European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 10, 2020

Management of Melanin-associated pigmented lesion using diode laser, scalpel and electro-surgery: A comparative study

Dr Mouneshkumar C D[1], Dr Shipra Sepolia[2], Dr Shivangi Gupta[3]

[1]*Reader, Department of Oral and Maxillofacial Surgery, School of Dental Sciences, Krishna Institute of Medical Sciences, Deemed University, Karad, Maharashtra*
[2]*Lecturer, Department of Periodontics and Implantology, Indira Gandhi Government Dental College, Jammu*
[3]*Reader, Department of Periodontics and Implantology, MMCDSR, Deemed to be University, Mullana, Ambala*

Abstract: Background: Melanin is the pigment that is responsible for the hyperpigmentation of skin and gingival tissues. This can result in significant amount of esthetic dilemma and affect the smile line which forms integral part of oro-facial esthetics. Numerous cosmetic modalities have been used for correction of hyperpigmentation. However, repigmentation can be seen few months following surgery. Aim: The aim of this study was to compare three techniques of scalpel, electrosurgery and diode laser therapy for management of gingival hyperpigmentation for repigmentation and comparing pain intensity using the visual analogue scale (VAS). Materials and methods: Thirty subjects with gingival pigmentation were categorized into Group 1: Depigmentation performed using Scalpel surgery method; Group II: Depigmentation by using electro-surgical method and Group III: Depigmentation procedure using Laser therapy. Results: Treated subjects were observed at baseline, at first month and six months post-operative period for repigmentation occurrence and intensity of pain score immediately following surgery and after twenty four hours. All observations were entered in Microsoft Excel 2007 work sheet. Mean and standard deviations were calculated and inter-group comparisons were made using Analysis of Variance (ANOVA) tool. A p value of <0.05 was considered statistically significant. All methods demonstrated lack of repigmentation after six months follow-up and almost similar VAS score significance (P<0.05 for electrosurgical and laser technique and >0.05 for scalpel technique. Conclusion: Since comparable results were demonstrated in this study, it is choice of clinician and patient selection based on which appropriate technique can be selected.

Keywords: Gingival, melanin, scalpel, electrosurgery, diode.

1. INTRODUCTION

A perfect smile can be attributed to color, shape and tooth position along with gingiva. Color of gingival depends primarily on vasculature, thickness of epithelium, keratinization and pigmentation. Various pigments responsible for gingival pigmentation are- melanin, carotene, oxy- and deoxy-hemoglobin. Most common cause of gingival pigmentation is melanin pigment which is produced by melanocytes localized within basal and parabasal epithelial layers of gingival. Melanin-induced pigmentation initiates approximately three hours following birth in oral tissues. Moreover, it may be evident only in gingiva. [1]

The term 'melanin' is derived from Greek 'melanos' which means 'dark'. Melanin is the end-product of L-tyrosine metabolism and is comprised of polymorphous biopolymers like- a) Pheomelanin; b) Eumelanin and c) Neuromelanin. Melanocytes are dendritic cells originating from neural crestal cells. Melanin is synthesized with in organelles which are known as- 'melanosomes' contained within melanocytes. [2, 3, 4, 5]

Pigmentation of gingiva may be either of endogenous or exogenous origin. Endogenous causes may be due to racial pigmentation or systemic conditions like Addison's disease to malignancies like- Kaposi's sarcoma and malignant melanoma. Pattern of melanin pigmentation in gingival tissue varies among various ethnic populations, for example, subjects belonging to Africa show higher melanocytic activity when compared to other ethnicities such as Albinos. Apart from physiological presence, pathological pigmentation of gingival tissue can be observed in- a) Endocrine disorders like Albright's syndrome, Acromegaly; b) Heavy metal poisoning such as mercury or lead, c) Malignancies associated with pigmentation like- Kaposi's sarcoma or medications and drugs-induced such as menocyclin, cyclophosphamide, bleomycin, ketoconazole, zidovudine etc., d) Post-healing pigmentation seen in conditions like oral lichen planus, smoking-associated melanosis, f) amalgam or graphite tattoos, g) benign conditions like hemangioma and melanoacanthoma; HIV-associated oral melanosis and h) Pigmentary incontinence associated with hemochromatosis.[6]

