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A Comparative Evaluation of Post-Operative Pain and Function after Gingival Depigmentation Using 940 Nm Diode Laser And Conventional Bur Method: 6 Months Study

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Abstract: **The aim of the study** was to evaluate the efficacy of diode laser (λ=940 nm) in the management of gingival hyperpigmentation compared to the conventional bur method. **Materials and methods**: Eighteen patients with gingival hyperpigmentation were selected for the study with an age between 12-37 years old. The site of treatment was the upper gingiva using diode laser for the right half and the conventional method for the left half. All patients were re-evaluated after the following intervals: 3 days, 7 days, 1 month and 6 months post-operation. Pain and functions were re-evaluated in each visit for a period of 1 day, 3 days and 1 week post-operation. Laser parameters included 1.5 W in continuous mode with an initiated tip (400 μm) placed in contact with tissues and Power density (irradiance) was 1250 W/cm^2. **Results:** A significant difference was observed in post-operation pain and functions between the groups (Level of significance as: Not significant P>0.05 and Significant P<0.05, highly significant P<0.01). **Conclusions**: Diode laser is considered an effective treatment in the management of gingival hyperpigmentation compared to the conventional bur method.

Keywords: gingival pigmentation, diode laser, gingival depigmentation, melanin pigment, melanocyte.

Introduction

Gingival pigmentations appear either as a solitary or as a diffuse area of dark or brown discoloration with defined margins that can be seen more clearly in the facial aspect of gingiva especially in dark-skinned individuals (Butchibabu, K., Koppolu, P.et al. 2014). Potential causes of gingival pigmentation include smoking, heavy metals, medications, inflammation, genetics and endocrine disturbances (Lee, K.M., Lee, D.Y., et al., 2011). Pigmentation of gingiva can be classified into either physiological or pathological pigmentation. The physiological pigmentations can be induced by certain factors that lead to increasing the activity of melanocyte cells resulting in an increase of melanin production and deposition (Meleti, M., Vescovi, P., et al. 2008), while the pathological pigmentation can be induced by certain inflammatory diseases like oral lichen planus, pemphigus or pemphigoid and can be seen near vesicular lesion of oral cavity (Eisen, D., 2000). Melanin is a non-hemoglobin derived brown pigment which is considered the most common endogenous pigment (Cicek, Y. and Ertas, U., 2003). One of the most important functions of melanin pigments is that it absorbs UV radiation and protect the DNA from ionization and damaging effect (Meredith, P. and Riesz, J., 2004). Other pigments that associate with gingival pigmentation are carotene, reduced hemoglobin, melanoid and oxyhemoglobin (Bhardwaj, A. and Grover, H.S., et al., 2012). A lot of depigmentation techniques were introduced in order to manage this condition especially for those with high lip line (gummy smile). These techniques include scalpel surgery (Narayankar, S.D., Deshpande, N.C.et al., 2017), abrasion by bur (Alqahtani, S.M., 2015), electro surgery (Chandna, S. and Kedige,

S.D., 2015) cryosurgery (Kumar, S., Bhat, G.S., et al., 2013), graft surgery (Pontes, C.C., Novaes, A.B., et al., 2006) and finally by lasers such as diode laser (Bakutra, G., Shankarapillai, R., et al., 2017) Nd:YAG laser (Li, H., Wang, P, et al., 2017) Er:Cr:YSGG laser (Kusakcİ Seker, B., 2017), Er:YAG laser (Rathod, D.M. and Mulay, S., 2013), and CO_2 laser (Mahdi A.S.AL-Faraaon and Noor T.I. Al- Rubaie 2013).

Materials and Methods

The following materials and instrument which are shown in (Figures 1 and 2) were used in this study:

- ❖ Anesthetic carpul (2.2 ml carpul containing 2% lidocaine with epinephrine 1:80.000, France).
- ❖ Cheek retractor
- ❖ Mirror, tweezer and probe.
- ❖ Disk diamond bur (4 mm)
- ❖ Hemostatic solution (Switzerland).
- ❖ Diode laser 940 nm (Epic™, Biolase, USA) with fiber optic delivery system and additional accessories which include (Figure 3):
- Goggles for eye protection.
- Initiation kit for tip activation.
- Disposable end firing tips (400 µm).

Fig. 1: Dental equipment for conventional depigmentation procedure.

Fig. 2: Hemostatic agent and dental disk bur used during the procedure.

