



COMPARATIVE EVALUATION OF CLINICAL EFFICACY OF CONVENTIONAL SURGICAL TECHNIQUE WITH SCALPEL & DIODE LASER FOR GINGIVAL DEPIGMENTATION – A SPLIT MOUTH STUDY DESIGN

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ABSTRACT

Introduction: Gingival hyperpigmentation can significantly affect the aesthetic appeal of a smile, prompting the need for effective depigmentation techniques. It represents a periodontal plastic surgical intervention, with various techniques documented in the literature such as de-epithelization and scraping with a scalpel, gingival abrasion with diamond bur, gingivectomy combined with free gingival autografting, acellular dermal matrix allografting, electrosurgery, LASER, and cryosurgery. Periodontal procedures serve as the cornerstone of aesthetic dentistry offering a comprehensive treatment approach especially in aesthetic concerns following conventional surgical depigmentation with a scalpel and diode LASER technique. **Aim & Objective:** To compare & evaluate the clinical efficacy, patient comfort, and changes in gingival color following conventional surgical depigmentation with a scalpel and diode LASER technique. **Materials And Methods:** In this split mouth study, a total of 10 systemically healthy patients between 20- 45 years of age group were selected and randomly divided into two groups/sites: - Group 1/ Site 1 - Gingival depigmentation with conventional surgical technique. Group 2/ Site 2 - Gingival depigmentation with Diode LASER. Phase I therapy was performed in all the patients. The surgical site was treated by diode LASER 910nm angled at an external bevel of 45 degree in contact mode. All the patients were evaluated for clinical parameters i.e. Melanin pigmentation index, Dummett oral pigmentation index and wound healing assessment recorded at baseline, 1 month and 3 months. Visual analogue scale was recorded immediately post operative, 1 week and after 1 month. The clinical parameters were tabulated and put to statistical analysis. **Results:** Both the techniques i.e., conventional surgical and diode LASER technique were effectively reduced the melanin pigmentation, as evidenced by improvements in Melanin pigmentation Index and Dummett Oral Pigmentation Index scores. However, the diode LASER demonstrated significantly lower pain levels (Visual Analogue Scale), faster wound healing and higher patient satisfaction, suggesting a more comfortable and efficient method for gingival depigmentation. **Conclusion:** Diode LASER showed promising advantages in terms of patient comfort and recovery, making it a favorable alternative to traditional surgical technique for gingival depigmentation.

KEYWORDS : Melanin depigmentation, diode LASER, conventional surgical technique, Visual Analogue Scale, wound healing

INTRODUCTION

The aim of aesthetic dentistry is an ideal smile which is achieved through the perfect integration of both soft and hard tissues within the oral cavity. Factors such as tooth position, size, and their shape draw an appealing smile which is equally influenced by soft tissue display such as gingival color, extent of gingival display and the framing provided by the lips. Gingival color holds a significant control on overall aesthetics.¹ It is influenced by various factors including the density and size of blood vessels, epithelial thickness, extent of keratinization, and the presence of pigments within the gingival epithelium.²

Periodontal procedures serve as the cornerstone of cosmetic and aesthetic dentistry, offering a comprehensive treatment approach in terms of aesthetic concerns. There are common aesthetic concerns that include excessive gingival display, hyperpigmented gingiva, uneven gingival contours, loss of interdental papilla, and exposure of the root surface. Various pigments such as melanin, carotene, reduced hemoglobin, and oxyhemoglobin contribute to the normal color of gingiva and oral mucosa.³ However, excessive deposition of these pigments within the oral soft tissues results in hyperpigmentation. Although melanin pigmentation typically doesn't constitute any medical problem and patients may

have only concern with the appearance of their darkened gums.

Melanin pigment is the most prevalent endogenous, non-hemoglobin derived brown pigment, produced by melanocyte cells and distributed within the basal layer of the epithelium. When melanin accumulates excessively in the basal and supra-basal cell layers of the epithelium, it may result in gingival hyperpigmentation. Literature studies have mentioned the highest levels of gingival pigmentation in the attached gingiva and interdental papilla (25.4%), followed by marginal gingiva which exhibits least pigmentation (10.2%).⁴

Gingival depigmentation procedure is a periodontal plastic surgical intervention, with various techniques and methods documented in the literature.⁵ These methods encompass de-epithelization and scraping with a scalpel, gingival abrasion employing a diamond bur, gingivectomy, gingivectomy combined with free gingival autografting, acellular dermal matrix allografting, electrosurgery, cryosurgery, and the application of chemical agents such as 90% phenol and 95% alcohol. Recently, LASERs such as Nd: YAG LASER, semiconductor diode LASER, and CO₂ LASER have been used for depigmentation procedure.⁶ It's important to note that these techniques yield variable outcomes, with each carrying

its own set of advantages and disadvantages.