Classification of depigmentation techniques of gingival pigmentation

Roshni and Nandakumar (2005) have classified the various gingival depigmentation methods as follows: [7, 8]

I. Surgical methods/techniques: These are as follows-

a. Scalpel surgery; b) Bur abrasion technique; c) Cryosurgery; d) Electrosurgery; e) Laser and radiosurgery,

II. Chemical-based technique or methods like- Free gingival graft and acellular dermal matrix allograft.

Most important confounding reason is that these are very expensive techniques. Significant limitation of cryosurgery and chemical cauterization is complete lack of control of working depth while electrosurgical method produces latent heat thus, causing tissue damage. Gingivectomy is an invasive technique which may sometomes result in loss of bone. Similarly, free gingival grafting results in variations in shades of recipient and site from which graft was taken. [8, 9]

This study aims to compare three depigmentation techniques- Scalpel surgery, Electrosurgery and diode laser in management of gingival hyperpigmentation caused by melanin pigmentation.

Various oral or gingival pigmentation indices which have been proposed are as follows-

I. Oral pigmentation index: It was proposed by Dunmet in 1964. It is most commonly used due to its simple presentation and it is easy to use. For this, maxillary and mandibular gingival arches have been divided into thirty two units of 16 on lingual nad 16 on buccal and labial gingival surfaces. Each unit is approximating marginal gingival and extends four to five millimeters apically up till level of attached gingiva.[5]

Scoring system is as follows-

Score 0 No clinically evident gingival pigmentation

Score 1 Mild clinically evident gingival pigmentation

Score 2 Moderate clinically evident gingival pigmentation

Score 3 Heavy clinically evident gingival pigmentation

Oral pigmentation index assessment = Sum of assigned estimate of components/32 unit spaces

0	No pigmentation
0.031 to 0.97	Mild pigmentation
1.0 to 1.9	Medium gingival pigmentation
2.0 to 3.0	Heavy gingival pigmentation

(II) Melanin index (1997): It was proposed by Hedin. As per this index, gingival pigmentation has been classified into- i) Absence of pigmentation; ii) 1 or 2 solitary unit/units of papillary gingival pigmentation without any continuation; iii) Great than three papillary gingival pigmentation units without any continuation; iv) More than one continuous gingival pigmentation units; v) Continuous gingival pigmentation between canines.[5]

(III) Takashi's melanin pigmentation index (2005): According to this index, scoring is done as follows: [5]

According to this index, scoring is done as follows:

Score 0- Absence of gingival pigmentation
Score 1- Solitary pigmented papillary gingival units without any continuity between separate units
Score 2- Continuous pigmented area.

(III) Peeran et al (2014) index of gingival pigmentation due to melanin: [5]

Score	Features/characteristics
0	Absence of gingival pigmentation
1	Mild, solitary, diffuse pigmentation of anterior gingival with or without posterior gingival involvement
2	Moderate to severe, solitary to diffuse pigmentation of anterior gingival with or without posterior gingival involvement
3	Posterior gingival pigmentation only
4	Pigmentation associated with tobacco usage such as smoker's melanosis
5	Exogenous pigmentation such as- amalgam tattoo, bismuth, lead line (Burtonian line), mercury, silver etc.
6	Endogenous pigmentation like- hemosiderin, bilirubin, hemochromatin etc.
7	Drug-associated such as- minocyclin, oral contraceptive pills, anti-malarial medications
8	Gingival pigmentation associated with systemic diseases such as- Albright's syndrome, Addison's disease, HIV, Peutz-Jegher's syndrome etc.
9	Benign pigmented lesions like- nevus, hemangioma etc.
10	Malignant pigmented lesions like- Kaposi's sarcoma, Angiosarcoma, melanoma etc.