Fig. 3: Laser device with its accessories (eye goggles and initiation kit for laser tips)

The Method

Eighteen patients (3 males and 15 females) aged between 12-36 years old were selected for this study. They were completely healthy and nonsmoking individuals. A full and detailed explanation of the procedure was explained to the patients before the procedure and they signed a consent that they are willing to going through the procedure. On the day of the procedure, two case sheets were recorded for each patient; one of them was used to record the medical history while the other was used to evaluate pain, discomfort, bleeding, healing, tenderness, re-pigmentation, duration of the procedure and functions. Some of these parameters were recorded during the procedure while others were recorded after the procedure. Only the upper gingiva was treated in the study using laser method for the right half and conventional method for the left half. The procedure was done in a private clinic for both methods.

Laser Procedure

The surgical site for laser method was the upper right half of gingiva (central incisor to 1st premolar). The steps of the procedure included:
Injectable local anesthesia to the surgical site.
Protective eyewear was worn by the patient and the operator
Cheek retractor to expose the surgical site.
Epic x diode laser (940 nm) was used during the procedure (Epic™ 10 W, Biolase Inc, USA).
The parameters of laser device included:
Power: 1.5 W
Operation mode: CW
Diameter of the tip: (400 µm)
Power density (irradiance): 1250 W/cm^2

The pigmented tissues were removed by applying the laser tip into the pigmentation

using brushing like strokes. When all the pigmentated tissues were removed, wet gauze was used to remove the debris from both the tip and the surgical site. The surgical site was left exposed without using periodontal pack. The duration of procedure was about (3-7 minutes).

Conventional Bur Procedure

The surgical site for conventional method was the upper left half of gingiva (central incisor to 1st premolar). The steps of the procedure included:

Injectable local anesthesia to the surgical site.

Cheek retractor to expose the surgical site.

Suction tube for water evacuation

4 mm diamond disk bur was used during the procedure accompanied by copious water leverage.

The bur was placed perpendicular to the gingiva during the procedure and the pigmentations were removed by abrasion. Normal saline was used to wash and clean the surgical site. Bleeding was observed when using this method, so a gauze soaked in hemostatic solution was applied to the surgical site using firm pressure (for 3 minutes) to achieve hemostasis. No periodontal pack was used to cover the surgical site. The duration of procedure was about (7-15 minutes). (The complete procedure with the result can be seen in (Figure 4)

Fig. 4: Depigmentation procedure. A) before treatment. B) immediately after laser procedure. C) immediately after conventional bur procedure. D) after 3 days. E) after one week. F) after one month. G) after 6 months

Clinical Assessment

When the procedure was done certain parameters were evaluated. Also, medications were prescribed for the patients (when necessary) include analgesics and antibiotics (Acetaminophen tab 500 mg and Amoxicillin cap 500 mg) along with chlorhexidine mouth wash and oral hygiene instructions. All patients were asked for a recall visit after 3 days, 1 week, 1 month and 6 months. Pain was evaluated using VAS (visual analog scale 0-10) after 1 day, 3 days and 7 days postoperatively. Limited functions (inability to eat, speak or smile) were evaluated after 1 day and 3 days postoperatively.

Results

Pain : A highly significant difference in pain was observed in conventional group while in laser group a significant difference could be seen. With time, a decrease in weighted mid rank can be observed which indicates a decreasing in pain within period of time as shown in Table 1 and Figure 5.

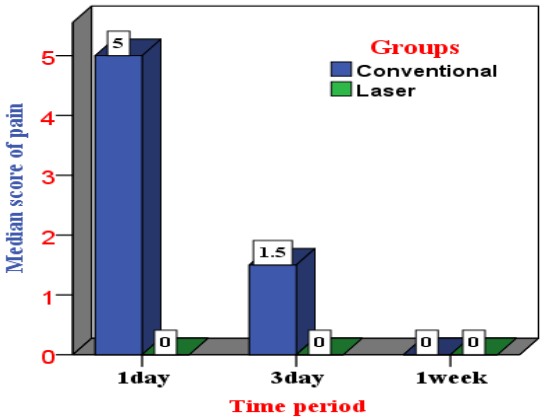

Fig. 5: Median of post-operative pain score by time and groups

Table 1: Descriptive and statistical test of post-operative pain by time and groups.

