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Comparing Traditional and laser methods for gingival Depigmentation

A Project Submitted to
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By

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CERTIFICATION OF THE SUPERVISOR

I certify that this project entitled "Comparing Traditional and laser methods for gingival Depigmentation" was prepared by Maryam Habib Jaheel Alaa Mohammed Jassim, Adyan Faisal Ali, Duaa Ghanim Abdulwahid under my supervision at the College Of Dentistry/University of Alzahrawi in partial fulfilment of the graduation requirements for the Bachelor degree in dentistry.

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بِسْمِ ٱللَّهِ ٱلرَّحْمَـٰنِ ٱلرَّحِيمِ

﴿وَأَمَّا بِنِعْمَةِ رَبِّكَ فَحَدِّثْ﴾

بسم الله الذي لا يتمّ فضلٌ إلا بحمده، ولا يُنال توفيقٌ إلا بكرمه.
إلى نوري ومُلهمي، سيد الشهداء الإمام الحسين (عليه السلام)، الذي علّمني معنى الثبات والصبر في درب الحق،
إلى أمي وأبي، شكرًا بحجم السماء، ودعاء لا ينقطع أبدًا.

إلى دكاترتي الأفاضل، الذين علّموني بحب، وأرشدوني بصدق، فلكم في القلب دعاء لا يفتر.

إلى أخواتي أصدقائي الذين خفّفوا عني ثقل الطريق، وشاركوا خطواتي وهمومي، جزاكم الله كل الخير.

إلى كل روح طيبة كانت سببًا في وصولي لهذا اليوم..
أهديكم ثمرة تعبي، راجيةً من الله أن يجعلها علمًا نافعًا، وعملاً متقبلاً، وخطوة أولى في طريقٍ يُرضي الله وأهل البيت (عليهم السلام)

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Abstract

Gingival depigmentation is a cosmetic periodontal procedure aimed at reducing or eliminating hyperpigmentation of the gingiva, often caused by factors such as smoking or genetic predisposition. This study compares two prevalent methods for gingival depigmentation: traditional surgical techniques and modern laser-assisted approaches. Traditional methods, including scalpel excision , have been widely used but may result in longer recovery times and increased discomfort. In contrast, laser techniques, such as the use of diode lasers, promise enhanced precision, reduced bleeding, and quicker healing. This comparative analysis evaluates the efficacy, safety, patient satisfaction, and postoperative outcomes associated with each method. A cohort of patients undergoing both procedures was assessed using clinical measurements and patient-reported outcomes. Results indicate that while both methods effectively reduce gingival pigmentation, laser techniques demonstrate superior outcomes in terms of recovery time, patient comfort, and aesthetiuc results. These findings suggest that laser depigmentation may be the preferred choice for clinicians and patients seeking effective and minimally invasive treatment options for gingival hyperpigmentation. Further research is warranted to establish long-term outcomes and refine procedural protocols.

Introduction

Aesthetics play a crucial role in enhancing self-confidence in daily activities such as laughing, smiling, and interacting with others. Among the key structures in the oral cavity that may sometimes need cosmetic enhancement is the gingiva. **(Sedeh SA et al.,2014)**

Gingival hyperpigmentation refers to a heightened level of pigmentation in the oral mucosa that exceeds what is typically expected. This condition can result from various physiological or pathological factors. many pigments including melanin, carotene, reduced hemoglobin, melanoid, and oxyhemoglobin, are frequently linked to gingival pigmentation, however melanin is the most common pigment associated with gingival pigmentation**(Bhardwaj A al.,2012)**

melanocyte cells are produce melanin , which are found in the basal layer of the epidermis and excessive melanin deposition can result in gingival hyperpigmentation **(Kusakcİ Seker B. al.,2017)**

Gingival hyperpigmentation is more noticeable in Caucasian and darker-skinned individuals and manifests as a dark or brown discolored region of diffuse or isolated units with distinct borders, particularly in the labial side of gingiva

Those individuals and those with fair skin have the same number of melanocytes; the only distinction is in the activity of those melanocytes. Gingival hyperpigmentation may be brought on by genetics, endocrine disorders, inflammation, smoking, heavy metals, and some drugs. **(Butchibabu KR.2014).** These individuals have the same number of melanocytes as those with fair skin, but their activity varies. Possible reasons of gingival hyperpigmentation include genetics, endocrine disorders, inflammation, smoking, heavy metals, and certain drugs. **(Kusakcİ Seker B. al.,2017)**

