

Clinical Outcomes of Gingival Depigmentation Procedure Using Scalpel and Diode Laser Technique: A Digital Analytical Study

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ABSTRACT

Background: The harmony of a smile is not only determined by the shape, position and colour of the teeth, but also by the gingival tissues. It is primarily influenced by quantity of keratinisation and pigments within the epithelium named melanin, a non-haemoglobin derived brown pigment which is produced by the melanocytes. The aim of this study is to compare the clinical effectiveness of Scalpel and Diode laser technique in the management of gingival melanin pigmentation.

Materials and Methods: 50 subjects randomly divided into two groups. Group A (Scalpel) consist of 25 subjects and Group B (Diode Laser) consist of 25 subjects. Depigmentation procedure was done. Dummette Index , Bleeding Index and Digital Colour Intensity were assessed at different time interval to evaluate the clinical effectiveness between 2 techniques.

Results: Statistical Analysis revealed significant difference between Pre-operative and Post-operative Dummett Index scores in both Scalpel and Diode Laser group. There was no statistically significant difference between Post-operative Dummett Index scores in both the groups till 6 months follow up.

Conclusion: It can be concluded that both Scalpel and Laser procedure was equally effective in gingival depigmentation. Laser has got advantage over Scalpel regarding patient's pain perception and discomfort. Scalpel technique does not require any advanced armamentarium.

Keywords: Depigmentation, Oral health, laser.

INTRODUCTION

A good smile is the first aspect of an individual's personality that is perceived by others. Esthetics is an inseparable part of modern day living and applies equally to the dental field as well.¹⁻² Esthetic considerations have influenced the management of dental maladies in varying degrees for many years. Patient awareness and expectations have increased recently to the point that less than optimal aesthetics are no longer an acceptable outcome.³

With the increase emphasis on facial esthetics, both patients and dentists are developing a greater awareness of the impact of the gingiva on the beauty of the smile. Today, the shift in the clinical paradigm of periodontal treatment has created an environment in which esthetic problem that can be encountered includes excessive gingival display, different color of gingiva, uneven gingival contours, loss of interdental papillae.

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The color of the gingiva is an integral part of many epidemiological evaluations of gingival health, ranging from pale pink and coral pink to deep red and violet.⁴ The attached and marginal gingiva is generally described as coral pink and is produced by the vascular supply, the thickness and the degree of keratinization of the epithelium and the presence of pigment containing cells (melanocytes). The gingiva is the most frequently pigmented intra oral site.⁶ According to Dummett¹¹, the distribution of oral pigmentation in black individuals is as follows gingiva 60% hard palate, 61% mucous membrane, 22% and tongue 15%.

Physiologic gingival hyper pigmentation is caused by excessive melanin deposition by the melanocytes mainly located in the basal and supra-basal layers of the epithelium. The degree of hyper-pigmentation depends on a variety of factors, especially the activity of melanocytes, which depends the enzyme tyrosinase. Active melanocytes convert the melano-protein (melanin), which is transferred to the basal and prickle layer.⁸ Melanin pigmentation often occurs in the gingiva as a result of an abnormal deposition of melanin. This type of pigmentation is symmetric and persistent, and it does not alter the normal architecture. This pigmentation may be seen across all the races and at any age. The gingiva are the most frequently pigmented intraoral tissues. It is not a medical problem, but 'black gums' are a common complaint, fair-skinned people with moderate to severe gingival pigmentation frequently request for cosmetic therapy which makes one of the most popular technique of depigmentation is scalpel technique.⁹

The increasing awareness and the demand for cosmetic gingival surgery has led to an evolution of various procedures through the years. Gingival depigmentation is the treatment modality used to remove the melanin hyper-pigmentation for cosmetic reasons.¹⁰ It is a procedure which has been carried out from several years, with the first procedure dating back 1950s.¹¹ Several techniques have been employed for this purpose. Gingival depigmentation has been carried out using many procedures,^{12,13} employing mechanical,¹⁴ surgical^{15,16,17} electrosurgical, and cryosurgical techniques. Recently lasers have been used to ablate cells containing and producing the melanin pigment.^{18,19} Each techniques has its own advantages and limitations.

