Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 7 Issue 4 April 2023

Research Article

Evaluation of Surgical Scalpel Versus Semiconductor Diode Laser Technique in the Management of Gingival Melanin Hyperpigmentation Along with Crown Lengthening: A Split Mouth Randomized Clinical Comparative Study

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DOI: 10.31080/ASDS.2023.07.1616

Received: March 07, 2023

Published: March 30, 2023

Abstract

Background: Gingiva that is dark or black in colour and has a lower clinical crown height is an aesthetic concern, especially in people who have a high lip line or a gummy smile. Gingival depigmentation and crown lengthening are perioplastic treatments in which the gingival epithelium is removed using various ways to obtain the results. The goal of this study was to examine two different treatments for gingival melanin pigmentation and crown lengthening.

Material and Methods: This was a randomised split-mouth trial in which 18 patients with diffuse, dark brown to black gingival discolouration and a short clinical crown were treated with a diode laser and surgical excision, and then followed up for 3 and 6 months. The data was analysed usingmann-whitneytest.

Results: When comparing the scalpel and laser techniques, bleeding during surgery, pain score, and the difficulty of the procedure as judged by the operator were all statistically higher for the scalpel technique. There was no statistically significant difference in wound healing between the two approaches.

Conclusion: Depigmentation and crown lengthening procedures can be accomplished using either a laser or a scalpel. The laser-treated locations, on the other hand, demonstrated less pain for the patient and improved operator comfort.

Keywords: Gingival Pigmentation; Melanin; Diode Laser; Surgical Scalpel Technique; Wound Healing

Abbreviations

Nd-YAG: Neodymium, Aluminum-Yttrium-Garnet; ERB-YAG: Erbium-Yttrium-Garnet; CO_2: Carbon Dioxide; DOPI: Dummett Oral Pigmentation Index; VAS: Visual Analog Scale; SPSS: Statistical Package for Social Sciences

Introduction

Melanin pigmentation of the oral mucosa has been reported in people of all ethnicities, and it is usually limited to the keratinized mucosa. One of the main worries of patients who visit dental clinics is a dark or black coloured gum. Excessive melanin deposition in the gingival epithelium causes dark pigmentation of the gums. Gingival melanin pigmentation is a biological process that affects people of all races [1]. Melanin, a brown pigment formed from non-hemoglobin, is one of the most common natural and endogenous pigments in the gums. Oral melanin pigmentation is assumed to be multifactorial [2]. Gingival depigmentation is a periodontal plastic surgeryol/operation that uses a range of techniques to eliminate or minimise gingival hyperpigmentation. The original and most essential cause for depigmentation is the patient's desire to improve their appearance Surgical techniques for depigmentation include the scalpel surgical technique, cryosurgery, and electrosurgery [3-5]. Lasers of various types, such as neodymium, aluminum-yttrium-garnet (Nd-YAG) lasers, diode lasers, erbium-yttrium-garnet (ERB-YAG) lasers and Carbon dioxide (CO_2) lasers have recently been introduced.

Gingival repigmentation occurs when melanin pigmentation returns after a period of treatment [6-9]. It is dependent on the surgical treatment.

Crown lengthening refers to operations that extend the surpagingival tooth structure for restorative or cosmetic reasons [10]. Dentists frequently face the need for crown lengthening in the area of dentistry, and they must also make treatment selections while

considering how to effectively manage each tooth's functional and biological requirements. The purpose of this study was to evaluate and compare the efficacy of gingival depigmentation and crown lengthening with a traditional scalpel approach and a diode laser.

Materials and Methods

The present study is a split-mouth, randomized, comparative, clinical trial and was carried out in patients visiting the Outpatient Department of Periodontics. Ethical clearance from the Institutional Review Board was obtained prior to the start of the study.

Patient selection (Figure 1A-C)

18 patients who were complaining about bilateral physiologic melanin hyperpigmentation of gingiva (dark gums) with age ranging from 20 to 40 years were included in this study. The procedure of gingival depigmentation was planned in both maxilla and mandible on both sides, i.e., midline to distal of the right first molar and midline to distal of the left first molar. The depigmentation procedure was randomly allotted to either of the areas by the flip of a coin. All the participants were informed regarding the procedure and prior informed consent was obtained.

Periodontally healthy individuals with bilateral melanin pigmentation in the anterior segment were included in this study. And also, individuals who were categorized as moderate or heavy clinical pigmentation as per the Dummett Oral Pigmentation Index (DOPI) were included [11]. Patients with thin gingival biotype, pregnant and lactating women, medically compromised patients, patients using drugs or chemicals that got potential to cause oral pigmentation and also patients who were under medication or condition that will interfere with bleeding or wound healing, and smokers were excluded from the study.