(IV) Oral pigmentation index proposed by Dummet-Gupta (1971): [4]

1. No gingival pigmentation (pinkish gingiva)
2. Mild gingival pigmentation (Light brown gingival)
3. Moderate gingival pigmentation (Mixed or medium gingival pigmentation)

As per Dummet (1960), degree of gingival pigmentation is related to physical, chemical and mechanical stimuli. Selection of an appropriate depigmentation technique is dependent upon experience of a clinician, cost-effectiveness, affordability and preference. [6]

2. MATERIALS AND METHODS

A total of 30 subjects were selected for the study for depigmentation procedure. Subjects were divided into three groups- a) Group 1: Depigmentation performed using scalpel surgery; II) Depigmentation performed using electro-surgery and III) Depigmentation performed using diode laser.

Inclusion criteria were: 1) clinical esthetic compromise and 2) subject willingness

Exclusion criteria were lack of any systemic disease or medication use that can cause gingival pigmentation.

Following is the detailed account of all procedures performed.

a) Depigmentation method as per scalpel surgery in this study:
In this method, after onset of adequate local anesthesia, the pigmented portion of gingiva (which includes epithelium and connective tissue) is surgically excised using number 15 and 11 BP blades. Special care was taken to remove all pigmented gingival remnants. After achieving hemostasis, periodontal pack was applied. An uneventful healing with complete epithelialization occurred between seven to fourteen days.
b) Electrical surgical method for depigmentation:
After local anesthetic administration, small sized diamond loop electrode which was attached to a hand-piece was swiftly moved on pigmented gingival in light brushing stroking movements. The tip was kept moving the entire time as the contact of electrode tip with tissue must be kept for a brief period of time since excessive heat build up can take place. After each stroke, the electrode tip was wiped over a gauze piece soaked with normal saline.
c) Depigmentation method using diode laser as performed in this study is as follows:

This procedure was initiated after applying topical anesthetic agent made of 2.5 percent lignocaine with 2.5% Pilocarpin cream (EMLA, Astra Pharmaceuticals Pvt. Ltd., Wayne, Philadelphia). The topical anesthetic agent was applied for five minutes prior to beginning the treatment and was repeated during the procedure as well. Laser unit was used at a power setting of 1 to 1.75 Watts with 11 percent and 7 percent air and water settings. Laser beam was used at above setting for de-epithelialization in non-contact module while 0.5 Watt power setting, air and water settings of 11 % and 0 % for biological bandaging of site operated upon. The equipment tip was kept at a distance of 1 to 1.5 millimeters from tissue while maintaining a shank angle of 130 to 135 degrees with the tissue surface. Initial ablation was performed in attached gingival mid-way between free gingival margin and mucogingival junction. Short vertical movements of the tip was moved mesio-distally. Extreme caution was exercised to avoid gingival margin disfigurement. In the first setting, most of the pigmented gingival epithelium was removed while in the second sitting, deeply seated pigmented areas were removed. The second sitting was repeated after two weeks duration. Total operatory duration was around forty five minutes first ablative procedure and fifteen minutes for second ablation procedure. During the bandaging procedure, the wound surface was covered with a protein coagulum which disappeared after moistening with saliva. No analgesics and antibiotics were prescribed and all post-operative instructions were given which included- avoidance of spicy and hot foods any trauma to the operated site. All subjects were followed –up at following intervals- immediately post-treatment, one week, second weeks, one month, six months and one year post-operative period.

Post-operatively all patients were prescribed with paracetamol, 325 miilli grams in combination with diclofenac potassium, 50 milli grams and serratiopeptidase, 10 miilli grams for three days duration.

3. RESULTS

Post-operative outcome was assessed at baseline till six months interval and observationa were recorded. ANOVA was applied and P value of <0.05 was considered statistically significant. All the procedures demonstrated statistically significant and satisfactory clinical results (Table 1). Statistical significance was noted on comparison of electrosurgical and post laser ablation associated pain scores while no significance in VAS score was obtained with scalpel surgery (Table II). In cases treated with Diode Laser, wound healing was complete within one week. Cases with bone exposure demonstrated healing period of maximum of three days followed by, two weeks of complete wound healing.

