



RESEARCH ARTICLE

ESTHETIC GINGIVAL DEPIGMENTATION BY CRYOSURGICAL THERAPY AND SURGICAL SCALPEL TECHNIQUE-A COMPARATIVE STUDY

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ABSTRACT

**Aim:** To clinically assess and compare cryosurgical therapy with tetrafluoroethane (TFE) and surgical scalpel technique in gingival melanin depigmentation.

Twenty periodontally healthy, esthetically inclined males and females, with black gums were included in the study. Split mouth design was carried out in anterior maxilla and for each subject; area extending from mesial surface of right central incisor to distal surface of right canine was designated as Group A and treated with cryosurgical therapy. Area from mesial surface of left central incisor to distal surface of left canine was designated as Group B and treated with surgical scalpel technique. Melanin index and Area of pigmentation evaluated with help of standardized images, recorded at day one, 30<sup>th</sup> day, 90<sup>th</sup> day and 180<sup>th</sup> day, postoperatively.

**Statistical Analysis:** Mann-Whitney U Test for intragroup and Wilcoxon Signed Ranks Test for intergroup comparison was used.

**Results:** Mean Melanin index score and Area of pigmentation (sq.mm) in Group A and Group B had decreased from day one - 30<sup>th</sup> day. Thereafter, there was an increase in repigmentation on 90<sup>th</sup> day and 180<sup>th</sup> day in both groups. On comparison, Group B showed a statistically significant decrease in repigmentation compared to Group A.

**Conclusion:** Both techniques were clinically efficient for gingival depigmentation from day one -30<sup>th</sup> day. All subjects were satisfied esthetically and did not report any pain or discomfort during or after procedure. Though repigmentation had occurred in both groups, extent was less in surgical scalpel technique, compared to cryosurgical therapy.

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INTRODUCTION

Today's esthetically inclined world has a special regard for a beautiful smile which is enhanced by a pleasing gingival color and contour (Arikan and Gürkan 2007). The color of gingiva and oral mucosa is influenced by natural pigments such as Melanin, Carotene, reduced Hemoglobin, and Oxyhemoglobin (Azzeh, 2007). Often an atypical deposition of melanin occurs in the gingiva which is fairly symmetric and enduring; however, the normal gingival architecture is left unaltered (Yeh 1998). Melanin pigmentation generating cells are called melanocytes which are of neural crest origin and confined to the basal and the suprabasal cell stratum of the epithelium.

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The level of gingival pigmentation depends on functional efficacy of melanocytes and may occur as a diffuse, deep-purplish discoloration or as irregularly shaped brown and light brown patches (Azzeh, 2007). Occurrence of Physiologic gingival melanin pigmentation has been noticed not only among dark populations but also in light skinned nationalities like the Middle East and ethnic groups native to East Asia. Pathologic pigmentation can be an outcome of endogenous or exogenous factors. The endogenous factors comprise of Addison's disease, Wilson's disease, Gaucher's disease, Von Reckling Hausen's disease, syndromes like Peutz-Jeghers and Albright's syndrome, pregnancy or other causes like Human immunodeficiency virus (HIV) infection, chronic pulmonary disease, hemochromatosis, thalassemia, hepatitis, melanoma, traumatic injuries and inflammation (Suthprasertporn 2007). The exogenous factors causing pigmentation are heavy metals like gold, silver, copper,