Different lasers have been used for gingival depigmentation, including carbon dioxide lase (10,600 nm), semiconductor diode (wavelength-820nm)²⁰ erbium doped: yttrium aluminium, and garnet(Er,Cr:YAG,2940nm)⁹ and Er, Cr:YSGG (wavelength2780nm).

In order to find a better approach in laser therapy, this present study is undertaken to calculate and compare the effectiveness of scalpel and diode laser technique both intra-operatively and post-operatively for the treatment of gingival melanin depigmentation with due importance given to the patient considerations.

AIM

Comparative clinical evaluation of effectiveness of diode laser and surgical blade in the management of gingival hyperpigmentation.

OBJECTIVES

1. To evaluate the effectiveness of diode laser in the management of gingival hyperpigmentation.
2. To evaluate the effectiveness of surgical blade in the management of gingival hyperpigmentation.
3. To compare the clinical out-come of diode laser with surgical blade in the management of gingival hyperpigmentation.
4. To find out the correlation of clinical outcome & intensity of re-pigmentation with image analysis software

MATERIALS AND METHODS

Subject selection:

50 subjects in the age between 20-45 years who were attending the out-patient section of the Department of Periodontics, Institute of Dental Sciences, Bareilly were selected for the study. They are further subdivided into 2 groups as group A (Scalpel) and group B (Laser) and each group consists of 25 subjects each.

The outcome of depigmentation by different techniques, pain perception, bleeding were analyzed and evaluated.

Selection criteria

Inclusion criteria:

- ☑ Age between 20 – 45 yrs.
- ☑ Subjects with healthy periodontal condition.
- ☑ Subjects were significant physiological hyper-pigmentation in the esthetic zone.
- ☑ Patient who are conscious of esthetics and are motivated undergo treatment for gingival hyper-pigmentation.

Exclusion criteria:

- ☑ Subjects with a habit of smoking.
- ☑ Medically compromised subjects or systemic disease which can affect wound healing.
- ☑ Patients with periodontitis, with clinical attachment loss.

Preparation of the patient-

All the selected patients were explained about the depigmentation procedures by Scalpel and Diode Laser, required visits, importance of oral hygiene maintenance and follow-up visits. A written consent was obtained from all the subjects.

Depigmentation by Conventional Blade Scraping Method

In each subject, after adequate anesthesia and isolation with surgical blade no.15 and Bard Parker handle was used to remove the epithelium with small amount of connective tissue carefully. If any small piece of tissue or epithelium left after procedure, care has taken to remove it completely. The raw surface was irrigated with saline solution. The surface was cleansed and bleeding was controlled. The exposed depigmented surface was covered with periodontal dressing.

Depigmentation by Laser Ablation Method:

Depigmentation was done using semiconductor diode laser (Unicorn™ Denmart 980 nm diode laser unit). After adequate anesthesia and isolation, the depigmentation was done using contact method power setting 1.2 W, continuous mode. The laser beam was directed to target tissue in sweeping motion with a paint-brush strokes. The gingiva was then cleaned with wet cotton to remove the

epithelium Post-operative analgesics was prescribed for all the subjects if they had any pain.

Clinical Assessments-

1-DUMMETT ORAL PIGMENTATION INDEX-(DOPI)^{13,15}

For intensity of pigmentation. DOPI assessment involves the assignment of a composite numerical value to the total melanin pigmentation manifested on the clinical examination of various tissue distribution of gingiva was recorded in all the subjects.

The index based on the following scale

- 0-pink tissue (no clinical pigmentation)
- 1-Mild light brown tissue (Mild Clinical pigmentation)
- 2-Medium brown or mixed brown and pink tissue (Moderate Clinical pigmentation)
- 3-Deep brown/Blue black tissue (Heavy Clinical pigmentation)

Dummett oral pigmentation index score was taken at baseline, 7th day, following 1st month, 3rd months till 6th months.

