Diode laser 940nm versus scalpel surgery in the treatment of chronic inflammatory gingival enlargement

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Abstract
Background Chronic inflammatory gingival enlargement treated by surgical excision using a scalpel when oral hygiene control fails to resolve the overgrowth. Considerable attention focused on using lasers as an alternative to conventional scalpel surgical techniques as they provide a less invasive approach. Diode lasers proposed as one effective surgical tool in the management of this highly vascular tissue. To compare conventional surgical excision with laser therapy, for treatment of inflammatory gingival overgrowth, by evaluating selected clinical parameters together with patients› feedback about the two methods. **Materials and methods** thirty patients with an age range of (17-35) year divided randomly into two groups. The study group included 14 patients (treated with diode laser 940nm, irradiated power 1.5 W, P3 mode with a pulse duration of 20 msec.) compared to the control group that included 16 patients treated by the scalpel. **Results** significant differences observed in healing criteria, amount of the injectable anesthesia, duration of the surgery and bleeding score. No significant differences in pain and discomfort found between the two groups. **Conclusion** within selected parameters, the diode laser is more effective and less invasive when compared to the scalpel.

Keywords: Diode laser, gingivectomy, scalpel, gingival enlargement, periodontal pack.

Introduction

Chronic inflammatory gingival enlargement developed secondary to plaque accumulation. Gingival overgrowth compromises the maintenance of oral hygiene. It also causes esthetic and masticatory problems; the case becomes more complicated when the patient wearing an orthodontic appliance, and it may interfere with the orthodontic treatment itself (Aboelsaad and Attia, 2013; Tony et al. 2013; Leena and Nabil, 2008; Camargo et al. 2001). The first step in the treatment of gingival enlargement is oral hygiene control which includes patient motivation and instruction, using mouth rinse and mechanical removal of plaque and calculus (Leena and Nabil, 2008; Araújol, 2012). When the gingival enlargement is not resolved through oral hygiene meas-

ures, then the surgical option (gingivectomy) is the treatment of choice (Devi, 2013; Araújol, 2012). Gingivectomy performed by using scalpel, electrocautery, or lasers. The scalpel is still the most popular one due to its simplicity and availability of the instruments. However, difficulty in bleeding control is a major disadvantage especially when the patient has a bleeding disorder (Amaral et al. 2015; Funde et al. 2015). Electrocautery is another option in periodontal surgery as it provides excellent hemostasis, but due to the need of using high power this will lead to the thermal damage that affects wound healing as it causes healing delay (Araújol, 2012; Amaral et al. 2015; Funde et al. 2015; Kumar et al. 2015). Since the invention of the laser in 1960 (Maiman, 1960) the researchers have investigated the role of laser in dentistry for both hard and soft tissue. The biological mechanisms of laser action depend on laser parameters and tissue properties. Laser parameters include wavelength, exposure time, power setting, pulse duration, spot size, and other parameters such as the direction of the laser beam and the speed of movement (Samo, 2007). Different types of lasers are been used in dentistry includes CO2, Nd: YAG, diode lasers and Erbium family lasers. The first successful used laser in oral surgery was in 1977 (Ize-Iyamu et al. 2013; Mavrogiannis et al. 2004; Shafir et al. 1977; Stabholz et al. 1993), CO2 and Nd: YAG lasers are the first two types used in periodontal surgery (Coleton, 2004). In recent years, diode lasers become more popular in dentistry due to their compact size and considerable price. Diode lasers have a wavelength between 800-980 nm that match with a peak absorption of melanin and hemoglobin make them excellent soft tissue lasers, thus it is safe to use around the dental hard tissue due to weak absorption of these wavelengths by water and hydroxyapatite (Sobouti et al. 2014). Researches had shown the superior advantages of using lasers in soft tissue surgery and periodontal therapy. Lasers have proved their ability in reduced bacterial population so it cuts coagulates and sterilizes at the same time (Coleton, 2004). Aboelsaad and Attia, (2013) reported the using of diode laser in the treatment of orthodontic induced gingival hyperplasia is of great value, Sobouti et al. (2014). Reported the use of diode laser 940 nm in performing gingivectomy reduced postoperative pain and bleeding. Mavrogiannis et al. (2006) found that diode laser has a superior advantage in tissue excision compared to the scalpel in the treatment of drugs induced gingival overgrowth but with increased postoperative pain in laser group as well as the cost is more. Amaral et al. (2015) reported that the diode laser is effective in the treatment of fibrous hyperplasia with minimal bleeding and eliminates the need for suture. There is a paucity of studies compared to diode laser 940 nm to the scalpel in performing gingivectomy.