Gingival depigmentation is a procedure designed to eliminate melanin

hyperpigmentation from the gums, utilizing various methods that exhibit varying levels of success. These methods include gingivectomy, gingivectomy combined with free gingival autografting, electrosurgery, cryosurgery, chemotherapy using 90% phenol and 95% alcohol, and diamond bur abrasion. However, some of these techniques can lead to side effects and complications. Recently, lasers have emerged as a method for ablating the cells that contain and produce melanin pigment. Commonly utilized lasers for gingival de-epithelization include semiconductor diode lasers, Er:YAG lasers, Nd:YAG lasers, and CO2 lasers. **(**Hanaa **S et al.,2015).**

Chapter one:

Review of literature

PHYSIOLOGY OF MELANIN PIGMENTATION :

The gingival color depends primarily upon: - The number and size of vasculature - Epithelial thickness - Degree of keratinization - Pigments within the gingival epithelium include:

1.1.1 Melanin

Melanin, a non-hemoglobin derived brown pigment, is the most common of the endogenous pigments and is produced by melanocytes present in the basal layer of the epithelium. The name “melanin” comes from the Greek word “melanos”, meaning “dark,” and the term was first applied by the Swedish chemist Berzelius in 1840 to call a dark pigment extracted from eye membranes **(Patil KP et al.,2015).** Melanin pigmentation appears as early as 3 h after birth in the oral tissues and in some cases is the only sign of pigmentation on the body.

melanosomes within the keratinocytes disintegrate releasing melanin ‘dust’ that protects the oral mucosa against microbial toxins and other microenvironmental stressors. Various stimuli can result in excessive deposition of melanin located in the basal and supra-basal cell layers of the epithelium will result in gingival hyperpigmentation, such as trauma, hormones ,radiation and medication**(Dummett CO and Barens G,1971).**

1.1.2 Melanocytes

Melanocytes constitute a heterogeneous group of cells. These unicellular dendritic cells reside in the basal cell layer of the epidermis and oral epithelium. Primitive melanocytes originate from neural crest of ectoderm. Melanocytes have a round nucleus with a double nucleus membrane and clear cytoplasm lacking desmosomes or attachment plates, but possess long dendritic processes **(Dummett CO and**

Barens G,1971).

Melanin provides protection from environmental stressors such as ultraviolet radiation and reactive oxygen species; and melanocytes function as stress-sensors having the capacity both to react to and to produce a variety of microenvironmental cytokines and growth factors, modulating immune, inflammatory and antibacterial responses.

The population of melanocytes of the oral epithelium appears to be more or less constant throughout life, despite the fact that some melanocytes are lost owing to the natural process of programmed cell death, and to mechanical, thermal or chemical injury. The mechanism by which the population of oral melanocytes is maintained in a steady state is unknown .

1.1.3 Melanosomes

Melanocytes synthesize melanin in organelles called melanosomes. There are four stages in melanosome development **(Cichorek M et al.,2013)**Stage I Premelanosomes: They are round, small vesicles with an amorphous matrix. Stage II Melanosomes: They have an organized, structured fibrillar matrix and tyrosinase is present but pigment synthesis has not been noted. Stage III: The beginning of melanin production takes place at this stage, where pigment is deposited on protein fibrils. Stage IV: At the last, pigment fills the whole melanosome. Fully melanized melanosomes lose tyrosinase activity and are transported to surrounding keratinocytes by elements of the cytoskeletal system.

Major determinant of normal human skin color is the melanogenic activity within the melanocytes and the quantity and quality of melanin production, but not melanocyte density. The degree of clinical melanin pigmentation in human epidermis and in the epithelium of oral mucosa is related to the amount of melanin i.e. the maturation of melanosomes, the number of keratinocytes containing melanosomes and the distribution of melanin loaded keratinocytes throughout the

epithelium **(Lerner AB and Fitzpatrick TB,1950) .**

1.2 ETIOLOGY OF PIGMENTATION

The causes of pigmentation mainly classified into **endogenous** and **exogenous**

. 1.2.1 Endogenous pigmentation

1.2.1.1 Physiologic pigmentation or Racial pigmentation

Physiological Pigmentation is a common occurrence that results from an increased production of melanin by melanocytes (Prabhuji M et al., 2013). Individuals with darker skin tones are more frequently affected. The color of physiological pigmentation can vary from light brown to nearly black. This pigmentation tends to increase with age, and factors such as smoking, hormonal changes, and systemic medications can influence its intensity (Kumar S et al., 2013). The attached gingiva is the most common site for this type of pigmentation, but it can also be observed throughout the oral cavity, including on the tips of the fungiform papillae on the dorsal surface of the tongue. Typically, the diagnosis of physiological pigmentation is made based on clinical observation, and no treatment is required. **(Nagati R et aj.,2017)**.

