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A review on gingival depigmentation procedures and repigmentation

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Abstract

A beautiful smile surely enhances the individual's self-confidence. The harmony of smile is attributable to the shape, colour, and position of the teeth in conjunction with the gingival tissue. Gingival pigmentation occurs in all races of man and it varies from one race to another. Gingival hyperpigmentation usually occurs due to the abnormal accumulation of melanin in the gingival tissue and confers a dark appearance to the gingiva. Gingival hyper-pigmentation is removed by using different procedures of gingival depigmentation. Though the initial results of de-pigmentation procedures are highly encouraging, repigmentation is one of the common issue associated with them. This article aims at reviewing briefly about gingival depigmentation procedures and repigmentation.

Keywords: Pigmentation, gingival depigmentation, repigmentation, healing

Introduction

A beautiful smile surely enhances the individual's self-confidence. The harmony of smile is attributable to the shape, colour, and position of the teeth in conjunction with the gingival tissue [1]. Gingival health and appearance are essential components for an attractive smile and removal of unsightly pigmented gingiva is the need for a pleasant and confident smile [2].

Gingival colour is generally described as "coral pink". Gingival pigmentation is presented as a diffuse deep purplish discoloration or as irregularly shaped brown and light brown or black patches, striae or strands.³Melanin, carotene, reduced haemoglobin and oxy-haemoglobin are the prime pigments contributing to the normal colour of the gingiva, out of which melanin shows the maximum incidence rate.⁴ Excessive deposition of melanin located in the basal and supra-basal cell layers of the epithelium will result in gingival hyperpigmentation (Dummett, 1979) [5].

Gingival hyper-pigmentation is removed or reduced by using different techniques of gingival depigmentation. The first and foremost indication for depigmentation is patient demand for improved esthetics. Various depigmentation techniques have been employed, with similar results. Selection of a technique should be based on clinical experience and the individual's preferences [6].

Though the initial results of de-pigmentation procedure are highly encouraging, repigmentation is a common problem. The large variation in time of repigmentation may be related to the depigmentation procedure used and the race of the patient. The repigmentation is described as spontaneous and this process may be attributed to the fact that active melanocytes from the adjacent pigmented tissues migrate to the treated areas. The procedure however, is performed primarily for cosmetic reasons.

Gingival depigmentation procedures

Different procedures have been proposed for gingival depigmentation.

Roshni & Nandakumar in 2005 classified different gingival depigmentation methods as [9]

Methods used to remove the gingival pigmentation

Surgical methods

- a. Scalpel surgical technique
- b. Bur abrasion method

- c. Electro-surgery
- d. Cryosurgery
- e. Lasers
- f. Radiosurgery.

Chemical methods.

Methods used to mask the gingival pigmentation

- a. Free gingival graft.
- b. Acellular dermal matrix allograft.

Methods used to remove the gingival pigmentation

Advantages and disadvantages of each technique described in table no: 1

Surgical Methods

Scalpel surgical technique

It was one of the initial techniques described for gingival depigmentation and still it is the most popular treatment modality. In this technique, after achieving adequate local anesthesia, the pigmented gingival epithelium and a layer of the underlying connective tissue is surgically removed by splitting the epithelium with B.P blade no: 15 & 11. Due care is taken to not to leave any pigmented remnants over the denuded area. After adequate hemostasis, periodontal pack is needed. Healing is generally uneventful and complete epithelial healing is achieved in 7 to 14 days. Depigmentation allows the denuded connective tissue to heal by secondary intention. Thus new epithelium is formed without melanin pigmentation^[10].

Bur abrasion method

This involves de-epithelisation of pigmented areas of the gingiva by using high speed rotary instruments after giving adequate amount of local anesthesia. In this technique a medium grit football shaped diamond bur is used at high speeds to denude the epithelium with copious saline irrigation. Medium size round bur is used because small bur might produce small pits rather than surface abrasion. Pressure application should be minimal and feather light brushing strokes without holding the bur in one place are recommended. Extensive care is required to avoid over pitting of the gingival surface or removal of excessive tissue due to high speed^[11].

