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Review Article

# Depigmentation: A demystifying approach from black to pink

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ABSTRACT

Pigmentation of gingiva not just hampers esthetic appearance but also effects the psychological status of an individual. Although there are wide variety of depigmentation techniques available, there is still a great deal of opinion to choose the appropriate technique. Hence, the aim of this review is to understand the process of pigmentation and its therapeutic modalities so that we can avoid re-pigmentation to the minimal degree possible.



## 1. Introduction

The synchronization of the smile is summarized not only by the shape, color, and position of the teeth but also by the gingival tissues.[1] Cosmetic expectations concerning facial aesthetics have increased with time and current trends speaks volumes about gingival aesthetics and smile designing as an approach to enhance the personality and appearance of an individual.[2] The colour of the gingiva plays a key role in the aesthetics of the patient.[3] The normal physiologic colour of gingiva is coral pink or salmon pink with variations in the amount of gingival melanin pigmentation. Gingival pigmentation particularly on the labial surface of anterior teeth has plays an integral component of general aesthetics of an individual.[2]

Gingival pigmentation is defined as the discolouration of the gingiva due to extrinsic and intrinsic causes. Melanin is the commonest implicated pigment in the oral cavity. It is a non-haemoglobin derived brown pigment produced by melanocytes and is also a powerful cation chelator. Melanocytes are dendritic cells originating from neuroectoderm. They are self-regulating cells and work as unicellular exocrine gland, converting tyrosine into melanin which is transferred to keratinocytes by melanosomes. Thus, melanin is accumulated in the basal layers of the epidermis and eventually becomes visible on the surface.

Numerous attempts have been made to classify gingival melanin pigmentation. Broadly lesions have been classified as physiologic pigmentation which is because of greater melanocyte activity and pathologic pigmentation which is because of several causes including endocrine disorders, heavy metal, malignancies, so on.[2]

## 2. Classification of Gingival Pigmentation

According to the extent of involvement:

### 2.1. *Localized pigmentations*

Amalgam tattoo, graphite or other tattoos, nevus, malignant melanoma, Kaposi's sarcoma, melanoacanthoma, epithelioid ligomatosis, melanotic macules, verruciform xanthoma.

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### 2.2. Multiple or Generalized Pigmentations

1. **Genetics:** Idiopathic melanin pigmentation (racial or physiologic pigmentation), Peutz-Jegher's syndrome, Laugier-Hunziker syndrome, complex of myxozomas, spotty pigmentation, endocrine overactivity, Carney syndrome, Leopard syndrome, and lentiginosis profuse
2. **Drugs:** Smoking, betel, anti-malarials, antimicrobials, minocycline, amiodarone, clorpromazine, ACTH, zidovudine, ketoconazole, methyldopa, busulphan, menthol, contraceptive pills, and heavy metals exposure (gold, bismuth, mercury, silver, lead, copper)
3. Endocrine: Addison's disease, Albright's syndrome, Acanthosis nigricans, pregnancy, hyperthyroidism
4. Post inflammatory: Periodontal disease, postsurgical gingival repigmentation
5. **Others:** Generalized neurofibromatosis, incontinentipigmenti, Gaucher's disease, Whipple's disease, Wilson's disease, HIV disease, thalassemia, pigmented gingival cyst, Haemochromatosis, and nutritional deficiencies.[4,5]

Of all these, the most commonly observed pigment in oral mucosa is gingival melanin pigmentation. Studies suggest that the process of melanin pigmentation is similar in skin and oral pigmentation.[6]

### 2.3. Process of pigmentation

According to the current nomenclature, melanocytes are dendritic cells, found in the basal and spinous layers of the gingival epithelium. They synthesize melanin in organelles called melanosomes. Melanophages or melanophores are cells that phagocytose melanin granules.[7] The process of pigmentation consists of three phases:[8]

1. **Activation of melanocyte**
2. **Synthesis of melanin**
3. **Expression of melanin**

(a) The **activation phase** occurs after the melanocytes are stimulated by stress hormones, sunlight etc. producing chemical messengers like melanocyte stimulating hormone.[4]

(b) In **synthesis phase**, melanocytes prepare granules called melanosomes. This process starts when the enzyme tyrosinase converts amino acid tyrosine into a molecule called dihydroxy phenylalanine (DOPA). Tyrosinase converts DOPA into secondary chemical dopaquinone. After these reactions, dopaquinone is converted into dark melanin (eumelanin) or light melanin (pheo-melanin).[4]

**Synthesis of melanin:** Starting with the amino-acid tyrosine, the enzyme tyrosinase, is a essential requirement and the successive steps in the production of melanin are as follows:

Tyrosine → Dopa → Dopa-quinone
↓
Dihydroxy-indole ← Dopa-chrome ← Leuco-dopa-chrome
↓
Indole 5, 6- quinone → Melanochrome → Melanin.