1.2.1.2 Pathological pigmentation

1.2.1.2.1 Peutz-Jeghers syndrome

Peutz-Jeghers syndrome (intestinal polyposis) is a genetic disorder characterized by mucocutaneous pigmentation and hamartomas of the intestine. It manifests itself as freckle like macules about the hands, perioral skin, and intraorally to include the gingiva, buccal, and labial mucosa. Pigmented spots are particularly found on the lower lip and buccal mucosa but rarely on the upper lip, tongue, palate, and gingiva **(Kopacova M et al.,2009)**

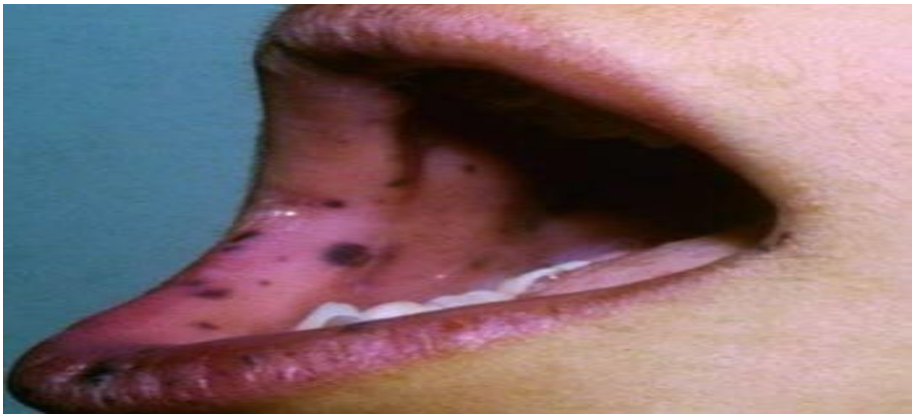


Figure 1 : Peutz-Jeghers syndrome

1.2.1.2.2 Addison's disease

Addison's disease, or primary hypoadrenalism, is due to progressive bilateral destruction of the adrenal cortex by autoimmune disease, infection or malignancy. The lack of adrenocortical hormones in the blood stimulates production of adrenocorticotropic hormone (ACTH) by the anterior pituitary gland. The increased production of ACTH induces melanocyte-stimulating hormone, which results in diffuse pigmentation of the skin and oral mucosa **(Kim HW,1988).** Oral pigmentation may be the first sign of the disease. A biopsy of the oral lesions shows acanthosis with silver-positive granules in the cells of the stratum germinativum. Melanin is seen in the basal layer **(Chuong R and Goldberg MH,1983).**

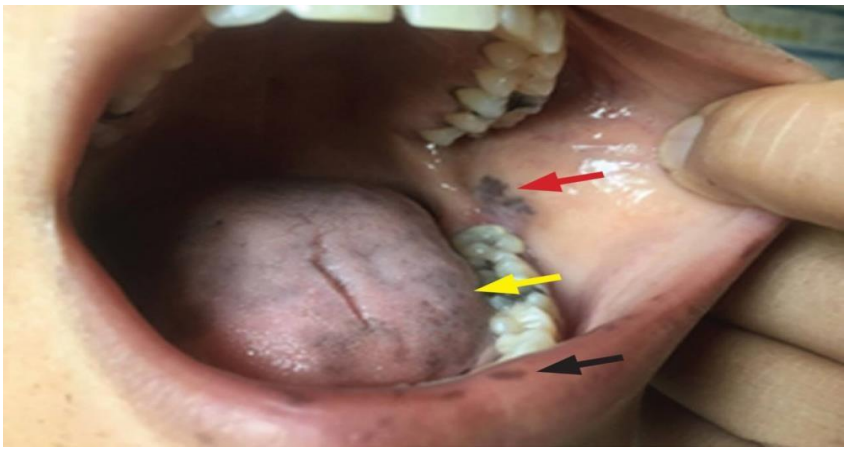


Figure 2: Addison disease

1.2.1.2.3 Kaposi's Sarcoma

Kaposi's sarcoma (KS) is a type of multifocal vascular cancer that primarily occurs in individuals infected with HIV. In the oral cavity, KS frequently affects areas such as the hard palate, gums, and tongue (Mohanna S et al., 2007). Initial lesions typically present as flat or slightly raised brown to purple spots, often appearing bilaterally. As the condition progresses, these lesions can develop into dark red or purple plaques or nodules, which may become ulcerated, bleed, or undergo necrosis. **(Lager I et al.,2003).**