mercury bismuth, arsenic, lead or oral tattoos such as amalgam tattoo, graphite or intentional tattoos. Habits like smoking, tobacco, chewing nuts and certain drugs like anti-malarial medications, minocycline, ketoconazole, oral contraceptives may contribute unambiguously to oral pigmentation. These dark and unesthetic patches often coerce the beauty conscious individuals to seek dental help for their elimination (Atsawasuwan, Greethong and Nimmanon, 2007). Numerous procedures ranging from modest scalpel depigmentation to refined procedures like cryosurgery and electrosurgery have been employed for the same (Tal, Oelgiessr and Tal, 2003). Recently, Lasers have been used to ablate melanin containing cells, likewise, radiofrequency surgeries, where 4 MHz radio signals are being used for removal of the pigmented areas (Sherman, 2009). Despite excellent initial results, regardless of the method used, repigmentation is a general problem as it starts as a consequence of migrating melanocytes from free gingiva (Arikan and Gürkan, 2007). In order to find an enhanced approach for treating gingival pigmentation, a comparative analysis of cryosurgical method using tetrafluoroethane and surgical scalpel technique was undertaken in this study.

## MATERIALS AND METHODS

Twenty subjects with pigmented gingivae, with a Melanin index score-III and IV given by Hedin (1977) (Table/Fig 1), 18 to 36 years of age, males and females, were selected from the patient pool of our institution. Inclusion criteria were periodontally healthy subjects, complaining of "black gums" with degree III or IV pigmentation (Hedin 1977) in maxillary anterior region with adequate width of attached gingiva. Subjects with systemic diseases associated or not associated with gingival melanin pigmentation, those on medications that can cause gingival pigmentation, smokers, and those with history of pregnancy, breast feeding and intake of hormonal contraceptives were excluded from the study. Prior to the commencement, the purpose and the procedure of the study were explained to all the subjects and written informed consent was taken. Ethical approval was obtained from the Institutional Ethical committee, and the study was conducted according to the principles outlined in the Declaration of Helsinki on experimentation involving human subjects.

A split mouth design was carried out and the maxillary anterior arch was divided into two groups.

Group – A: The maxillary anterior arch was treated from mesial surface of right central incisor to the distal surface of the right canine with cryosurgical therapy.

Group – B: The maxillary anterior arch was treated from the distal surface of the left central incisor to the distal surface of left canine with surgical scalpel technique.

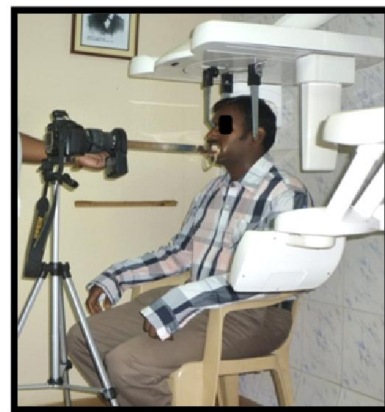
For all the selected cases digital images of pigmented gingiva and clinical parameters-Melanin Index and Areas of pigmentation (sq.mm) were recorded at baseline (day one), 30<sup>th</sup> day, 90<sup>th</sup> day and 180<sup>th</sup> day. Also, the total surface area of pigmentation was measured with the help of 4 standardized photographs of each subject, taken at the above time points, which was then calculated with help of an image analyzing

software. Photographs were standardized by obtaining digital photo images using digital camera (D-70S Nikon, 105 macrolens, 10 megapixels) mounted on a tripod (Table/Fig.2). The head of each patient was stabilized using a Lateral Cephalogram imaging unit (PlanmecaProMax) at a standard distance of 32 cms from the camera. This standardization was in accordance with the method used by Esen *et al.* (2004) and Arikan and Gürkan (2007). Images were analyzed using software (Adobe Photoshop CS5). Pigmented gingiva extending from the distal of the right canine to distal of the left canine in the maxillary arch was measured by drawing grid lines, which provided with squares of 1mm. By calculating the number of squares which had pigmentation the total surface area of pigmentation was measured. For convenience of observation, the squares were filled with two different colors. Blue squares indicated the cryosurgically treated area, whereas red squares indicated area treated with surgical scalpel method. (Table/ Fig-3)