Group	Statistics	1days	3day	1 week	Quade test	Sig.	Multiple comparisons P-value		
Conventional	Mean	4.611	1.778	.000	36.363	0.000 HS	1 day	3 days	**0.000**
	SD	2.725	1.987	.000			1 day	1 week	**0.000**
	Median	5	1.5	0			3 days	1 week	**0.003**
	Minimum	9.000	6.000	.000					
	Maximum	5.000	1.500	.000					
	Weighted Mid ranks	165	-25	-140					
Laser	Mean	.556	.000	.000	3.39	0.045 S.	1 day	3 days	**0.031**
	SD	1.294	.000	.000			1 day	1 week	**0.031**
	Median	.000	.000	.000			3 days	1 week	**1.00**
	Minimum	4.000	.000	.000					
	Maximum	.000	.000	.000					
	Weighted Mid ranks	51	-25.5	-25.5					
Two sample KS	Z	2	1.667	0					
	P-value	0.001	0.008	1.00					

Limited Function

A highly significant change of limited function was observed among conventional group within period of time while in laser group no significant change was observed as shown in Table 2 and Figures 6 and 7

Table 2: Association and change of limited function between groups and time.

Group	Status	NO & %	Period		Mc Nemar's test
			1day	3days	
Conventional	with	NO.	14	5	0.004 HS
		% within Group	77.78	27.78	
		% T	38.89	13.89	
	without	NO.	4	13	
		% within Group	22.22	72.22	
		% T	11.11	36.11	
Laser	with	NO.	1	0	1.00 NS
		% within Group	5.56	.00	
		% T	2.78	.00	
	without	NO.	17	18	
		% within Group	94.44	100.00	
		% T	47.22	50.00	
Statistics			19.314(1)	5.806(2)	
			0.000	0.045	
Total	with	NO.	15	5	
		% within Group	41.67	13.89	
		% T	41.67	13.89	
	without	NO.	21	31	
		% within Group	58.33	86.11	
		% T	58.33	86.11	

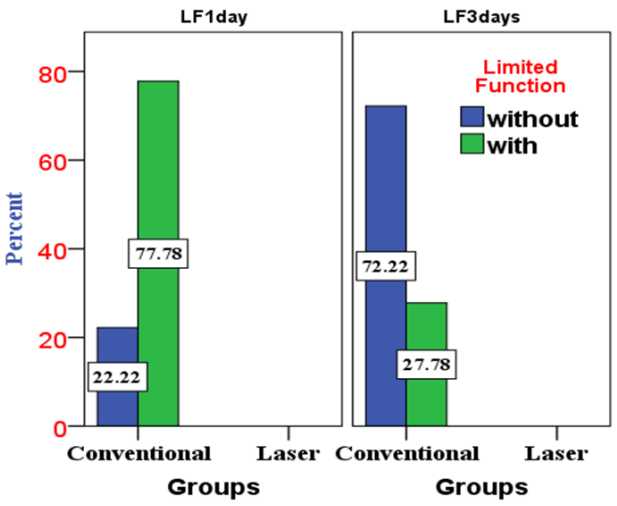

Fig. 6: Distribution of limited function by time and group for conventional method.

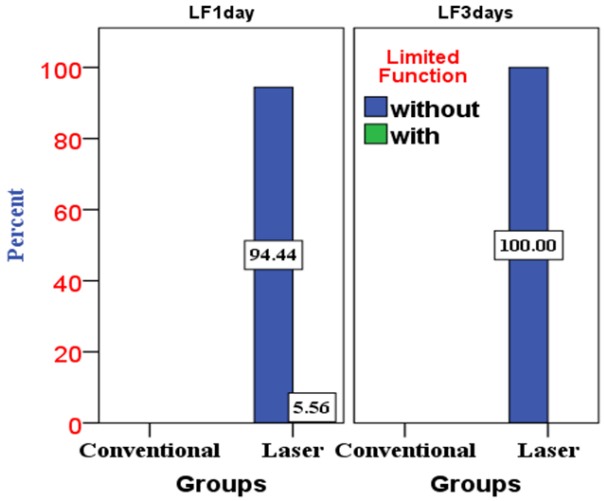

Fig. 7: Distribution of limited function by time and group for laser method.