2 BLEEDING DURING THE PROCEDURE ¹²

The assessment was done on visual examination and based on the bleeding encountered during the procedure and the case of carrying out the procedure. It was assessed on the following scale.

- 0-No bleeding, complete Hemostasis.
- 1- Isolated bleeding points during surgery.
- 2- Mild bleeding but clear field.
- 3- Moderate to severe bleeding, difficulty in procedure.

Bleeding score was evaluated during the depigmentation procedure of all the subjects.

3-ASSESSMENT OF PAIN:

Assessment of pain was done at the time of depigmentation procedure and after 1week by questioning the patients.

THE VISUAL ANALOGUE SCALE:²⁰

The visual analogue score used retrospectively measure the intensity of the pain during the

treatment. Pain was assessed on a 100mm horizontal continuous interval scale where left end point was marked “no pain” and the right end point was marked worst pain depending on subject’s experience.

VAS scoring criteria.

Score	Visual analogue score
0	No pain
0.3-3.0	Slight pain
3.1-6.0	Moderate pain
6.1-10	Severe pain

EVALUATION OF COLOR INTENSITY BY COMPUTERIZED IMAGE ANALYSIS SOFTWARE-

A standardized distance and angulation of the camera in relation to the subjects were maintained. (Model No. - Nikon P 520 camera being used). In all the images semiconductor image sensor, 4.3-180 mm was used, and with shutter speed fixed at 1/4000 to 30 seconds with a focal length of F=3.0.

The standardized images were cropped, using graphics software **Image J (Image J Developers ,NIH , United States)** from the mid-cervical region of the right canine to the left canine. The cropped image was then introduced into an upgraded version of the graphics software. Melanin areas were then separated from the image. The separated melanin image was introduced to the image-analyzing software. A histogram of the image was analyzed using the histogram options present in an analysis and the histogram reading was calculated.



Fig 1: Histogram values-(Mean-221.530)

STATISTICAL ANALYSIS

The results of the study were subjected to statistical analysis by applying following tests.

- 1) Unpaired t test and 2) paired t test.

RESULTS

The clinical evaluation of both the groups at different time intervals were given in Figure 1 and Figure 2 respectively. It was observed that visual analogue score is statistically less in Group B than Group A immediately and 7th day post operative.(Table 1 & 2).Mean Bleeding score for Group B was comparatively low immediate postoperatively than Group A (Table 3). Oral Pigmentation Index score were statistically decreased from Pre operative to 180 days post operative in both the groups (Table 4,5 & 6).Color intensity value as observed from Histogram were also statistically decreased from Pre operative to 180 days post operative in both the groups ,However these decrease was not statistically significant amongst both the group (Table 7,8& 9).

TABLE - 1: MEAN VISUAL ANALOGUE SCORE IN GROUP A AND GROUP B INTRA-OPERATIVELY

Table 1: Visual analogue score on day-1in group A and group B.

	Day-1		P-Value
Group	Mean	S.D	
Group A(scalpel)	7.6	1.0	<0.0001(H.S)
Group B(Laser)	2.8	0.9	

Table 2: Mean visual analogue score in group a and group b on day-7.

	Day-7		P-Value
Group	Mean	S.D	
Group A(scalpel)	4.6	0.9	<0.0001(H.S)
Group B(Laser)	0.9	0.7	

Table 3: mean bleeding score intra-operatively in group a and group b.

	Bleeding during surgery	P-Value
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Group	Mean	S.D	
Group A(scalpel)	2.2	0.4	<0.0001(H.S)
Group B(Laser)	1.0	0.2	

Table 4: Mean pre-operative dummett oral pigmentation index score in between group a and group b.

	Pre-op		P-Value
Group	Mean	S.D	
Group A(scalpel)	2.68	0.48	.7648(N.S)
Group B(Laser)	2.72	0.46	

Table 5: Mean post-operative dummett oral pigmentation index score in between group a and b.