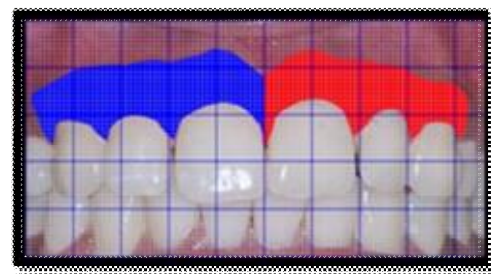
**Table/Fig-1.Melanin Index (Hedin 1977)**

<b>Degree I</b>	Pigmentation localized to the central part of one or two solitary interdental papillae.
<b>Degree II</b>	Pigmentation of more numerous solitary interdental papillae without formation of a continuous ribbon.
<b>Degree III</b>	Isolated pigmented areas had converged into short continuous ribbons.
<b>Degree IV</b>	Isolated pigmented areas had converged into one long continuous ribbon that included the greater part of the gingiva in front of the canines and incisors.

**Table/Fig2. Standardization of Photographs Digital Camera mounted on a tripod and positioned at a distance of 32cm from the subject**



■ Cryosurgical Therapy  
■ Surgical scalpel Technique



**Table/Fig-3.Evaluation of Area of Pigmentation (Sq.mm) using Grid**



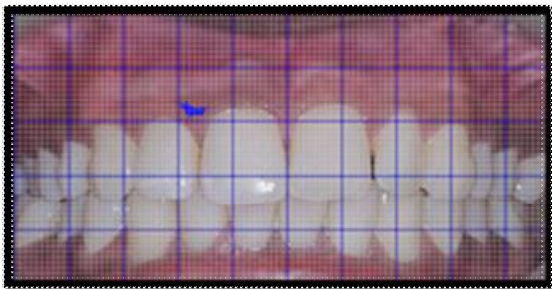
Table/Figure 4 -a. Gingival melanin pigmentation - day one (Pre-operative)



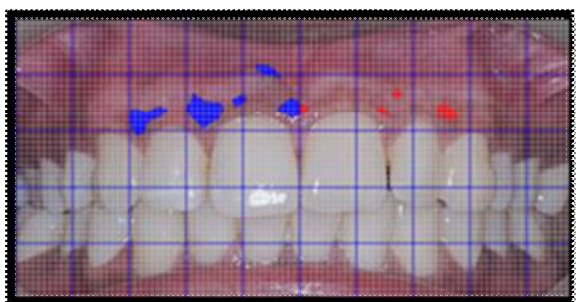
Table/Figure- 4 b. Right side - Cryosurgical therapy, (freeze Zone) Left side - Surgical scalpel technique



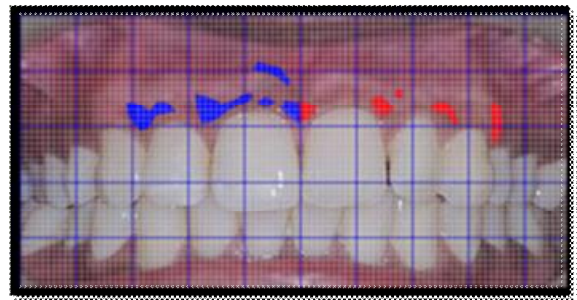
Table/Figure - 4 c. Immediate Post-operative



Table/Figure-5a. 30<sup>th</sup> day Post-operative



Table/Figure-5b. 90<sup>th</sup> day Post-operative



Table/Figure-5c. 180<sup>th</sup> day Post-operative

Table/Figure-6. Melanin Index Scores between Group A and Group B at Different Time Points

Time points	Group A (n=20) Mean ± S.D	Group B (n=20) Mean ± S.D	p - value
Day One	3.95 ± 0.224	3.90 ± 0.308	0.553 (N.S)
30 <sup>th</sup> day	0.20 ± 0.410	0.15 ± 0.366	0.681 (N.S)
90 <sup>th</sup> day	1.05 ± 0.605	0.55 ± 0.605	0.014 (S)
180 <sup>th</sup> day	2.20 ± 0.523	1.20 ± 0.523	<0.001 (S)