All enrolled patients underwent oral prophylaxis and were asked to follow oral hygiene instructions. The depigmentation procedure was performed using conventional scalpel or diode laser, and an interval of one week was kept between the two procedures to assess the pain and healing pattern.

Dummett-Gupta oral pigmentation (DOP) index was used to grade the level of gingival hyper pigmentation. Scoring criteria for DOP

- **1:** No clinical pigmentation.
- **2:** Mild clinical pigmentation.
- **3:** Moderate clinical pigmentation.
- **4:** Heavy clinical pigmentation.

Crown lengthening procedures

Scalpel technique (Figure 2A-E)

2 percent lignocaine and 1:80,000 adrenalines were used to anaesthetize the area around the teeth that would be subjected to the treatment. After determining the probing depth and obtaining adequate anaesthetic, the biologic width was calculated using the transgingival probing method with a William's periodontal probe. An external bevel incision was done and the gingival tissue was excised after the biologic width was estimated and the amount of gingival tissue to be excised was delimited to achieve optimal exposure of the tooth structure. To achieve a flat surface, any remaining tissue tags and granulation tissue beads were removed.

Laser technique (Figure 3A-E)

A topical anaesthetic gel was administered to the affected area before to the surgery. Despite the fact that a local anaesthetic gel is sufficient for such a minimally intrusive technique, the area was effectively anaesthetized with 2 percent lignocaine and 1:80,000 adrenaline. Prior to the surgery, the clinician and the patient both wore safety glasses that blocked the wavelength in question. The operation was performed using a diode laser (Ezlase, Biolase Technologies; CA, USA) with a wavelength of 940nm.After achieving adequate anaesthesia, the laser unit, which included a 400-m disposable tip, was used in a contact mode with a setting of 0.8 to 1.5 watts in continuous mode along the demarcated area with paint brush like strokes progressing slowly to remove the gingival tissue and expose adequate tooth structure. The tip was constantly checked for any debris from the ablated tissues and cleansed with sterile moist gauze throughout the procedure. During the process, the angulation of the tip was changed as needed to obtain a physiological gingival contour.

Depigmentation procedures

Scalpel scraping technique (Figure 2A-E)

The whole epithelium and a layer of connective tissue were scraped with surgical scalpel blade No. 15 until all visible pigmentation was removed from the margin to the mucogingival junction after appropriate anaesthetic (2 percent lignocaine hydrochloride) was applied to the operative area. The bleeding from the surgical location was controlled with a direct pressure pack administration, and the periodontal dressing was completed.

Laser technique (Figure 3A-E)

A local anaesthetic of 2% lignocaine hydrochloride was applied at the operative site. In continuous wave mode, the diode laser used in the study has an 810 nm wavelength and is powered by 1.5-2.0 watts with a flexible fiberoptic delivery system in continuous contact mode. The melanin-pigmented gingiva was removed

using this laser. Precautions were taken before employing the laser, including the use of protective glasses by both the operator and the assistant. Furthermore, because the laser beam may be reflected, extremely reflective equipment or devices with mirrored surfaces were avoided. To avoid operating the laser in the presence of explosive gases, precautionary steps were adopted. Light sweeping brush strokes were conducted with the laser point in light contact with the tissue. It was applied to the target tissue until blisters developed. The epithelium carrying melanin pigmentation was then scraped off using wet, saline-moistened gauze to remove the blistered gingiva. In all pigmented areas, the treatment was carried out in a cervicoapical orientation. A periodontal dressing was then applied to the depigmented region. Following the depigmentation operation, the patient was advised to maintain proper oral hygiene and avoid eating any hot, spicy foods for the first 24 hours after the procedure. They were also recommended to prevent any trauma throughout the healing period (4-7 days after treatment) and to rinse twice daily with 0.2 percent chlorhexidine digluconate.

Parameters measured

A single calibrated operator recorded clinical parameters such as bleeding, pain, time taken for depigmentation procedure, wound healing, recurrence of pigmentation, and intensity of repigmentation. Parameters such as pain, wound healing, and bleeding were recorded according to the criteria of Ishii., *et al*. and Kawashima., *et al.* Assessment of clinical repigmentation was done using Dummett Oral Pigmentation Index (DOPI) at 3rd and 6th months postoperatively [12,13].

Method of Scoring

The pain felt during the treatment was documented immediately afterward, as well as on the seventh day. The subjects were asked to rate the degree of pain, on a 10 cm horizontal visual analog scale (VAS) by placing a vertical mark to assess position between the two endpoints [14]. The left end point of the pain scale was designated as "no pain," while the right end point was designated as "unbearable pain," with a VAS score of 0 indicating no pain and 100 indicating severe pain. The amount of bleeding that occurred during the procedure and thereafter was measured. The operator's difficulty with the technique was assessed. On day seven, the wound healing was evaluated. After 3rd and 6months, the recurrence of melanin pigmentation was assessed using DOP index.