Aim of the study

The current study aimed to compare conventional surgical excision with laser therapy, for treatment of inflammatory gingival overgrowth, by evaluating selected clinical parameters together with patients› feedback about the two methods.

Materials and methods

The study carried out from November 2015 to May 2016. Forty patients underwent surgical treatment for gingival overgrowth 10 patients excluded from the study because they failed to commit to the follow-up visits; only thirty patients were included in the study. All patients are systemically healthy and not taken any drugs that may cause gingival enlargement or interfere with surgery or healing, had no previous

surgical treatment of gingival enlargement and the gingival overgrowth is of inflammatory origin only that not resolved with non-surgical treatment. Pregnant women and patients not willing to participate were excluded from this study. The surgical treatment decided after clinical oral examination by periodontal and laser specialists. Patients allocated in two groups, distributed randomly. Patients attended Teaching Hospital, College of Dentistry /Al-Mustansirya University treated by the conventional method in the periodontics department using a scalpel. These considered as the control group. The second group of patients who attended Dental Units in Laser Medical Research Clinics was treated by using the diode laser 940nm (EpicTM, Biolase, San Clement, CA, USA).The surgical procedures were explained for all patients and consent form was signed by them at the time of recruitment prior to surgery. Scaling and polishing performed for all patients at least two weeks before the surgery. Infiltrative local anesthesia (lidocaine 2% and 1:80000 epinephrine, Lignospan special, septodont, France) applied for the patients in both surgical techniques. For both groups, the bleeding points demarcated using a pocket depth marker. The pocket depth and clinical attachments level measured before, during and after tissue excision for both surgical techniques; to make sure that all the overgrowth gingival tissue has been removed. The control group (conventional scalpel technique) consists of 16 patients. The primary incision performed by Kirkland knife (beveled incision at 45°). The secondary releasing incision performed using surgical blade No.15. The remaining granulation tissue removed using a curette and blade no.12. Irrigation with normal saline and chlorhexidine rinse continued through the whole surgery. The procedure followed by scaling and root planning to ensure a clean and smooth root surface. The surgical site covered by a periodontal pack (septo-pack, septodont, France). The bleeding was continuous through the whole procedure; it was controlled by applying direct pressure. No one of the patient needs hemostatic agents or hemoclip (Figure 1). For laser group, in general there is no bleeding during the surgery except for two patients with minimal self-limiting bleeding. The second study group (diode laser gingivectomy) consists of 14 patients. After initiation of the surgical tip, beveled tissue cutting is done using fiber tip in contact mode with sweeping brushing stroke motions, tissue remnants removed with wet gauze, final reshaping done to retain the normal contour of the gingiva with same surgical laser tip. Wet gauze was used to remove the tissue debris from the surgical site and the tip, the laser was stopped every 20 sec to check the gingival tissue and to avoid excessive heat accumulation, high-volume suction used to evacuate the laser plume. This accompanied by the irrigation of the surgical site with normal saline. The subgingival calculus removed by the curette, and the surgical site left without coverage (Figure 2).

Laser parameters

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

Surgical and postoperative assessment

The following parameters evaluated for both surgical techniques: 1. Amount of injectable anesthesia, 2. Need for the periodontal pack, 3. Duration of the surgery, 4. Postoperative pain and discomfort, 5. Clinical observation of healing criteria, 6. Intra-