N.S-Non significant, S-Significant

Table/Figure-7. Area of Pigmentation (sq.mm) between Group A and Group B at Different Time Points

Time points	Group A (n=20) Mean ± S.D	Group B (n=20) Mean ± S.D	p - value
Day one	140.20±51.74	132.26±38.26	0.925(N.S)
30 <sup>th</sup> day	7.00±10.43	5.15±10.07	0.447 (N.S)
90 <sup>th</sup> day	49.30±11.846	14.05±10.797	< 0.001 (S)
180 <sup>th</sup> day	65.85±9.697	24.80±12.094	< 0.001 (S)

N.S-Non significant, S-Significant

Table/Figure-8. Melanin Index Score & Area of Pigmentation in Group A and Group B (Intragroup and Intergroup)

Time points	Group A (n=20)	Group B (n=20)	p-value
<b>Melanin Index Score</b>			
Day one – 180 <sup>th</sup> day	1.750 ± 0.638	2.700 ± 0.656	0.001 (S)
p - value	(<0.001)		(<0.001)
<b>Area of Melanin Pigmentation</b>			
Day one – 180 <sup>th</sup> day	73.60 ± 49.639	108.00 ± 35.397	0.015 (S)
p - value	(<0.001)		(<0.001)

N.S-Non significant, S-Significant

**Depigmentation Procedures:** Before undertaking any of the procedure all the subjects underwent scaling and oral hygiene instructions were given. Right side was chosen for cryosurgical depigmentation and the left for surgical scalpel technique. Both the procedures were done at the same appointment. (Table/Figure- 4 a)

**Cryosurgical technique:** Before cryosurgical application, the pigmented area was isolated and air dried. Topical anesthesia with 15 % Xylocaine spray was used to minimize uneasiness. Tetrafluoroethane (TFE) was sprayed on a cotton swab and immediately rolled gently over the pigmented area, starting from the midline (Table/Figure-4b). A freezing zone was continuously maintained for 30 to 40 seconds in each zone. This procedure was carried out until the entire zone was covered with overlapping applications. The subject was then

asked to rinse thoroughly. In the presence of any residual pigmentation, a reapplication of tetrafluoroethane was done one week post operatively to eliminate any residual pigmentation.

**Surgical scalpel technique:** Before starting the procedure the area to be operated was infiltrated with a local anesthetic agent (2% lignocaine with 1: 2,00,000 adrenaline). The gingiva was surgically de-epithelialized with Bard Parker blade No.15. All the perceptible pigmentation was removed by exposing the underlying soft connective tissue (**Table/Figure-4c**). The area was then irrigated with normal saline, bleeding was controlled by pressure pack and once hemostasis was achieved, the site was covered by periodontal dressing (Coe-pak™) for a minimum of 1 week. All subjects were prescribed ibuprofen (400 mg), to be taken 3 times a day for 3 days and post-operative instructions were given. Patients were recalled on 30th, 90th and 180th day, and standardized images as well as clinical parameters were recorded at all time points. Statistical analysis was done using software SPSS (16.0, version for windows). A non-parametric approach using Mann-Whitney U Test and Wilcoxon Signed Rank Test were carried out to analyze the data. Mean and Standard Deviation for all parameters were estimated at different time points and  $p < 0.05$  was considered as the level of significance.