Results and Discussion

Statistical analysis

Collected data were subjected to statistical analysis. SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA) was used. Paired t-test performed for continuous variables for comparison between treatment groups. Categorical data were analyzed using Chi-square test. Results were represented as mean ± standard deviation; with $P < 0.05$ was considered statistically significant.

Sl no	Bleeding during surgery	
	Scalpel	Laser
1	3	1
2	2	1
3	2	1
4	4	1
5	3	2
6	3	1
7	3	1
8	2	1
9	4	2
10	2	1
11	3	1
12	3	1
13	2	1
14	3	1
15	4	2
16	3	1
17	3	1
18	2	1

Table a: Bleeding During the Surgery Assessed by Operator.

Sl no	Scalpel		Laser	
	Vas score on day 1	**Vas score at day 7**	**Vas score on day 1**	**Vas score at day 7**
1	45	20	20	5
2	50	25	15	0
3	40	20	10	0
4	35	10	5	0
5	40	15	15	5
6	30	15	10	0
7	25	10	5	0
8	35	20	15	5
9	40	15	10	0
10	30	10	5	0
11	30	5	10	0
12	45	20	5	0
13	25	5	15	5
14	40	5	10	0
15	25	10	5	0
16	30	10	10	5
17	30	15	5	0
18	40	10	10	0

Table b: Pain perception for Scalpel and Laser Techniques.

Sl no	Difficulty of procedure	
	Scalpel	**Laser**
1	2	1
2	3	1
3	2	1
4	2	1
5	3	1
6	1	1
7	2	1
8	2	1
9	3	1
10	3	1
11	2	1
12	2	1
13	2	1
14	3	1
15	2	1
16	3	1
17	1	1
18	2	1

Table c: Difficulty of Procedure Assessed by the Operator.

Sl no	Wound healing			
	Scalpel		**Laser**	
	Day7	**1 month**	**Day7**	**1month**
1	2	1	2	1
2	2	1 1	2	1
3	2	2	2	1
4	2	1	2	1
5	2	11111	2	2
6	2	11	2	1
7	2	11	2	1
8	2	11	2	2
9	2	11	2	1
10	2	1	2	1
11	2	1	2	11
12	2	1	2	1111
13	2	1	2	111
14	2	1	2	1111
15	2	1	2	11
16	2	1	2	11
17	2	2	2	1 1
18	2	1	2	

Table d: Wound Healing Between Scalpel and Laser techniques.

Sl no	Scalpel				Laser			
	Baseline	1 month	3month	6months	Baseline	1 month	3month	6months
1	3	0	0	0	3	0	0	0
2	4	0	0	1	4	0	1	1
3	3	0	1	1	3	0	0	0
4	3	0	0	0	3	0	0	0
5	3	0	0	0	3	0	0	1
6	4	0	1	1	4	0	0	0
7	4	0	0	0	4	0	0	0
8	3	0	0	1	3	0	0	0
9	3	0	0	0	3	0	0	0
10	3	0	0	0	3	0	1	1
11	3	0	0	1	3	0	0	0
12	4	0	1	1	4	0	0	0
13	3	0	0	0	3	0	0	0
14	4	0	0	0	4	0	0	0
15	3	0	1	1	3	0	0	0
16	3	0	0	0	3	0	0	0
17	3	0	0	0	3	0	0	1
18	3	0	0	0	3	0	0	0

Table e: Melanin pigment evaluation with dummett-gupta index.

Sl no	Scalpel		Laser	
	3 months	6 months	3 months	6 months
1	0	0	0	0
2	0	1	1	1
3	1	1	0	0
4	0	0	0	0
5	0	0	0	1
6	1	1	0	0
7	0	0	0	0
8	0	1	0	0
9	0	0	0	0
10	0	0	0	1
11	0	1	0	0
12	1	1	0	0
13	0	0	0	0
14	0	0	0	0
15	1	1	0	0
16	0	0	0	0
17	0	0	0	1
18	0	1	0	0

Table f: Melanin Repigment Evaluation with Dummett-Gupta Index.

Figure 1A-C: Preoperative.

Figure 2: (A) Bleeding point marked (B) Scalpel procedure (C) Scalpel crown lengthening (D) Scalpel depigmentation (E) Periodontal pack placement.

Figure 3: (A) Bleeding point marked (B) Laser therapy (C) Laser crown lengthening (D) Laser depigmentation (E) Periodontal pack placement.

Figure 4: (A) 1 week follow-up (B) Laser (C) Scalpel.