operative bleeding. The patients asked to rate the degree of pain and discomfort by using a verbal rating scale according to the following grades (Rosa et al. 2007; Kawashima, 2003): 1. None, 2. Slight, 3. Moderate, 4. Severe. The pain and discomfort feedback of the patient was measured daily depending on the patient questioner that has given to them. These two criteria recorded for seven days. These data collected by a single operator. The primary operator and the supervised specialist evaluated the postoperative infection and clinical healing criteria by depending on Healing Index of Landry, Turnbull, and Howley (Landry, 1985; Masse et al. 1993): 1. Very poor, 2. Poor, 3. Good, 4. Very good, and 5. Excellent. This criterion depends on tissue color, texture, presence of granulation tissue and bleeding as a response to palpation. Duration of the surgery measured in minutes by using a digital timer. Intraoperative bleeding assessed for the presence or not. All patients instructed to maintain good oral hygiene by using chlorhexidine mouthwash, avoid crunchy, spicy, hot, and acidic food. Data analysis performed using SPSS, (version 21.0, IBM Company, USA). This analysis included descriptive statistics and association tests for comparisons between the two surgical techniques. The Mann–Whitney U-test was used to compare ordinal variables (to compare healing index) and t-test (to compare duration of the surgery and amount of local anesthesia need). The level of significance was set at $p \leq 0.05$. Statistically, two systems used t-test and Mann–Whitney U-test for detecting the presence of significant differences between the two methods of surgery in each day. The level of significance for statistical differences was set at $p \leq 0.05$.

Results

Thirty patients were analyzed in this study 15 were females and 15 were males, and they ranged in age from 17 to 35 years. Pain and Discomfort were evaluated using the Verbal Rating Scale (VRS), these two parameters recorded daily for seven days, this done by using the patient Questioner. During the operation, no patients in either group felt pain because all of them anesthetized by injectable infiltrative anesthesia. There was no significant difference in pain and discomfort between two groups in the first two days while differences appear in the last five days postoperatively (Figure 1, Figure 2, Figure 3 and Figure 4). Soft tissue clinical healing index evaluated for one week and 2 weeks after surgery, the difference was highly significant by using Mann-Whitney U-test with better results in the laser group (Table 1). The laser group required less amount of injectable anesthesia compared to the conventional group (Table1). As shown in statistical analysis, there was a significant difference in the duration of surgery between two groups with less operation time during using diode laser 940nm (Table1). No postoperative infection observed in either group. For laser gingivectomy, the surgical site left without the periodontal pack, all scalpel surgical sites covered with the periodontal pack. For intraoperative bleeding, no or minimal bleeding observed in the laser group.

Table 1: Summary and statistical analysis of the clinical evaluation scores in both surgical.

Parameters	Study group	Control group	*P*-value
Amount of anesthesia (ml), Mean ±SD	1.35±0.74*	6.6±0	0.000§
Duration of the surgery (minute) Mean ± SD	3.74±1.1	8.56±4.21	0.001§
Healing index /week Mean ±SD			
1st week	2.9±1.1	1.32±0.6	0.0002*
2nd week	4.4±1	3.13±0.8	0.001*

*Student's T- test.

*Mann–Whitney U-test.

Figure (1): Scalpel gingivectomy; a: Before treatment. b: Immediately after the Scalpel surgery. c: Placement of periodontal pack. d: One week after the surgery (Immediately after removal of pack). e: Two weeks after surgery.

Figure (2): Laser gingivectomy; a: before treatment. b: Immediately after Laser surgery. c: One week after surgery. d: Two weeks after surgery.