Discussion

Gingival hyperpigmentation is a common problem that is not considered as a disease, but the patients seek to manage this problem for aesthetic reasons. A lot of depigmentation techniques have been developed in order to solve this problem. The selection of a technique for depigmentation mainly depends on affordability of the patient, clinical experience and preferences. Diode laser is preferred among many methods for depigmentation due to minimal damage to the underlying bone and connective tissue. Thus the pigmented epithelium layer was removed easily and softly (Doshi, Y. and Khandge, N., et al., 2012). Diode laser also possesses a lot of advantages which include hemostasis less pain and discomfort postoperatively, minimal swelling, sterilization effect and Patients satisfaction (Soliman, M.M. and Al Thomali, Y., et al. 2014). The mechanism of diode laser in depigmentation is that the tip is initiated using tip initiation kit. This procedure causes the laser light to be absorbed by this coat at the end of laser tip to produce a concentrated heat effect at the end of the tip. So, according to laser-tissue interaction principle, this heat will cause vaporization of the cellular water content of epithelium layer (epithelium layer is cellular in nature while the underlying connective tissues are about 60% fibrous in nature (Newman, M.G., et al., 2011)) without causing damage to the underlying connective tissues due to low water content there.

The simplicity of conventional method and its low cost makes it preferred by the patients, though it possesses many disadvantages such as:
1. The far posterior areas of the gingiva were difficult to reach when using the conventional methods. Thus the posterior pigmentations were difficult to remove.
2. Care must be taken to avoid damage to underlying connective tissues and hitting tooth structures.
3. Bleeding from the surgical site.
4. Discomfort during the procedure was reported by the patients due to the sound and vibration of the bur, water leverage and presence of suction tube.
5. Difficulties in controlling the depth of de-epithelization during the surgery.

For pain, only 15 patients from 18 recorded pain during the first day after the procedure in the site treated by conventional method. Only four of them recorded a severe pain while the others recorded mild to moderate pain. For the laser site, only 3 from 18 patients recorded a mild pain during the first day. The reason for that is due to the formation of protein coagulum at the wound surface which acts as a biologic dressing by sealing the sensory nerve endings (Simsek Kaya et al., 2012).

After 3 days postoperatively, about 10 from 18 patients recorded pain that ranged from mild to moderate in the site treated by conventional method while for the laser site no pain was observed among the patients. After 1 week, no pain was observed among the patients for conventional and laser method. These results agree with the results reported by

Sathyanarayanan, C. and Iyer, V.H., (2014) who compared between the conventional bur method and 940 diode laser in management of hyperpigmentation.

Functions like smiling and eating were also assessed during the study. About 14 from 18 patients had limited function during the 1st day after the procedure for the site treated by conventional method while for laser site about 1 from 18 patients developed a limited function.

After 3 days, only 5 from 13 patients had limited functions in the site treated using conventional method, while no patient developed limited function from the laser group.

Conclusion

Compared to conventional method, Diode laser is considered an effective treatment in management of gingival hyperpigmentation. Conventional bur method is simple, easy and cost effective with good result, though it has a lot of disadvantages compared to laser during and after the procedure.

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مقارنة لتقدير اللآلام والوظائف بعد عملية تصلب اللثة باستخدام ليزر دايود 940 نانومتر وطريقة بور التقليدية: 6 أشهر دراسة

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الخلاصة: الهدف من الدراسة: تقييم كفاءة الدايود ليزر 940 نانومتر في ازالة تصبغات اللثة مقارنة بطريقة البير التقليدية **المواد والطرق:** تم اختيار ثمانية عشر مريضا ممن يعانون فرط في تصبغات اللثة للدراسة مع عمر يتراوح بين 12-37 سنة. وكان موقع العلاج اللثة العليا فقط وباستخدام الليزر لعلاج النصف الأيمن والطريقة التقليدية لعلاج النصف الأيسر. تم إعادة تقييم جميع المرضى بعد الفترات التالية: 3 أيام، 7 أيام، 1 شهر و 6 أشهر بعد العملية. تم إعادة تقييم الألم والفعاليات كل زيارة لمدة 1 يوم، 3 أيام و 1 أسبوع بعد العملية. أعدادات جهاز الليزر للعملية كانت: 1.5 واط في وضع مستمر مع طرف ليف مفعل (400 ميكرون) ملامس للأنسجة (كثافة الطاقة (الإشعاع) كان 1250 W / cm^2). **النتائج:** أظهرت نتائج الدراسة وجود فروقات معنوية في الألم والفعاليات بعد العملية بين المجموعات (مستوى الدلالة على النحو التالي: غير معنوية $P> 0.05$، معنوية $0.05> P$، ذات دلالة معنوية $P <0.01$. **الاستنتاج:** تبين من الدراسة ان الدايود ليزر 940 نانومتر اكثر فاعلية في ازالة تصبغات اللثة مقارنة بالطريقة التقليدية