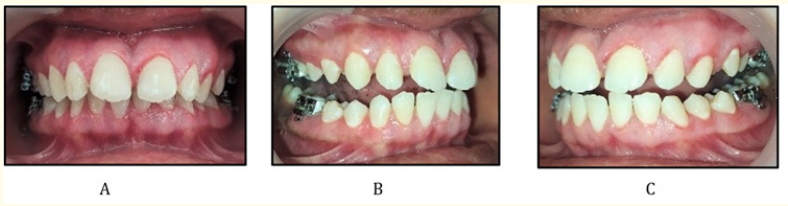

Figure 5: (A) 1 month follow up (B) Laser (C) Scalpel.

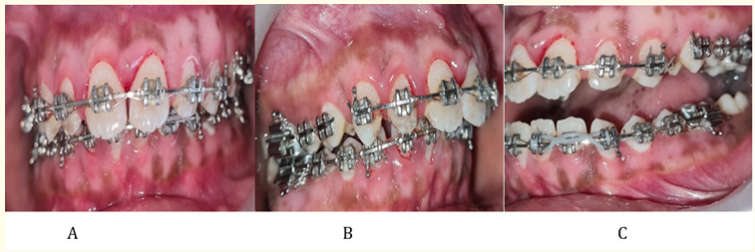

Figure 6: (A) 6 months follow-up (B) Laser (C) Scalpel.

Discussion

The unattractive appearance of gums is caused by melanin hyperpigmented gingival tissue. Patients are frequently forced to seek aesthetic therapy to brighten the colour of their gingiva. Several depigmentation techniques have been suggested in the literature, such as a simple slicing approach to liberate gingival grafts or a "push back" surgery [15]. The scalpel surgical technique is a ground-breaking procedure that has remained popular to this day because to its ease of use, accessibility to armamentarium, and affordability [16]. The method entails the surgical removal of the gingival epithelium as well as a layer of the underlying connective tissue, allowing the denuded connective tissue to recover on its own. There is no melanin pigmentation in the new epithelium that develops [17]. Traditional surgical stripping has, however, been supplanted by laser methods [18,19]. The purpose of this study was to compare surgical stripping and diode laser depigmentation procedures.

Because it does not interact with dental hard tissues, the diode laser is an effective soft tissue surgical laser. Thermal effects of diode lasers are linked to the 'hot tip' phenomenon, which is caused by heat accumulation at the fiber's end. As a result of these processes, a thick coagulation layer forms on the treated surface. The benefit of a diode laser is its smaller and more portable size, as well as the fact that it has no negative effects on the alveolar bone and root surface. Diode laser wounds heal more slowly and take longer to heal than traditional scalpel wounds. Scalpel surgery, on the other hand, causes uncomfortable bleeding during and after the procedure and necessitates the use of a periodontal dressing

to cover the surgical wound. The use of a diode laser caused a sterile inflammatory reaction in the gingival tissues. Hemostasis and a somewhat clean operation field are achieved by sealing blood vessels near the diode laser tip [20].

On day one, the laser depigmentation technique produced much less postoperative pain than the scalpel procedure. The results of this investigation are comparable to those of Ribeiro., *et al.* and Lagdive., *et al.* who found that laser-treated locations had minimal or no pain [21,22]. When comparing the difficulty of procedures as judged by the operator, the laser technique was found to be easier to conduct due to less bleeding during the operative operation and to be less technique sensitive than the scalpel technique.

To achieve the biologic width conducive to restoration and crown installation, a functional crown lengthening method combines a gingivectomy or an open flap surgical technique with resective osseous surgery. The decision between gingivectomy and open flap surgery is influenced by a number of factors, one of which is the width of the associated gingiva [23]. When the laser and scalpel approaches were compared, both techniques resulted in sufficient gingival tissue removal and appropriate exposure of the tooth structure. Patients in the laser group experienced minimal bleeding, allowing for greater view of the operating area and assessment of the essential tooth structure to be exposed, whereas patients in the scalpel group experienced unpleasant bleeding and poor visibility of the operative area. These findings matched those of Lagdive SB., *et al.* (2010) [24]. Patients in the laser group had lower VAS ratings than those in the scalpel group, owing to the fact that lasers deposit a protein coagulum that seals the sensory neurons, reducing inflammation [25]. For soft tissue and hard tissue crown lengthening treatments, a variety of lasers with specific wavelengths were used. We chose a diode laser because it is compact and cost-effective, and it has a superior penetration depth, better absorption for melanin and haemoglobin, and better hemostasis than other lasers. Other advantages of the laser over the scalpel include less edoema from the closing of lymphatic veins, less wound contraction, and scarring [26].

Conclusion

The results of this study demonstrate that both scalpel and laser procedures for gingival depigmentation and crown lengthening were successful. There were no postoperative complications with either surgery, and the gingiva healed normally without complications. When compared to the scalpel approach, lasers caused less postoperative pain. There was no statistically significant difference in rate of gingival pigmentation recurrence between both the procedures. Toestablish the comparative efficacy and usefulness of these treatments, randomised controlled studies with bigger study cohorts and longer follow-up periods are required to evaluate the

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