Removal of gingival melanin pigmentation should be performed cautiously and the adjacent teeth should be protected, since the inappropriate application may result in gingival recession, injury to underlying periosteum and bone, delayed wound healing, as well as enamel loss^[12].

Electro surgery

After achieving adequate local anesthesia, the desired diamond loop electrode is attached to the hand-piece. The hand-piece is held in a pen-like fashion and the tip of the electrode is swiftly moved over the pigmented tissue to be excised. Electrode is used in a light brushing stroke and the tip is kept in motion all the time. The contact time of the tip of the electrode with the tissue should be very brief. Keeping the tip in one place could lead to excessive heat buildup (Lateral-heat accumulation) and destruction of the tissues. After each use, the tip of the electrode is wiped on the rough surface of the saline-soaked gauze to remove all debris^[13].

Cryosurgery

In this technique a cryoprobe is attached to the liquid nitrogen spray gun. This technique does not require local anesthesia and can be performed after topical anesthesia. Water soluble

gel is applied over area of gingiva to increase the thermal conductivity. Expansion cryoprobe cooled to -81 °C is applied to the pigmented area for 10 seconds. Frozen site thaw spontaneously within 1 minute and mild erythema develops. Removal of pigments cannot be evaluated during procedure & thus requires a second sitting after about 5-7 days, during which the residual areas of pigmentation should be removed. Depth of penetration is difficult to control and prolonged freezing could cause excessive tissue destruction; precision is needed. Treated sites are covered by epithelium within 2 weeks following freezing and keratinization is completed after 3-4 weeks^[14].

Laser

Different types of lasers have been used for gingival depigmentation. It includes carbon dioxide (10.600 nm), diode (810 nm), Neodymium: Yttrium Aluminium garnet (1.064 nm) and Erbium: YAG (2.940 nm) lasers^[15].

Method

After application of topical anesthesia laser is used for depigmentation method. Depigmentation is done with light brushing strokes and the tip is kept in motion all the time. Remnants of the ablated tissue is removed using sterile gauze dampened with saline solution. This procedure is repeated until the desired depth of tissue removal is achieved. Then the wound is covered with periodontal pack. Recall after 1 week & 3 months^[16].

Radiosurgery

Radiosurgery is considered as the most advanced form of electro surgery. It includes the removal of soft tissue with the aid of radio frequency energy^[17].

Method

Touching the pigmented areas gently with the No. 135 ball shaped electrode or tapping the area with the No. 134 L-shaped electrode will result in depigmentation of the affected area. It is advised to touch the pigmented areas lightly with the electrode tip and remove the electrode as soon as the tissue around the electrode becomes whitish^[18].

Chemical agents (chemo exfoliation)

It is a treatment modality that destroys the epidermis and/or dermis using a chemical agent. A variety of chemical peeling agents are available; phenols, salicylic acid, glycolic acid, trichloroacetic acid, etc. These chemical agents have been classified into different types: Very superficial, superficial, medium depth and deep, based on their ability of penetration^[19].

90% phenol and 95% alcohol

Phenol penetrates the subepithelial connective tissue and result in necrosis or apoptosis of melanocytes. It will lead to incapacity of melanocytes to normally synthesize melanin. Phenol compromises melanocytic activity instead of destroying it.

The phenol pellet is applied and maintained for 1 min and the area needs to be rinsed with 99% alcohol. Eighty-eight to 90% phenol rapidly coagulates the epidermis thus decreasing its mucosal penetration^[20].

Advantages of chemo exfoliation includes ease of application and also anaesthesia is not required, but care must be taken not to contact other tissues as it causes undue effects. Transient or definite hypopigmentation is a feature of phenol

cauterizing. It can be repeated subsequently until satisfactory depigmentation is achieved. Phenol de-epithelization may be accompanied with inflammation of keratinocytes. Burning sensation remains for approximately one minute, followed by a transient period and pain returning after 10 min, with a lesser intensity that remains from minutes to hours [21].