4. DISCUSSION

A person's smile is the most effective way of non-verbal social communication. However, it can be influenced by orofacial esthetics comprising of teeth and gingival pigmentation. Pigmentation of gingival is present in people of various populations regardless of their ethnicity. Subjects with fair skin usually seek cosmetic intervention for darkly pigmented gums. Conventional surgical procedures like gingivectomy are associated with loss of alveolar bone, lengthy healing period and presence of pain. Also, the cosmetic effects are not long lasting. Use of free gingival graft has also been employed but drawback like creation of another surgical site, color match between graft and graft-site and demarcation of graft from surrounding tissue are esthetic issues associated with this technique. Use of bur abrasion technique (also known as de-epithelialization) has also been used but major drawback of this method is that it is difficult to control the depth of the procedure. Cryosurgical intervention requires high skill and use of specialized equipments. Use of laser ablative method has been proved to be a comparatively reliable technique with minimum post-operative pain and discomfort along with rapid healing of wound. Er,Cr:YSGG laser was developed during mid-90s. it was made available for commercial use in 1998 after approval by US-FDA (Food and Drug Administration). It was used for both soft as well as hard tissue procedures like endodontic treatment and osseous surgeries. The second generation Er.Cr:YSGG laser works by emission of photons at 2780 nm wavelength at a 140 to 150 per second duration of pulse and repetition of pulse at 20 per second and power output ranging between zero to six Watts. The laser beam is transmitted through a fiber-optic cable. Efficiency and cutting depth is adjusted by varying percentages of air and water, selection of appropriate tip, distance of tip from target tissue and appropriate power setting. Various advantages of using Erbium-based lasers include- comparative patient comfort during and following the procedure, reduced thermal tissue injury and faster rate of healing of operated wound site. [9, 10]

Techniques compared in present study include- scalpel method, electro-surgery method and laser ablation method which are described below:

a. Scalpel surgery method

In this surgical method, gingival epithelium tissue is surgically removed along with a thin layer of connective tissue using a surgical blade. Operator has to be careful so as to not leave any pigment epithelial remnants. Advantage of scalpel methods are- 1) It is cheap and 2) Armamentarium can be easily procured. However, one major drawback associated with this technique is excessive bleeding that takes place. As a result, periodontal dressing has to be placed for duration of seven to ten days. Also, re-pigmentation can occur after some time. [1]

b. Electro-surgical technique

In this method, high-frequency electrical energy is directly applied to gingival tissues. With passage of current, impedance created leads to heat generation. This causes boiling of tissue water without creation of steam which causes coagulation or cutting of tissue. Advantage of this method is its ability to control hemorrhage, good adequacy of tissue contouring, less amount of patient discomfort, less scarring and reduced chair-side time. However, drawbacks include- greater expertise and accidental contact with underlying periosteum or alveolar bone loss. [1]

c. Laser ablation technique

Ablation of gingival tissues with lasers is considered a reliable method for eliminating pigmentation and its added advantage is that there no requirement of periodontal dressing. Also, reduction in pain and discomfort is evident due to protein coagulum formation. Laser surgery also seals free nerve endings thus, reducing pain. Different types of lasers used are- Erbium:YAG laser (2.940 nm); Carbon dioxide laser (10.600 nm); diode laser (810 nm) and Neodymium:Yttrium:Aluminium garnet (1.064 nm). Diode laser is solid-state semi-conductor laser using conversion of electrical to light energy. Lasers can be delivered via flexible fiber-optic quartz hand-piece. In laser-treated cases, post-operative patient discomfort is considerably lower.[1]

History along with pros and cons of each technique

a) Scalpel technique: This method was first demonstrated by Dummet and Bolden (1963). Advantages of this technique are- 1) It is simple and easy to perform; 2) It is non-invasive and 3) It is cost-effective.[10]

b) Electro-surgical method or technique: This technique was first published by Ginwalla (1966). Its advantages include- a) Excellent control over bleeding; b) Adequate contouring of gingival tissue; c) Significantly less patient discomfort; d) Less tissue scarring; e) Less time spent on chair-side whereas disadvantages include- a) Expertise is required; b) Application of current may result in destruction of tissue.[10, 11]

c) Laser ablation technique: This was first introduced by Trelles (1992) by using Argon laser. Various advantages of this method are- a) There is no bleeding during the surgical

process; b) constant sterilization of surgical area takes place during the procedure; c) there is significant reduction in bactereamia; d) there is reduction in surgically induced trauma; e) occurrence of very less post-operative edema; f) reduction in scar formation and g) there is reduced post-operative pain. Various disadvantages include- a) Delay in epithelial regeneration, b) it is expensive; c) there is lack of tactile sensation while performing the procedure; d) there is risk of fenestration of gingival which can lead to exposure of bone can take place and e) There is a prolonged healing phase.[9, 10]