## RESULTS

The purpose of this study was to compare the clinical effectiveness of cryosurgical therapy using tetrafluoro-ethane and scalpel surgical technique, for the treatment of gingival melanin pigmentation. Initially, from baseline (day one) up to 30th day, there was a reduction in the mean Melanin index score and mean Area of pigmentation (sq .mm) (**Table/Figure-5a**). But, thereafter, on 90th day (**Table/Figure-5b**) and at 180th day (**Table/Figure-5c**), there was an increase in mean Melanin index score and Areas of pigmentation (sq .mm). On day one (baseline), the mean melanin index scores for Group A and Group B were  $3.95 \pm 0.224$  and  $3.90 \pm 0.308$  respectively. On comparison the difference was not statistically significant ( $p' = 0.553$ ). On 180<sup>th</sup> day, statistically significant difference was observed ( $p' < 0.001$ ). Group B showed a significant decrease in melanin index score when compared to Group A. (**Table/Figure- 6**) On day one (baseline), the mean area of pigmentation (sq.mm) for Group A and Group B was  $140.20 \pm 51.745$  and  $132.260 \pm 38.260$  respectively. On comparison the difference was not statistically significant ( $p' = 0.925$ ). On 180<sup>th</sup> day a statistically significant difference was observed ( $p' < 0.001$ ). Group B showed a significant decrease in area of pigmentation when compared to Group A. (**Table/Figure- 7**) In the intragroup comparison a significant difference was observed in both melanin index scores ( $P < 0.001$ ) and the area of pigmentation ( $P < 0.001$ ). In the intergroup comparison the melanin index score was statistically significant ( $p' = 0.001$ ) and in the area of pigmentation also statistically significant difference was observed ( $p' = 0.015$ ). (**Table/Figure-8**)

## DISCUSSION

Oral pigmentation is due to the formation of a complex iron-free pigment, melanin, produced in specific cells called

melanoblasts, found in the basal layer of epidermis and mucous membrane. This type of pigmentation produced in mouth is known as melanoplakia and is observed in mucous membranes, hard and soft palates, tongue, floor of the mouth but is more obvious on the gingivae. Consequently, perpetual efforts have been made to free the gingivae of unappealing hyper pigmentation. Innumerable methods including use of chemical agents such as 90% phenol and 95% alcohol, cryosurgery, gingivectomy, gingivectomy with free gingival autograft, abrasion with diamond bur, electrosurgery, Nd:Yag laser, semiconductor diode laser and Co<sub>2</sub> laser have been used toward this end. There have been several reports on the cryosurgical treatment of a variety of lesions, but the first description of gingival depigmentation was given by Tal *et al.* (1987). A simple method for cryosurgical depigmentation of melanin pigmented gingiva was employed by Yeh (1998) using direct application of liquid nitrogen to the pigmented gingiva with cotton swab and maintaining freezing zone for 20-30 secs. However, liquid nitrogen posed problems like high volatility, and very difficult to maintain 20-30 seconds of freezing at each site, and thus entailing multiple applications.

Broad benefits of cryosurgery are trivial general disturbance and pleasant acceptance by patients, low rate of complication and fairly predictable volume of tissue destruction and therefore particularly suited to extensive superficial lesions. Repetition can be done as often as necessary. However, its use is restricted to surface lesions since depth of destruction is limited and mandates the use of surgical excision for deeper lesions. Tetrafluoroethane (TFE) (also known as HFC 134 a) is a gaseous fluorocarbon with a faint ether-like odour, colorless and non-inflammable gas. Several animal and human toxicology studies evaluating the safety of TFE are cited in literature. Exposure to TFE via short term inhalation and skin contact show no adverse effects on inhibition of pulse, blood pressure, electrocardiogram or lung function in healthy volunteers. In our study, no discomfort was reported by any of the subjects treated. Clinically, a slight erythema of gingiva was seen in the cryosurgically treated area. The treated gingiva required no periodontal packing, since there was no bleeding and the epithelium was found to be intact. However, the subjects complained of pain that lasted for two days, following cryosurgery. Clinically, after 1 week, the depigmented area appeared normal and "pink" in color. The gingiva appeared normal within 1-2 weeks. The surgical scalpel technique is simple, easy to perform, does not require any extensive armamentarium and offers optically pleasing outcomes. However, certain shortcomings such as unpleasant bleeding during and post operatively and difficulty in using the blade in the interdental areas and in case of a thin gingival biotype, inadvertent excision of marginal gingiva leading to post-operative recession has been reported by Kulloli *et al.* (2009). Also, it is necessary to cover the surgical site with periodontal dressing for a minimum of 7 -10 days. In the present study, the presence of residual pigmentation was diagnosed at 1 week postoperatively in two study subjects, and the procedure was repeated to eradicate any residual pigmentation as also indicated by a study by Arian and Gürkan (2007), where a single session of cryosurgical treatment was not adequate to eliminate pigmentation. If pigmentation persevered, it was probably because insufficient depth of destruction allowed