Post-operative care should include gentle cleaning of the gingiva with saline and prescribed antibiotic regimen. Phenol may induce cardiac arrhythmia; hence, hydration before, during and after the procedure is suggested. Cardiac monitoring should be done, especially in patients with cardiac, liver or kidney disease [22].

Ascorbic Acid

Ascorbic acid has been used to treat melanin pigmentation. Shimada *et al.* in 2009 investigated the effects of ascorbic acid on melanin formation in B-16 mouse melanoma cells and three dimensional human skin models [23]. It was found that ascorbic acid significantly inhibited tyrosinase activity in both of the above. Moreover, a significant relative change in pigmentation was seen after four weeks with the application of ascorbic acid gel compared to the placebo [24].

Methods used to mask the gingival pigmentation

Free gingival grafts

Surgical procedure

Immediately before the surgical treatment, the patients are made to rinse their mouth with 0.2% chlorhexidine gluconate solution for one minute. The area subjected to surgery is anesthetized by infiltration anaesthesia, using local anaesthetic solution 2% xylocaine with 1:10,000 epinephrine.

Preparation of recipient site

Under all aseptic conditions, after giving local infiltration anaesthesia, a shallow horizontal incision is placed using Bard Parker Surgical blade number 15 over the mucogingival junction on the facial aspect maxilla. The incision is extended to the distal line angle of the canine on both left and right side. The recipient bed is prepared by excising the partial thickness flap of the gingiva from the mucogingival junction to the gingival margin in such a way that the underlying bone surface will remain covered with periosteum and part of the connective tissue [25].

Obtaining a free gingival graft from the donor site

Under aseptic conditions, after giving local infiltration anaesthesia, a free gingival graft is harvested from the unpigmented palate between the maxillary first molar and maxillary cuspid. A tin foil template is used on the recipient site to ensure adequate graft size. Using a Bard Parker surgical blade number 15, an incision is made in the palate parallel to the maxillary first molar and canine at a distance of approximately 3 mm apical to the gingival margin. A perpendicular incision is then made to establish the width of the graft for covering the entire area of the recipient site. A split thickness section of 1–2 mm graft was excised using Bard Parker Surgical blade number 15.

The graft is then placed in close contact with the recipient site and held in place by absorbable sutures. Immediately after surgery the sutured graft was covered with tin foil and periodontal dressing is placed on the recipient site and at the donor site [26].

Acellular dermal matrix allograft

Acellular dermal matrix allograft has been used to treat burn patients and patients with soft tissue defects. It is obtained

from human cadaver bone. After removal of cellular components, matrix constituents are preserved which are mainly type I Collagen and Elastin [27].

Surgical procedure

A horizontal sulcular incision should be given to reflect a partial thickness flap containing pigmented area. Reflected flap should be excised. After adequate hemostasis, the graft should be prepared according to the manufacturer's instructions and trimmed to fit the recipient site. The graft should be rehydrated and placed with the basement membrane side facing the oral cavity. Graft should be secured to adjacent attached gingiva with lateral bio-absorbable sutures. The area should be firmly compressed with moist gauze for 5 min to adapt the tissue to surgical site. This procedure is successfully applied in the elimination or greater reduction of gingival melanin pigmentations, and is more effective than epithelium abrasion after 12 months [28].

Repigmentation

The reappearance of melanin pigment after a period of clinical depigmentation is called as repigmentation. Repigmentation may be related to the technique used in depigmentation procedure and the race of the patient. The mechanism of re-pigmentation is explained by migration theory, according to this theory active melanocytes from the adjacent pigmented tissues migrate to treated areas, causing re-pigmentation [29].

Re-pigmentation may also be attributed to the melanocytes which are left during surgery as stated by Ginwalla *et al.* These may become activated and start synthesizing melanin. Ginwalla reported re-pigmentation in 50% of their cases between 24 and 55 days [30].