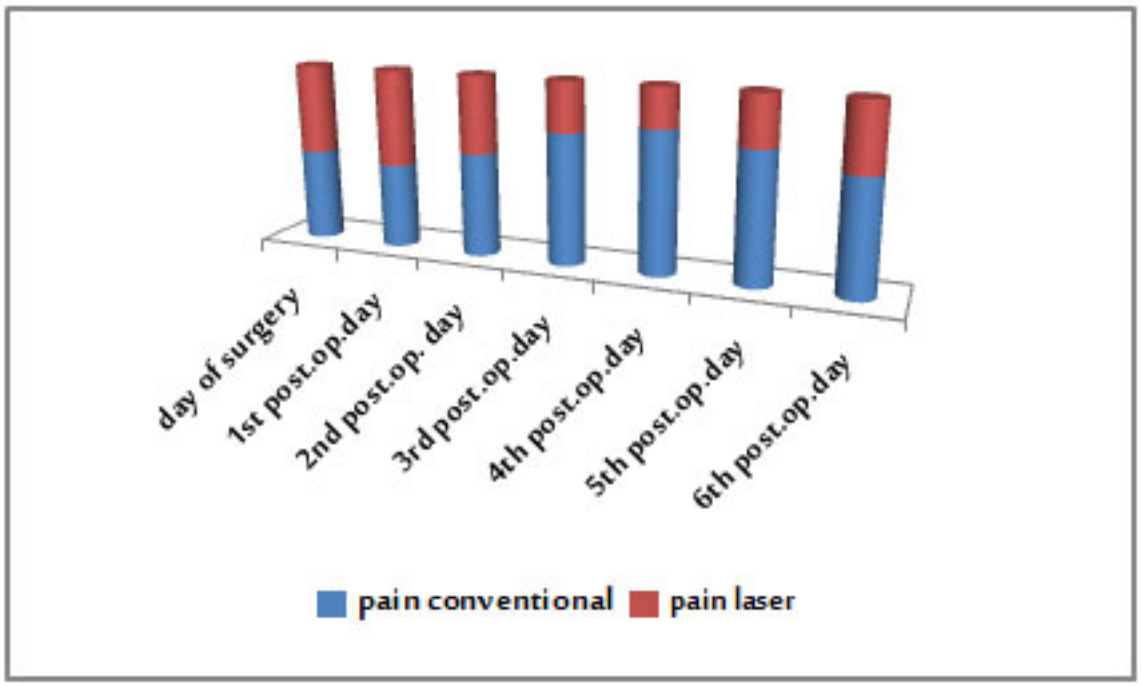

Figure (3): Differences in mean pain score between the treatment groups.

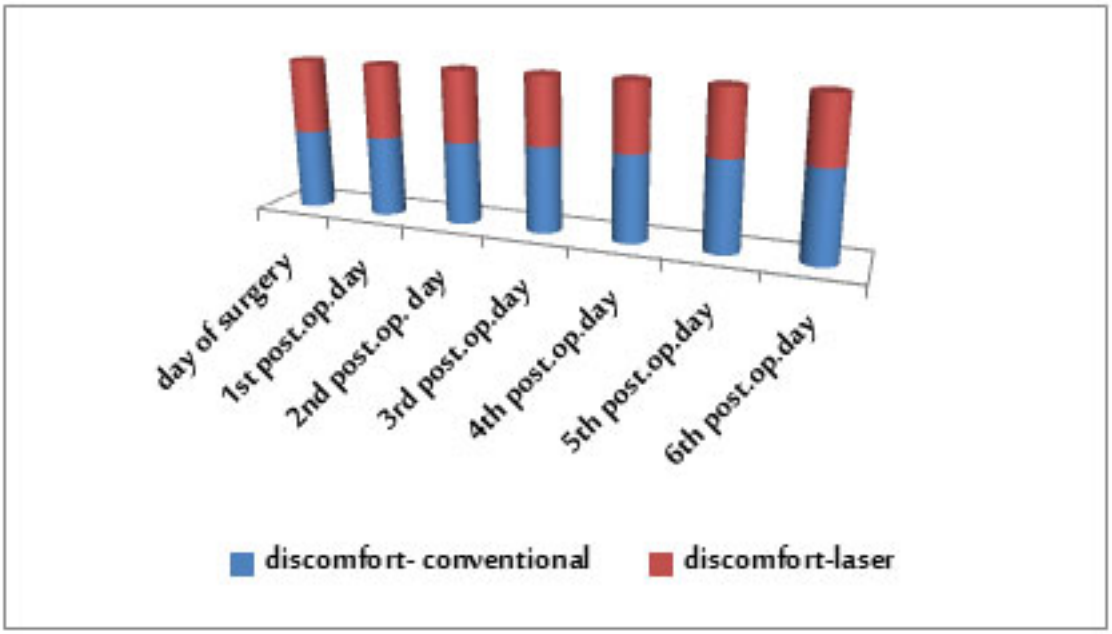

Figure (4): Difference discomfort means score between two groups.

Discussion

The present study aimed to verify the efficacy of diode laser 940nm surgical tissue excision in the treatment of chronic inflammatory gingival enlargement when compared to the conventional surgical technique by using a scalpel. The following clinical observation recorded for laser surgery:

1. Diode laser is effective in the surgical treatment of chronic inflammatory gingival overgrowth with no or minimal bleeding without need for the periodontal pack,
2. The surgical duration was reduced.
3. Less amount of local anesthesia is need.