Dopaquinone is produced as the immediate product, when tyrosine is oxidized by tyrosinase. In the absence of cysteine, dopaquinone undergoes the intramolecular addition of the amino group giving leucodopachrome.

The redox exchange between leukodopachrome and dopaquinone gives dopachrome. Dopachrome gradually decomposes to give mostly 5,6- dihydroxyindole (DHI), and to a lesser extent DHI-2-Carboxylic acid (DHICA). This latter process is catalyzed by tyrosinase-related protein-2, now known as dopachrometautomerase. Finally, these DHI are oxidized to eumelanin. tyrosinase-related protein-1 is believed to catalyze the oxidation of DHICA to eumelanin.

On the other hand, in the presence of cysteine, dopaquinone rapidly reacts with cysteine to give 5-S-cysteinyldopa and to a lesser extent 2-scysteinyldopa. Cysteinyldopas are then oxidized to give benzothiazine intermediates and finally to produce pheomelanin.[9]

## 3. Gingival Depigmentation

Melanin hyperpigmentation does not usually present as a medical problem, but patients may complain about their compromised aesthetic appearance due to black gums. This problem is more pronounced in patients with a gummy smile or excessive gingival display. Depigmentation is a periodontal plastic surgical procedure. The gingival hyperpigmentation is removed/reduced or masked by various techniques.

Various techniques have been employed with similar results. The selection of a technique should be based on clinical experience and individual preference.[10]

### 3.1. Different techniques employed

**Roshni and Nandakumari[11] i**n 2005 classified different gingival depigmentation methods as:

Methods aimed at removing the pigment layer

1. Surgical methods of depigmentation
   (a) Scalpel surgical technique:
      i. Slicing, or partial thickness flap technique
      ii. Bone Denudation
      iii. Abrasion
      iv. Scraping
      v. Gingivectomy
   (b) Cryosurgery

(c) Electrosurgery
(d) Radiosurgery
(e) Lasers

2. Chemical method of depigmentation using caustic chemicals, e g 90% phenol[10]

Methods aimed at masking the pigmented gingiva with grafts from less pigmented areas.

(a) Free gingival grafts (FGG
(b) Acellular dermal matrix allografts[10]

## 4. Methods aimed at removing the pigment layer

### *4.1. Surgical methods of depigmentation*

#### *4.1.1. Scalpel surgical technique*

4.1.1.1. Slicing or partial thickness flap technique:. In this technique, under local anesthetic infiltration, two incisions are given extending from the gingival margin to the vestibular area, a little beyond the limits of the pigmented band. These vertical incisions demarcate the surgical area. A no.11 or 15 BP blade is held parallel to the gingival surface, the epithelium and a portion of the connective tissue is gently dissected out from one end of the vertical incision. (Figure 1)

Scalpel surgical technique is highly recommended in consideration of the equipment constrains in developing countries. It is simple, easy to perform, cost effective and above all with minimum discomfort and esthetically acceptable to patient. This technique is contraindicated in thin gingival areas, as removal of pigmented gingival epithelium may lead to gingival recession.[10]

4.1.1.2. Bone denudation technique. Under local anaesthesia, two vertical incisions are placed, each extending from the gingival margin to the vestibular area, a little beyond the limits. Then the papillae are split into labial and lingual halves with B.P. blades. A horizontal incision is then made into the vestibule, apical to the pigmented band, connecting the two vertical incisions. With a periosteal elevator, the tissue along with the periosteum is gently separated from the underlying alveolar bone and is removed en mass entirely exposing the subjacent alveolar bone.[12]