Dummett and Bolden operated pigmented gingiva by gingivectomy procedure in 9 cases. Re-pigmentation occurred in 67% of the areas, as early as 33 days after surgical removal. Perlmutter and Tal have also reported gingival repigmentation that occurred 7 years after the gingival depigmentation in one patient. Tal *et al.* and Tal did not observe re-pigmentation until 20 months after cryosurgical depigmentation [31].

Re-pigmentation was not occurred in any of the four patients treated by Atsawasuwan *et al.* within one year after the gingival depigmentation using Nd: YAG laser. Nakamura *et al.* described gingival depigmentation by using CO₂ laser in ten patients. No re-pigmentation was noticed in the first year, but four patients showed re-pigmentation at two years. Tal *et al.* observed no re-pigmentation occurring in any of the patients with Er: YAG laser after 6 months [32].

The pattern of recurrence in all the cases with re-pigmentation was patchy in distribution and due to its mild intensity the results can be considered to be satisfying for the patients [33].

Recurrence can be prevented by the entire removal of melanin including free gingiva and interdental papilla since repigmentation starts as a result of migrating melanocytes from free gingiva. Adequate tissue removal may not be possible at the marginal gingiva and interdental papilla region due to close proximity of the adjacent teeth [34].

Healing Following Depigmentation of Gingiva

Healing after surgical depigmentation

After surgery it is found necessary to cover the exposed lamina propria with periodontal packs for 7 to 10 days. After 6 weeks the attached gingiva regenerated by only a delicate scar. The newly formed gingiva is clinically non-pigmented [35].

Healing following cryosurgical depigmentation

At second to third day superficial necrosis becomes apparent and a whitish slough could be separated from the underlying tissue, leaving a clean pink surface. In one to two weeks normal gingiva is formed. In 3-4 weeks: keratinization completed. No postoperative pain, hemorrhage, infection or scarring seen in these patients [36].

Healing following depigmentation by laser

During lasing, gingiva gets covered with a yellowish layer that could be easily removed by a wet gauze. After 1-2 weeks re-epithelization is completed. At fourth week gingiva is similar to normal untreated gingiva i.e., complete absence of melanin pigmentation [37].

Healing after electro surgery

Clot formation occurs after the surgery and underlying tissue become acutely inflamed with some necrosis. Then the clot is replaced by granulation tissue. After 24 hours there is increase in new connective tissue cells mainly angioblasts. By third

day numerous young fibroblasts also reached in the area. Highly vascular granulation tissue grows coronally creating a new marginal gingiva. Simultaneously after 12-24 hours epithelial cells at the margins start to migrate over the granulation tissues separating it from clot. Surface epithelialization is generally complete after 5-14 days [38].

Healing following depigmentation by free gingival grafts

Immediately after placement of the free gingival graft a fibrin clot forms between graft and the underlying tissue. This medium transports nutrients from the recipient area to connective tissue of the graft. Re epithelization occurs during the second half of the first post-operative week with cells originating from lateral wound margins of epithelial ridges within the graft itself. By third day connective tissue proliferation begins and by the end of the first week a tenuous fibrous attachment between the graft and the recipient is established. By 14th day the epithelium presents a near normal histologic thickness [39].

Table 1: Represents the history, advantages and disadvantages of various depigmentation procedures.