some melanoblasts to endure. Observations from our study reveal that initially, from day one up to 30<sup>th</sup> day, there was a reduction in the mean Melanin index score and mean Area of pigmentation (sq.mm). But, thereafter, on 90<sup>th</sup> day and at 180<sup>th</sup> day, there was an increase in mean Melanin index score and Areas of pigmentation (sq.mm). This clearly indicates that repigmentation had occurred at 90<sup>th</sup> day and 180<sup>th</sup> day in both the study groups A and B, however, in Group B, the extent of repigmentation was less as compared to Group A. The repigmentation that occurred was of varying moderation, in the form of very small spots, dots, and streaks of mild intensity as compared to the broad heavy bands seen preoperatively. Different studies have shown variation in the timing for early repigmentation. In the study done by Dummett and Bolden (1963) when using surgery to remove the pigmented area, repigmentation occurred in 67% of the areas, as early as 33 days after surgical removal. Ginwala *et al.* (1966), reported repigmentation in 50% of their cases between 24 and 55 days by surgical method. Prasad and Agrawal (2010) performed a scalpel surgery with bur abrasion in a 27 year old female and observed certain localized areas of repigmentation at the end of 1 month. Few studies have reported repigmentation after longer follow up periods, unlike our study, where author Bergamaschi *et al.* (1993), treated five white patients by gingivectomy for gingival pigmentation, out of which, two reached baseline pigmentation 1.5 years post-surgery, while three returned to baseline pigmentation by three years post-surgery. Mokeem (2006) treated three cases of gingival pigmentation by abrasion with a high speed hand piece and diamond bur and reported no repigmentation in 18 month follow up period, but in a similar technique, Farnoosh (1990), reported slight repigmentation in two cases in a corresponding follow up period. The cases treated by Shah (2012) using gingival slicing method, were followed for a period of maximum 30 months and no recurrence was observed. Whereas, in a study by Santosh Kumar *et al.* (2013) gingiva remained depigmented at the end of 2 years following depigmentation by bur abrasion. In our study in Group A, where subjects were treated with cryosurgery, repigmentation had occurred on 90<sup>th</sup> day. These results were dissimilar to the results observed by Tal, Landsberg and Kozlovsky (1987) when, using gas expansion probes for gingival melanin depigmentation reported no repigmentation up to a 20 -month follow up period. In a study by Arikan and Gürkan (2007), using TFE cryosurgery in 21 patients, reported no repigmentation up to a follow up period of 30 months. In the present study, both cryosurgical method and surgical scalpel technique were found to be clinically effective in the treatment of gingival melanin pigmentation. Though the clinical efficacy of gingival melanin depigmentation using surgical scalpel technique proved to be superior to cryosurgery, the patient acceptance of cryosurgery was greater, this may be due to the lack of need of infiltration anesthesia.

### Summary and Conclusion

The above observations conclude that both cryosurgical and surgical scalpel techniques were efficient in the reduction of gingival melanin pigmentation. Repigmentation occurred in both the groups at 90<sup>th</sup> day and further increased at 180<sup>th</sup> day, however, when both techniques were compared, the extent of

repigmentation was less in surgical scalpel technique as compared to cryosurgical therapy. The improvement in esthetics obtained from the above two procedures met with the expectations of the patients and also the treating surgeon. Limitations of the present study include small sample size and short term follow-up. Further studies with larger sample size and longer periods of clinical observations are required to assess the efficacy of the two techniques.

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