحصائية في مؤشر اللثة والنزيف في مجموعة ليزر مقارنة مع مجموعة مشرط في حين أن هناك لا توجد فروق ذات دلالة إحصائية في درجة التورم ومؤشر البلاك ، تم تعيين مستوى أهمية في $P \leq 0.05$. **الاستنتاج:** ليزر الدايدود 940 نانومتر مفيد في تحسين صحة اللثة مقارنة مع تقنية المشرط.