Technique	History	Advantages	Disadvantages
Scalpel surgical technique [40, 42]	First illustrated by Dummet and Bolden in 1963	Simple, easy to perform, noninvasive, cost effective, does not require any extensive armamentarium and faster healing	Causes unpleasant bleeding during and after the operation, more chances of infection in scalpel surgery
Bur abrasion method [43, 44]	The first documented case using this technique was reported by Ginwalla <i>et al</i> in 1966.	It is relatively simple, safe, non-aggressive method, shows less discomfort, easy to perform, can be readily repeated, does not require any sophisticated equipment and it is economical.	The procedure requires 45 min to 1hour for completion. It is difficult to control the depth of de-epithelialization. Moreover, bleeding and post-operative pain are anticipated.
Electro surgery [45, 46]	The first documented case report using electro surgery for de-pigmentation was by Ginwalla <i>et al</i> in 1966	It was found that this method controls hemorrhage, permits adequate contouring of tissues, causes less discomfort to patient, less scar formation and lesser chair time.	Requires more expertise than scalpel surgery. Prolonged or repeated application of current to tissue induces heat accumulation and undesired tissue destruction. This technique is uncomfortable to patients due to foul odor
Cryosurgery [47, 48]	First cryosurgical depigmentation was documented by Tal <i>et al</i> in 1987.	Easy and rapid to apply. Does not need anesthesia or suturing. It does not cause any bleeding or scars	Depth control is difficult, and optimal duration of freezing is not known. Prolonged freezing increases tissue destruction. Expensive specialized equipment is required. Cryosurgery is followed by considerable swelling and increased soft tissue destruction
Laser [49, 50]	Trelles <i>et al</i> , (1992) were the first to treat patients with gingival pigmentation by Argon laser	Dry and bloodless surgery Instant sterilization of surgical field Reduced bacteremia Reduced mechanical trauma Minimal post-operative swelling and scarring Minimal post-operative pain	Epithelial regeneration is delayed. Treatment is very expensive. Loss of tactile feedback while using lasers. Gingival fenestration and bone exposure may occur. More time is required for the healing of the periodontal tissues.
Radiosurgery [51, 52]	Drs. Arikian and Gurkan have reported on numerous cases of gingival depigmentation using radiosurgery	The main advantage of radiosurgery is its ability to produce coagulation. Patients are less apprehensive due to the lack of bleeding. It makes a pressure less incision. It is self-sterilizing and produces a sterilized cut. Some hand pieces and electrodes can be autoclaved. It produces little or no scar tissue. It requires hand support and finger rest. It eliminates bleeding or hemorrhage; there is better visibility. It is small in size; maintenance and repair are readily available.	It requires at least two sittings within 2 weeks for completion of treatment. Cannot be used on patients with poorly shielded pacemakers. Cannot be used near inflammable gases. This technique is uncomfortable to patients due to foul odor. The initial cost of the equipment is far greater than the cost of a scalpel.
Free gingival graft [53, 54]	Tamizi M and Taheri M in 1996 documented the treatment of physiologic gingival pigmentation with free gingival autografts	More esthetic results. Less recurrence rate.	This technique required the use of additional surgical sites with added discomfort. Healing is slow and painful. The amount of tissue available in the donor area is limited. Furthermore, the presence of a demarcated line commonly observed around the graft in the recipient site may itself pose an esthetic problem
Acellular dermal matrix allograft [55, 56]	Novaes AB Jr <i>et al</i> in 2002 demonstrated the use of acellular dermal matrix allograft for the elimination	Reduced surgical time compared with free gingival graft (due to elimination of the surgical procedure for donor tissue) Decreased postoperative complications Unlimited amount	It is expensive and requires clinical expertise. Possibility of graft contraction

	of gingival melanin pigmentation	of graft material A predictable and satisfactory esthetic result. one surgical site and less post operative discomfort	
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5. Conclusion

Cosmetic expectations have increased with time and nowadays patients are more concerned with gingival esthetics and smile designing. Gingival pigmentation especially on the labial aspect of anterior teeth has become an important component of esthetics. Pigmentation has multifactorial etiology. Most of the pigmentation is physiologic but sometimes it can be a precursor of systemic diseases. Gingival hyperpigmentation are major concerns for a large number of patients visiting the dentist. Melanin hyperpigmentation commonly does not present a medical problem, but patients usually complain of dark gums as unaesthetic. Oral melanin pigmentation can be eliminated by a variety of surgical techniques. Including free gingival grafts and soft tissue allografts and de-epithelialization by bur abrasion, scalpel, laser and cryosurgery.

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