The surgical depigmentation procedure is a traditional and popular technique which removes the gingival epithelium layer that contains melanin pigment. In conventional surgical technique, wound healing occurs through secondary intention which allows the formation of a new epithelium layer devoid of melanin pigmentation. Recently, LASER technology has emerged as one of the most effective, advanced, and reliable methods for this purpose. LASER treatment enhances homeostasis, reduces post-operative pain and bleeding, and offers promising outcomes. The most common used LASER for gingival depigmentation is diode LASER showed a promising and successful results. Diode LASERS are solid-state semiconductor LASERS that convert electrical energy into light energy using combinations of various materials such as aluminium, gallium, and arsenide and Indium. In terms of their efficacy in soft tissue surgery, diode LASERS are well-suited for cutting and coagulating gingival tissue which ablate melanin-containing and producing cells.⁷

Therefore, the present clinical study was conducted with an aim to evaluate the clinical efficacy, patient comfort and change in the color (intensity and extent) of gingiva using conventional surgical technique with scalpel and diode LASER.

MATERIALS AND METHODOLOGY

The study was performed at the Department of Periodontology and Oral Implantology, National Dental College and Hospital, located in Derabassi, Punjab. Ten patients, aged between 20 and 45 years, who were in good systemic health, were selected based on specific inclusion and exclusion criteria. The patients were divided into two groups: Group 1/Site 1, which underwent gingival depigmentation via a traditional surgical approach, and the Control Group, which received treatment with a Diode LASER. Each group comprised 10 individuals. The study received ethical clearance from the Institutional Ethical Board Committee at National Dental College and Hospital, Derabassi, Punjab.

Study Design:

In this split mouth study, a total of 10 systemically healthy patients between 20- 45 years of age group were selected and randomly divided into two groups/sites:-

- **Group 1/ Site 1-** Gingival depigmentation with conventional surgical technique.
- **Group 2/ Site 2-** Gingival depigmentation with Diode LASER.

Inclusion Criteria

- Patients with physiologically pigmented gingiva in maxillary anterior region were evaluated as moderate to heavy pigmentation according to dummett et al.
- Patient of both sexes between the age group of 20-45 years.
- Patients who were systemically and periodontally healthy subjects.
- Patients with aesthetic concerns & good oral hygiene.
- Patients having thick gingival phenotype.

Exclusion Criteria

- Systemically compromised patients.
- Chronic Smoker or alcoholic patient.
- Pregnant or lactating women.
- Patients with healing disorders.

Methodology

Phase I therapy was performed in all the patients & the surgical site in the maxilla was selected randomly by the coin toss method for treatment either by scalpel technique or diode LASER. The surgical procedure was performed using topical

anesthesia or under local anesthesia.

In Group 1/site1: Gingival depigmentation with conventional surgical technique

The surgical procedure was performed using topical anesthesia or under local anesthesia. Pigmented epithelium and a layer of connective tissue was stripped off using a BP blade no. 15. The melanin pigmented was eliminated from the free gingival margin to the mucogingival junction. Periodontal pack was placed and post operative instructions were given.

In Group 2/site2: Gingival depigmentation with Diode LASER

The depigmentation procedure was performed using topical anesthesia or under local anesthesia. Diode LASER with 910nm wavelength angled at an external bevel of 45 degree in contact mode was used. The energy output was set at 0.5 to 1.5 W and pulse mode was set as a continuous wave. LASER ablation started from the mucogingival junction toward the free gingival margin, including interdental papilla. The motion of ablation was performed as light brushing strokes back and forth and the tip was kept in motion all the time. After the removal of the pigmented layer the exposed surface was wiped with a sterile gauze soaked in saline. After depigmentation tin-foil template was placed over the area and periodontal dressing (Coe Pak) was placed over the template. Patients were recalled after 1 week for Coe-pak removal.

Post-operative instructions were given to all the patients in both the groups. Patients were recalled after 1 week, 1 month and 3 months post operatively to evaluate wound healing, bleeding and melanin pigmentation. All the postoperative clinical parameters were checked and recorded on all the operated sites as per follow up protocol.