	Post-op 180 days		P-Value
Group	Mean	S.D	
Group A(scalpel)	0.16	0.37	.1931(N.S)
Group B(Laser)	0.32	0.48	

Table 6: Mean pre-operative abd post-operative dummett oral pigmentation index score in between group a and b.

Group	Pre-op		Post-op 180 days		P-Value
	Mean	± S.D	Mean	± S.D	
Group A(scalpel)	2.68	± 0.48	0.16	± 0.37	< 0.0001(H.S)
Group B(Laser)	2.72	± 0.46	0.32	± 0.48	< 0.0001(H.S)

Table 7: mean pre-operative color intensity value through computerized image analysis software in between group a and b.

	Pre-op		P-Value
Group	Mean	S.D	
Group A(scalpel)	166.84	14.17	.8641(N.S)
Group B(Laser)	167.51	13.35	

Table 8: Mean post-operative color intensity value through computerized image analysis software in between group a and b.

	Post-operative 180 days color intensity values		P-Value
Group	Mean	S.D	
Group A(scalpel)	208.30	5.47	.8215(N.S)
Group B(Laser)	207.94	5.75	

Table 9: mean pre-operative and post-operative color intensity, Value through computerized image analysis software in between group a and b.

Group	Pre-op	Post-op 180 days	P-Value
	Mean ± S.D	Mean ± S.D	
Group A(scalpel)	166.84 ± 14.17	208.30 ± 5.47	< 0.0001(H.S)
Group B(Laser)	167.51 ± 15.35	207.94 ± 5.75	< 0.0001(H.S)

DISCUSSION

Recently, laser ablation has been recognized as one of the most effective, comfortable, and reliable techniques. Many laser systems such as Argon laser, CO2 laser, Nd:YAG laser, and Er:YAG laser have been used for dermal depigmentation.²¹ Few authors even claim that depigmentation procedure using laser does not require anesthesia also.²²

In all patients visual analogue scale (VAS) was taken at Intra-operatively (just after the surgery) and 1st week postoperative period to evaluate the subjective pain level experienced by each patient for two groups. In table-1, Mean visual analogue score in group A (scalpel) was 7.6 ± 1.0 and it was 2.8 ± 0.9 in group B (Laser) intra-operatively (during procedure). There was statistically significant difference in visual analogue score day-1 in group A and group B ($p < 0.0001$).

Table 2 shows Visual Analogue Score (VAS) in group A (scalpel) on day -7 was 4.6 ± 0.9 and it was 0.9 ± 0.7 in group B (Laser). There was highly statistically significant difference in visual analogue score on

day-7 in group A and group B ($p < 0.0001$). This finding suggests that at intra-operative period, pain was highest in Scalpel technique as compared to laser technique. There was statistically significant difference in pain between laser side and Scalpel technique ($p < 0.05$, "t" value = 0.00). This indicates laser will cause less pain and discomfort when it was compared to Scalpel technique.

The result is in agreement with the findings of **Lagdive et al**²², who had found increased pain at sites treated by surgical scalpel method compared to diode laser treated sites and many other authors who had also found minimal postoperative pain or discomfort following the use of different lasers.^{4,6,23}

One of the major disadvantages of the surgical scalpel technique is unpleasant bleeding during and after the procedure due to the damage to the underlying connective tissue includes blood vessels which hampers the visualization of the surgical area. In our study, bleeding intra-operatively was evaluated by using the criteria of **Simoes et al**.¹² Mean bleeding during surgery in group A (scalpel) was 2.2 ± 0.4 and it was 1.0 ± 0.2 in group B (Laser). There was statistically significant difference in bleeding during surgery in group A and group B ($p < 0.0001$).

This finding is consistent with the findings of **Lagdive et al**²², where moderate to severe bleeding was present at the surgically treated area using scalpel, whereas depigmentation with laser area had less bleeding.

Re-pigmentation is a major concern in the treatment of gingival melanin pigmentation (GMP). The recurrence of pigmentation can be due to the nature of melanocytes.