The degree of pigmentation is directly proportional to the size and degree of melanin production. In dark skinned subjects, increase in production of melanin is generally governed by hyperactive melanocytes. [11, 12, 13]

Most significant treatment failure sign in any of this de-pigmentation procedure is"re-pigmentation". Most important reason of re-pigmentation is- the "Migration theory". According to this theory, melanocytes which migrate from adjacent pigmented tissues result in re-pigmentation and treatment failure. Other most common reason is persistence of smoking habit which causes activation of melanin production. [7]

Manickam et al (2020) reported in their case series that the use of scalpel for denuding gingival results in secondary process of wound healing while in curettage done in electrosurgical technique, tissue resistance produces heat during passage of current. Certain investigators like- Manickam (2020), Almas (2002) and Kathriya (2011) have reported faster healing process following scalpel scrapping method when compared to other techniques.[14,15,16]

Narayankar et al (2017) in their study compared scalpel surgery with cryosurgery in twenty five subjects using a randomized control split mouth study. This study showed that the rate of re-pigmentation was higher in scalpel method when compared to cryosurgical pigmentation. Also, on comparing pain on visual analogue scale (VAS), it was found that the VAS scores were three and two for 10 (out of 25 surgical sites) and 12 (out of twenty five surgical sites). [17]

Gupta et al (2014) in their split mouth study on fifteen subjects for comparing depigmentation techniques of scalpel surgery and electro- surgery demonstrated better clinical healing in sites treated with scalpel technique. However, re-pigmentation was seen in only four sites treated with electrosurgery compared to seven in sites treated with scalpel method. Although, pain and discomfort was reported more in sites treated electrosurgery along with delayed epithelial healing. Pain was assessed based on visual analogue scale (VAS) which contained a horizontal ten centimeters line marked at 100 millimeters or 10 centimeters endpoints. Study participants rated their pain experience by marking at a point on this line. The score ranged from zero to ten. Scoring for pain was done as: 0 (no pain), 0.1 to 3 (slight pain); 3.1 to 6 (moderate pain) and 6.1 to 10 (severe pain). [18]

Sharma et al (2018) reported reduced patient discomfort along with reduced pain following gingival ablation using diode laser. [19]

Berk et al (2005) found that the use of Er,Cr:YSGG laser in defocused mode is a safe as well as effective procedure. There is uneventful healing and complete tissue regeneration along with no pain, swelling, infection or scarring. They reported no case of repigmentation after using this technique after six months follow-up. [20]

Elaverasu et al (2015) in their case series compared efficacy of electrosurgery and laser depigmantation techniques. Following ablation procedures, patients treated with laser therapy demonstrated full healing in one week period. Both of these techniques have a distinct advantage of a blood-less working field. In their study, no post-operative complications were observed. [7]

5. CONCLUSION

Facial esthetics is determined by a combination of factors of which gingival pigmentation plays an important role. There are various techniques available that have been employed for the same. This paper has compared three techniques for their longevity and post-operative complications. Based on which, the results have been put forth for self-assessment by clinicians.