Assessment Of Clinical Parameter:

Clinical parameters included the assessment of the following:

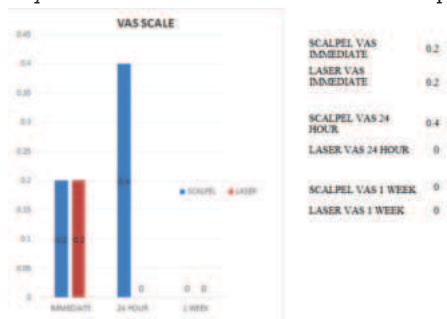
1. Visual analogue Scale (VAS) for Pain
2. Melanin Pigment index (Takashi et al, 2014)
3. Dummett oral pigmentation index (DOPI, 1964)
4. Wound Healing assessment by Landry et al. (1988)

RESULTS AND STATISTICAL ANALYSIS

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 23.0 Version. The descriptive statistics included mean and standard deviation frequency. The level of the significance for the present study was fixed at 5%. The intergroup comparison was done using the independent t test and intragroup comparison between time intervals were done using the Paired t test.

Visual Analogue Scale (VAS):

The p-value is 0.0368, which is less than 0.05, indicating a statistically significant difference in the pain experienced by patients 24 hours after treatment with the Scalpel technique compared to the LASER technique. This suggests that patients treated with the Scalpel experienced more pain 24 hours post-operatively than those treated with the LASER technique.



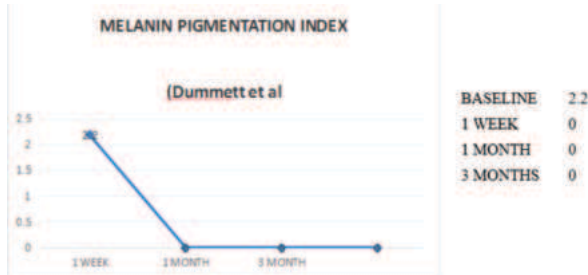
Melanin Pigmentation Index (MPI)

Both methods demonstrated complete elimination of gingival pigmentation, with MPI reducing from a mean baseline score of 1.8 ± 0.42 to 0 within the first week and maintained at 0 over the 3-month follow-up period. These results suggest that both scalpel and diode LASER techniques are equally effective in achieving sustained gingival depigmentation and there were no cases of recurrence.



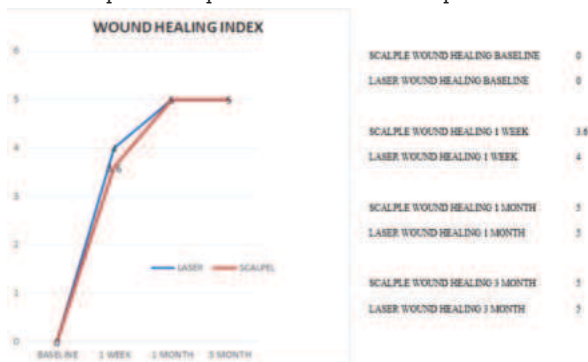
Dummet Oral Pigmentation Index:

Both methods demonstrated complete elimination of gingival pigmentation, with MPI reducing from a mean baseline score of 2.2 ± 0.63 to 0 within the first week and maintained at 0 over the 3-month follow-up period. These results suggest that both scalpel and diode LASER techniques are equally effective in achieving sustained gingival depigmentation and there were no cases of recurrence.



Wound Healing Index:

The p-value is which 0.0368 indicates a statistically significant difference between the wound healing scores for the Scalpel and LASER groups at 1 week. This suggests that the LASER technique resulted in slightly better wound healing compared to the Scalpel technique at the 1-week follow-up.



DISCUSSION:

Esthetics plays an important role in patients psychological and social well-being. Gingival health and appearance are essential components for a pleasant and confident smile. Gingiva is the most frequently pigmented oral tissue caused by deposition of melanin pigment. Melanocyte cells produce melanin pigment located in the basal and spinous layers of the gingival epithelium. Melanin granules are phagocytosed and contained within other cells of epithelium and connective tissue called melanophages or melanophores. It is generally accepted that pigmented areas are present only when melanin granules synthesized by melanocytes are transferred to keratinocytes. This close relationship between melanocyte

and keratinocytes is known as "the epidermal melanin unit"

The demand for gingival depigmentation procedures is primarily driven by aesthetic concerns, especially among individuals with a high or very high smile line that exposes more of the gingiva. One of the earliest and most widely accepted techniques for pigment removal is the scalpel technique, which is still considered the gold standard. In recent years, LASER photoablation has emerged as an effective, comfortable, and reliable method for gingival depigmentation. Commonly used LASERs for gingival depigmentation include semiconductor diode, Er:YAG, Nd:YAG, and CO₂ LASERs.