4.1.1.3. Abrasion technique. The first documented case using this technique was reported by Ginwalla et al in 1966. It is a relatively simple and versatile technique and requires minimum time and effort. Technique involves de-epithelisation of pigmented areas of the gingiva by using high speed rotary instruments after adequate local anesthesia. A large surgical (round, straight or tapered) bur with copious saline irrigation is used. It involves removing the epithelium of the pigmented areas with a high-speed hand piece. 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 overpitting of the gingival surface or removal of excessive tissue due to high speed. The crudeness of the procedure and not of spatter and aerosol limits the use this procedure. It is recommended to use larger size diamond bur because smaller burs do not smoothen the surface easily and has a tendency to make small pits in the area to be corrected.[10](Figure 2)

4.1.1.4. Scraping technique. After infiltrating the area with local anesthesia No.15 or 11 B.P. blade with handle is used to scrape the epithelium with underlying pigmented layer carefully. The raw surface is irrigated, cleaned and dressing is given for 1 week.[13]

4.1.1.5. Gingivectomy technique. Dummett and Bolden in 1963 used gingivectomy to remove pigmented gingiva. Incisions were made to remove clinically pigmented tissue as much as possible and surgical pack was placed. They concluded that gingival respective procedures, if performed solely for cosmetic reasons, offer no permanent results. This procedure resulted with prolonged healing by secondary intention, excessive pain and discomfort caused by exposure of the underlining bone. It also results in non-permanent depigmentation.[14]

#### *4.1.2. Cryosurgical treatment of melanin-pigmented gingiva*

It is the application of extreme cold to destroy abnormal or diseased tissue. Allington was the first to use liquid nitrogen in the year 1950. It is a non-scarring, suture less and a dressing free method with no bleeding and causes minimum damage to surrounding tissue. The melanin is found in surrounding basal keratinocytes and subjacent macrophages, and destruction of subjacent cells is sufficient for depigmentation. Minimum temperature needed for cell damage is cell specific and melanocytes are very sensitive to low temperatures at -4 C to -7 C where cell death can occur. Superficial gingival cryosurgery has demonstrated healing by complete regeneration. In this method, topical anaesthesia with 4% xylocaine spray was used to minimize discomfort for 1-2 minutes. A swab, 5 mm in diameter, is gently rolled forward and backward across 1 cm of the affected area. The method used for treatment is direct application of liquid N2 (-196oC) with a cotton swab to the pigmented area with freezing being maintained for 20-30 seconds in each area. A colourless non chlorofluorocarbon, non-inflammable gas 1,1,1,2 tetrafluoroethene is another frequently used gas which serves as an inexpensive, easy to use, store and transport cryosurgery agent. A second course of cryosurgical treatment is usually needed after 1week to remove any residual pigmentation.[15] Slight erythema of gingiva develops immediately after the cryosurgery. During the next 2 to 3 days, superficial necrosis becomes apparent and a whitish slough could be separated from the

underlying tissue, leaving a clean pink surface. The gingiva appears normal within 1 to 2 weeks, and keratinization is completed in 3 to 4 weeks after the treatment.[16] Cryosurgical procedure of depigmentation is complicated by the necessity of providing special containers for liquid nitrogen saving and the requirement for fast (20 – 30 sec) application. There is also difficult control of penetration and risk for excessive tissue destruction after prolonged freezing.[17,18]