In the present study, the re-pigmentation was assessed in terms of change in Dummet Oral pigmentation Index from baseline to 6 months post-operatively. There was a steady fall in the area of pigmentation from baseline to 6 months both treatment groups. This is in agreement with studies done by **Lubart R et al 2005**.²⁴

Mean in pre-operative DOPI score in group A (scalpel) was 2.68 ± 0.48 and in post-operative day-180 DOPI score was 0.16 ± 0.37 . There was highly statistically significant difference in mean in pre-op and post op 180 day in group A ($p < 0.0001$). Mean

in pre-operative day in group B (Laser) was 2.72 ± 0.46 and in post-operative day-180 it was 0.32 ± 0.48 . There was statistically significant difference in mean in pre-op and post-operative 180 day in group B ($p < 0.0001$).

Clinical re-pigmentation of de-pigmented areas occurs spontaneously following subtotal gastrectomy, exposure to ultraviolet light. **Samuel Perl mutter** suggested mechanism of skin re-pigmentation to be the "**migration theory**". According to this theory, active melanocytes from normal skin and hair matrix proliferate and migrate into the depigmented areas.²⁰ Melanocytes are located in the basal layer of epithelium and epidermis. Laser removes melanocytes from superficial layer as well as from the connective tissue that helps in almost complete elimination of melanocytes.^{22,25}

The rapid rise in intracellular temperature and pressure leads to cellular rupture, as well as release of vapor and cellular debris, termed the laser plume.²² Recently **Harpreet et al (2014)**²⁶ evaluated patient response and recurrence of pigmentation following depigmentation carried out with a surgical blade and diode laser. They concluded that, both the techniques were found to be equally efficacious. These findings are in accordance with our present study.

This study uses an image-analyzing software that is a public domain^{27,28} named **image j 1.47v (Wayne Rasband National institutes of health USA)**. User-written plugins make it possible to solve problems associated with image processing and analysis. This software can edit, analyze, process, save, and print images.^{58,59}

The main use of Image J is that it can calculate area and pixel values which may be useful for graphic designers. With the help of a histogram we can analyze the images pre-operatively and post-operatively in both groups. Histogram is a graphical representation in which the Y axis denotes the no of pixels and the X axis denotes the intensity of the color, which can ultimately quantify the color distribution. It can calculate the darkness value of an image, which ranges from 0 to 255 (with 0 denoting pure dark and 255 denoting pure white).

Mean in pre-operative histogram score in group A (scalpel) was 166.84 ± 14.17 and it was 167.51 ± 13.35 in group B (Laser). There was no statistically significant difference in pre-op in group A and group B ($p=.8641$).

Mean in post-operative 180th day histogram score in group A (scalpel) was 208.30 ± 5.47 and it was 207.94 ± 5.75 in group B (Laser). There was no statistically significant difference in post-op in group A and group B ($p=.8215$).

Pre-operatively mean values were less and post-operatively after 1 week the values were highest in histogram regardless in both the groups.

The above mentioned results showed the same result accordance to DOPI scores pre-operatively and post-operatively and stated no clinical significance in between Scalpel and Diode Laser group. The image-analyzing software used in this study has also been used to analyze the outcomes of depigmentation techniques.

Thus the decision to use a laser should be based on the proven benefits of improved homeostasis, less postoperative pain and rate of re-pigmentation is also not very rapid. Most clinicians will accept slight delay in wound healing in view of clinical advantages. When used correctly in proven application, lasers offer an acceptable and impressive alternative within the field of Periodontics and other dental areas. However cost may be a limiting factor in case of laser along with delayed healing.⁷

It is been concluded that depigmentation using Scalpel and laser technique both groups showed equally efficacious results after 6 months. In order to establish the above mentioned fact further study is required with large sample size and longer post-operative follow up.

Limitations

Certain short-comings are associated with this study. Larger sample size is required along with longer follow-up records. Apart from that histological analysis of epithelium is the gold standard for determining the recurrence regarding the presence of melanocytes, but histological analysis was not included due to ethical clearance of the study.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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