Among these, the diode LASER is highly effective for soft tissue procedures, making it a preferred choice for cutting and coagulating gingival tissue. The use of semiconductor diode LASERs for depigmentation was first introduced by **Yousuf A et al. in 2000**.⁸ This LASER, composed of aluminum, garnet, and arsenide diode, emits in continuous mode and operates using a contact method with a flexible fiber-optic delivery system. The diode LASER, which emits light at 810 nm, has low water absorption but is highly absorbed by hemoglobin and other pigments. In 2009, a study by **Sushma Lagdive et al.** was conducted to compare the use of semiconductor diode LASER and the scalpel blade technique for gingival depigmentation. The researchers assessed pain levels using the Visual Analog Scale (VAS) and found that patients who underwent LASER treatment experienced little to no pain, in contrast to the scalpel method. These results are consistent with the findings of our study.

Its thermal effect, known as the "Hot-tip" effect, results from heat accumulation at the fiber's tip, creating a relatively thick coagulation layer on the treated surface. The diode LASER facilitates tissue ablation or decomposition through photochemical, thermal, or plasma-mediated mechanisms. Thermal ablation occurs when LASER energy is absorbed by irradiated material, leading to a temperature rise. As the temperature increases, soft tissue undergoes various changes, including warming (37° to 60°C), protein denaturation, and coagulation (above 60°C)

The Dummet Oral Pigmentation Index (DOPI) was used to check the intensity of pigmentation. There is no statistically significant difference between the two treatments with respect to the intensity of pigmentation at the end of 3 months. The non-significant p-value infers that the intensity level at the end of 3 months after the treatment has been similar for both the depigmentation techniques. The Melanin Pigmentation Index was used to check the intensity of pigmentation. The non-significant p-value infers that the extent status of the hyper pigmentation patients at the end of 3 months has been similar for both the depigmentation techniques with respect to the extent of pigmentation at the end of 3rd month.

In the present study gingival wound healing showed a statistically significant differences in both the depigmentation techniques. However, diode LASER yielded a complete removal of the gingival surface epithelium without causing stromal damage. Micro-vessel dilation and the epithelial photoablation was accompanied by micro-vessel narrowing, possibly related to direct vasomotor effects and/or deactivation of local proinflammatory mediators by the diode LASER light. Similar results were presented by **Walter Duki et al 2013** and **Geethi Gupta et al 2011** who also find excellent wound healing after using LASER on gingival pigmentation.^{9,10} **Amit Bhardwaj et al** observed that both the procedures scalpel technique and diode LASER, evaluation on 30 days revealed restoration of normal features of the gingiva without any scar formation. Thus, the healing of the depigmented gingiva was uneventful irrespective of the techniques used.¹¹ **Sharma S. et**

al. 2010 also concluded that diode LASER achieved similar or better pigmentation removal outcomes than scalpel techniques, with the added benefit of reduced post-operative pain and faster healing.¹²

The LASER procedure is more acceptable to the patients as less time is required and it is more comfortable for patient as well as operator and absence of post-operative pain and haemorrhage. Sulewski J. et al in 2000 also highlighted the advantages of LASERS in dentistry, including precision, minimal invasiveness, and improved healing due to reduced trauma and excellent hemostasis. The diode LASER is noted for its effectiveness in soft tissue procedures, including gingival depigmentation. Less number of subjects, shorter follow up period, and no Histological and Histochemical assessment for the activity of melanocytes are the limitations of the study. The study conducted would be more validated if Histochemical & Histological assessment for the Melanocyte activity and a longer follow up period was carried with increased sample size.

CONCLUSION:

This study aimed to compare the clinical outcomes of gingival depigmentation using the conventional scalpel technique and diode LASER. Both methods were effective in reducing gingival pigmentation, as assessed by the Melanin Pigment Index (MPI) and the Dummett Oral Pigmentation Index (DOPI). However, the diode LASER demonstrated notable advantages in terms of patient comfort, with lower Visual Analogue Scale (VAS) scores, indicating less pain. Additionally, the wound healing assessment based on Landry's criteria showed faster healing in the LASER-treated group, likely due to its minimally invasive and hemostatic properties.

While both techniques yielded satisfactory depigmentation results, the diode LASER provided a more favorable patient experience and quicker recovery. These findings suggest that diode LASER may be a preferred method for gingival depigmentation in clinical settings.

Clinical Pictures



Fig. 1: Pre-Operative



Fig. 2: Depigmentation With Scalpel



Fig. 3: Depigmentation With Laser



Fig. 4: Placement Of Tin Foil



Fig. 5: Placement Of Coe Pak



Fig. 6: Post Operative (1 Week)



Fig. 7: Post Operative (1 Month)



Fig. 8: Post Operative (3 Months)**REFERENCES**

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