For postoperative pain and discomfort, although there is no significant difference in the first two days interestingly the differences appeared in the last four days, this result may be explained by the formation of protein coagulum, which serves as biological dressing and sealed off the nerve ending (Amaral et al. 2015). This result agrees with Amaral et al. (2015) when using diode laser 808nm in comparison to the scalpel in the treatment of fibrous hyperplasia, results suggested no significant difference in postoperative pain between the two techniques. Our study result disagrees with other studies reported in the literature that showed less postoperative pain in patients treated with diode lasers. This disagreement might be explained by the sample size and the differences in laser wavelengths. Less amount of infiltrative local anesthesia needed during laser surgery compared to the scalpel group. This result agrees with the result reported by Ize-Iyamu et al. (2013) who used diode laser 810nm and scalpel in orthodontic soft tissue surgical procedures. This could be explaining by rapid cell vaporization, and as well as the bio stimulating and bio-modulating abilities of the diode laser, that reduces the need for local anesthesia (Gianfranco et al. 2010). The duration of the surgical procedure significantly reduced with minimal or no bleeding in the laser group in comparison to the conventional scalpel group. Excellent hemostasis and clear vision of the surgical field was obtained in this study during diode laser surgery, 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 a coagulated tissue layer along the incision line (Karvitz and Kusnoto, 2008). After absorption of laser light by biological tissue and as the tissue temperature reaches 60°C so it undergoes coagulation, this phenomenon is of great importance in the surgical application of lasers (Aoki et al. 2003) significant shrinkage of collagen fibers occurs when temperature greater than 60°C, this will cause contraction of vessel wall which enhanced homeostasis. Damaging of erythrocyte by laser radiation and platelet aggregation accelerate clot formation which decreased blood loss. Diode lasers highly absorbed by hemoglobin, which allowed precise cutting of soft tissue with excellent homeostasis that consequently, reduced the operation time and postoperative bleeding without the need for surgical pack or suture. this result agrees with Amaral et al. (2015)., in contrast, this result disagrees with the result reported by El-Kholey, (2014) who reported no significant difference between diode laser 970nm and surgical blade during second implant surgery. During scalpel surgery, proper hemostasis cannot be obtained, also gingivectomy with surgical blade required more instruments and steps to complete while during laser surgery, the surgical tip was used for cutting as well as for shaving the gingival tissue. The periodontal pack used in conventional periodontal surgery to protect the surgical wound reduced the possibility of bleeding and infection through reducing microbial accumulation and it used to prevent trauma to the surgical site during eating and talking (DURHAM, 2009). This study showed a significant difference in healing between the laser group and the conventional group with lower degrees of inflammation and better clinical healing seen in patients treated with diode laser 940nm. It has been argued that laser application increases the production of collagen fiber with less number of myofibroblasts resulting in less wound contraction and less scar formation; laser sterilizes the surgical field during the ablation of the tissue, which enhances the environment for better tissue healing (DURHAM, 2009). Healing after laser gingivectomy is still controversial; some investigators reported delay healing when compared to scalpel gingivectomy (Marita,1987; Pogrel et al. 1990; Gottsegen and Ammons, 1992) while some research shows that healing of laser wound either similar to the scalpel or accelerated (Charles, 2006). However, 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. (2003). The current study result agrees with the result reported by Evans and Abrahamse, (2008) that used three different wavelengths for evaluation of wound healing in vitro study and result reported by Elanchezhiyan et al. (2013) who compared diode laser to the conventional surgery in the treatment of hereditary ankyloglossia.

Conclusion

Diode laser 940nm can be used effectively in tissue excision at the selected parameters as an alternative technique in treatment of chronic inflammatory gingival enlargement, reduce postoperative gingival inflammation; better clinical healing with excellent hemostasis that improved vision, less chair time was required to complete laser surgery which makes it more acceptable to the patients in comparison to the scalpel surgery.

Ethical approval
The research was approved by the scientific committee of the Institute of Laser for Postgraduate Studies, University of Baghdad by an administrative order no.26 issued on 21/5/2017.

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