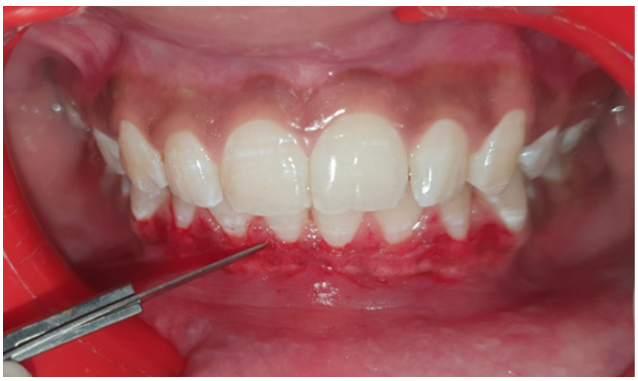

**Fig. 1:** Slicing or partial thickness flap technique

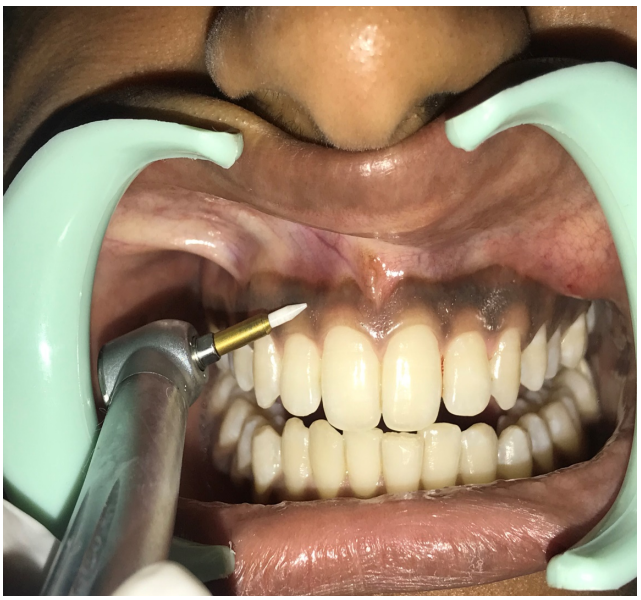

**Fig. 2:** Abrasion technique

*4.1.3. Electrosurgery*

Electro-surgery is the use of high frequency electrical energy in the radio transmission frequency band, applied directly to tissue to induce histological effects. As the current passes, the impedance to the passage of current though the tissue generates heat, which boils the tissue water, creating steam, resulting in either cutting or coagulation of tissue.[10] It is found that this method controls haemorrhage, permits adequate contouring of tissues, causes less discomfort to patient, less scar formation and lesser chair time. Electro-surgeryrequires more expertise than scalpel surgery.

Prolonged or repeated application of current to tissues induces heat accumulation and undesired tissue destruction. Contact with periosteum or alveolar bone and vital teeth should be avoided.[19]

*4.1.4. Radiosurgery*

Radiosurgery describes the most advanced form of electrosurgery. It is the removal of soft tissue with the aid of radio frequency energy.[20] This electromagnetic energy operates between the frequencies of 3.0 MHz (MHz) to 4.0 MHz, with 4.0 MHz being the optimal frequency. The main advantage of radiosurgery is its ability to produce coagulation in the operative area which would often have extensive bleeding. Also, some studies reported less thermal damage and faster healing with the 4.0 MHz radio wave technology over the scalpel and lasers. Radiosurgery produces a fine micro-smooth incision with no overt lateral heat being sent to the surrounding tissues. On the other hand, the main disadvantage of this method is that it is expensive and requires at least two sittings for completion within 2 weeks of treatment.[21,22]

*4.1.5. Laser*

It is an acronym for light amplification by stimulated emission of radiation. Lasers used for depigmentation include:[23]

1. CO2
2. Diode
3. Er:YAG
4. Er,Cr:YSGG
5. Nd:YAG

Laser ablation of gingival depigmentation has been recognized as one of the effective, pleasant and reliable techniques. It is usually sufficient to eliminate the pigmented areas and do not require any periodontal dressing. It also shows reduced pain and discomfort due to formation of protein coagulum. It allows clean and dry operating field and stable results. Laser light may also seal free nerve endings.

*4.2. Mechanism of action of lasers*

Generally, lasers utilize an optical cavity with, an enclosed (active) medium and a pumping source. The active medium is in inactive state initially, reaching an excited state when it is pumped by the pumping source. For efficient laser activity, the lasing medium is pumped by intense flashes of light and electrical discharges, which creates a collection of

atoms in an excited state. It can be in the form of a gas or a solid depending on the active lasing medium used (Figure 2). In dentistry, currently popular active mediums are argon and CO2 in the case of gas media and with a garnet crystal of yttrium and aluminium, known as YAG lasers, used in the case of a solid medium.[24]

### *4.3. Laser treatment for gingival hyperpigmentation*

Laser ablation with specified wavelength and diameter was used in contact mode from the mucogingival junction towards the free gingival margin, including the papillae in overlapping circles over the entire area of hyperpigmentation. A white fibrin slough was seen after 24 hours in the patients due to the formation of a thick coagulation layer (biological wound dressing) on the treated surface produced by the "hot tip" of the diode laser fibre-optic. This is characterized as a laser wound, which eventually heals.[25,26](Figure 3)