6. REFERENCES

[1] Moneim RAA, ElDeeb M, Rabea AA. Gingival pigmentation (cause, treatment and histological review). Future Dent J 2017;3:1-7.
[2] Ozbayrak S, Dumlu A, Ercalik-Yalcinkaya S. Treatment of melanin-pigmented gingiva and oral mucosa by CO2 laser. Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol 2000; 90(1):14-5.
[3] N Shahna, A Sucheta, N Sapna, B M Darshan, S M Apoorva. Gingival pigmentation: A review of literature. Int J Appl Dent Sci 2019;5(2):83-91.
[4] Dummett CO, Barens G. Oromucosal pigmentation: An updated literary review. J Periodontol 1971; 42(11):726-36.
[5] Sreeja C, Ramakrishnan K, Vijayalakshmi D, Devi M, Aesha I, Vijayabanu B. Oral pigmentation: A review. J Pharm Bioall Sci 2015; 7(2):403.
[6] Leston JM, Santos AA, Varela-Centelles PI, Garcia JV, Romero MA, Villamor LP. Oral mucosa: Variations from normalcy, Part II. Cutis 2002;69(3):215-217.
[7] Elavarasu S, Thangavelu A, Alex S. Comparative evaluation of depigmentation techniques in split mouth design with electrocautery and laser. J Pharm Bioall Sci 2015;7:5786-90.
[8] Ishida CE, Ramos‐e‐Silva M. Cryosurgery in oral lesions. Int J Dermatol 1998;37:283‐5.

[9] Suthprasertporn S. Treatment of gingival melanin hyperpigmentation by Er,Cr:YSGG laser: Report of two cases. Thai J Periodontol 2007;1:46-55.
[10] Shah SS. Surgical esthetic correction for gingival pigmentation: case series. J Interdisc Dent 2012;2(3):195-201.
[11] Gnanasekhar JD, al‐Duwairi YS. Electrosurgery in dentistry. Quintessence Int 1998;29:649‐54.
[12] A Sucheta, N Shalina, Bhat D, S M Apoorva, N Sapna: A review on gingival depigmentation procedures and repigmentation. Int J Appl Dent Sci 2018;4(4):336-41.
[13] El Shaenawy, Nasry SA, Zaky AA, Quriba MAA. Treatment of Gingival hyperpigmentation by diode laser for esthetical purposes. OA Maced J Med Sci 2025;3(3):447-54.
[14] Manickam P, Aspalli S, Mulla SA, Djeapragassam P. The reconstruction of pink esthetics through gingival depigmentation- A case series. Acta Scientific Dent Sci 2020;4(3):1-5.
[15] Almas K, Sadig W. Surgical treatment of melanin-pigmented gingival: an esthetic approach. Ind J Dent Res 2002;13(2):70-3.
[16] Kathariya R, Pradeep AR. Split-mouth de-epithelialization techniques for gingival depigmentation: A case series and review of literature. J Ind Soc Periodontol 2011;15:161-8.
[17] Narayankar SD, Deshpande NC, Dave DH, Thakkar DJ. Comparative evaluation of gingival depigmentation by tetrafluoroethane cryosurgical and surgical scalpel technique. A randomized clinical study. Contemp Clin Dent 2017;8:90-5.
[18] Gupta G, Kumar A, Khatri M, Puri K, Jain D, Bansal M. Comparison of two different depigmentation techniques for treatment of hyperpigmented gingival. J Ind Soc Periodontol 2014;18(18):705-10.
[19] Sharma H, kaushik M, Tomar N, Wadhawan A, Dureja D. Treatment of gingival melanin hyperpigmentation with diode laser: A report of two cases. Int J Orofac Res 2018;3:14-6.
[20] Berk G, Atici K, Berk N. Treatment of gingival pigmentation with Er,Cr:YSGG laser. J Oral Laser Appl 2005;5:249-53.

Table 1: Table showing intra-group comparison at baseline, one and six months

Study group	Scalpel surgery (mean ±SD)	Electro surgery (mean ±SD)	Laser surgery (mean ±SD)
Baseline	3 ± 0.01	3 ± 0.01	3 ± 0.01
1 month	1 ± 0.01	1 ± 0.00	1 ± 0.00
6 months	1.40 ±0.5	1.50±0.6	1.45±0.45
p value	0.000	0.000	0.000

Table 2: Table showing Visual Analogue Scale pain scores

Post-operative period	Patients treated with scalpel	Patients treated with electrosurgery	Patients treated with diode laser	P Value
Following procedure	2.4 ±0.5	3.1 ± 0.48	1.8 ±0.4	<0.05
24 hours	2.8 ± 0.7	4.9 ± 0.8	1.6 ± 0.2	<0.05
P value	>0.05	<0.05	<0.05	