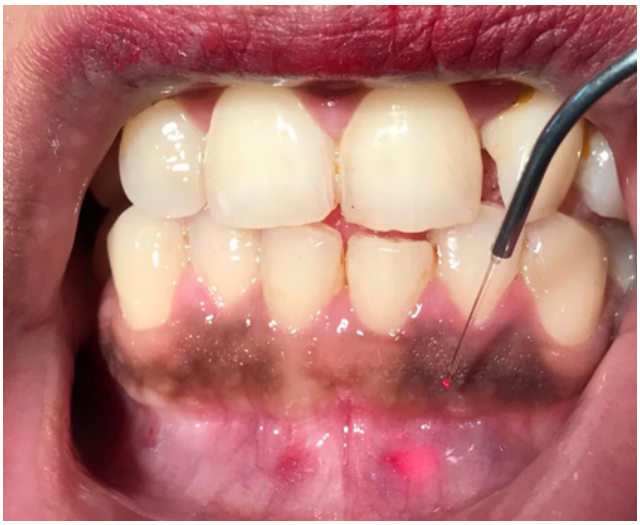

**Fig. 3:** LASER technique

### *4.4. Chemical method of depigmentation*

Hirschfeld and Hirschfeld[13] used phenol (90%) and alcohol (95%) to remove area of pigmentation in oral cavity. In this, the area to be depigmented is isolated using cotton rolls and dried using cotton or air.

A small pellet of cotton, grasped with cotton pliers is dipped in 90% phenol and lightly blotted, and then applied carefully to pigmented area. After 20 seconds, phenol is neutralized with 95% alcohol and patient then rinses with water. The area is dried and the procedure is repeated. The cauterized tissue sloughs off within 24 hours and heals completely within a week to 10 days.[27]

The disadvantages of this procedure are the use of chemicals which may be harmful to oral tissues, heavy bands of pigmented gingiva are difficult to remove and depth of action of chemicals is not controlled.[28]

### *4.5. **Repigmentation***

Repigmentation of the gingiva following depigmentation is a common finding and has been reported to occur as early as 24 hours to a variation of 8 years. It has been seen that permanent results cannot be offered when gingival depigmentation procedures are performed for cosmetic reasons. The main reasons for repigmentation include the migration and activity of melanocytic cells from the surrounding areas or the melanocytes which are left during surgery which may become activated and start synthesizing melanin again.[6]

## 5. Methods aimed at masking the pigmented gingiva with grafts from less pigmented areas.

### *5.1. Free gingival autograft:*

Free gingival grafts are used to create a widened zone of attached gingiva and in root coverage procedures and can also be used as a method to mask the area of pigmented gingiva.[29]

#### *5.1.1. Procedure*

**Preparation of the recipient site:** After application of local anaesthesia in the area of gingival melanin pigmentation, the recipient bed is prepared in the such a way that the bony surface would remain covered with periosteum and thin connective tissue (partial thickness dissection) or the periosteum, connective tissue, and epithelium are completely removed (full-thickness bed preparation).

**Donor site:** The autogenous gingival graft is obtained from the unpigmented area of the palate. A number 15 scalpel is used to elevate a split thickness section of a 1 to 2 mm thick graft. The graft is placed in close contact with the recipient site and held in place by simple sutures of 4-0 silk. Sutures were removed after 1week.[10,30]

### *5.2. Acellular dermal matrix allograft:*

After local anesthesia administration, two vertical incisions are performed on the nonpigmented tissue both mesial and distal to the pigmented area using a #15 scalpel blade. A horizontal sulcular incision is needed to reflect a partial thickness flap containing pigmented area and the reflected flap should be excised. The graft is trimmed to fit the recipient site and secured to adjacent attached gingiva with sutures.

This method has been successfully used in the elimination or greater reduction of gingival melanin pigmentations and was found to be more efficient than epithelium abrasion after 12 months.[25]

## 6. Conclusion

The colour of the gingiva plays an important role in overall aesthetics of an individual. Gingival pigmentation has intrigued clinicians and researchers alike owing to its numerous etiologies of origin and the difficulties faced in its absolute elimination. The guiding principle for depigmentation treatment is the patient's concern with respect to his/her cosmetic appearance techniques used to carry out the depigmentation procedure. More emphasis has to be made on the review of literate of depigmentation of gingiva in order to understand the process of pigmentation and choose better method to remove it.

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## 8. Conflict of Interest

The authors declare no potential conflicts of interest concerning the authorship and publication of this article.

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