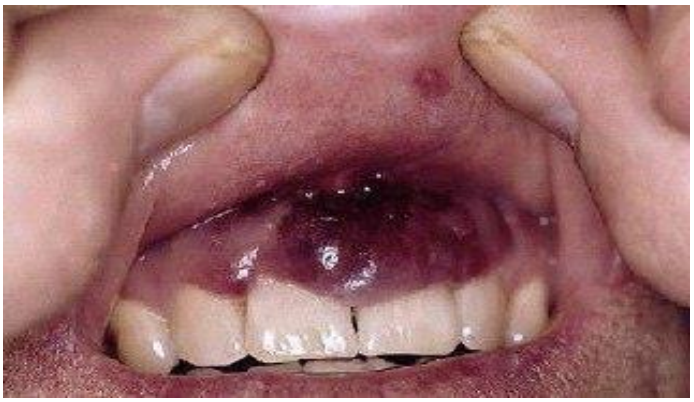


Figure 3: Kaposi sarcoma

1.2.1.2.4 Post inflammatory pigmentation

Oral post-inflammatory pigmentation (OPP) refers to the discoloration of the oral mucosa that arises from increased melanin production and accumulation in the basal layer of the epithelium and connective tissue in response to chronic inflammation. This condition is often associated with disorders such as oral lichen planus (OLP), various oral lichenoid lesions (OLLs), pemphigus, pemphigoid, periodontal disease, Stevens-Johnson syndrome, and graft-versus-host disease (Anjum R et al., 2012). Clinically, OPP presents as localized or widespread pigmentation ranging from black to brown. This pigmentation can remain for many years, despite reports of its gradual fading following the resolution of the underlying inflammatory condition. **(Mergoni G et al.,2011)**

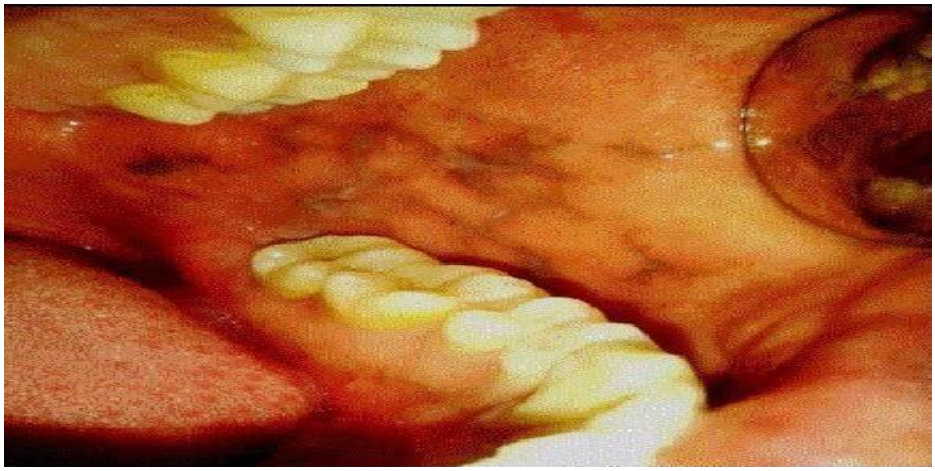


Figure 4: Post inflammatory pigmentation

1.2.1.2.5 Pigmented Nevi

Pigmented nevi in the oral cavity are rare. They typically present as elevated papules that are brownish-black to blue in color, with clear, well-defined borders. Nevi can be categorized by their time of occurrence into congenital and acquired types. Congenital nevi can further be divided into giant nevi and small nevi. In contrast, acquired nevi, commonly known as moles, usually develop in areas of the skin that are exposed to sunlight. Overall, a nevus is considered a benign growth resulting from the proliferation of melanocytes. **(Sreeja C et al.,2017)**

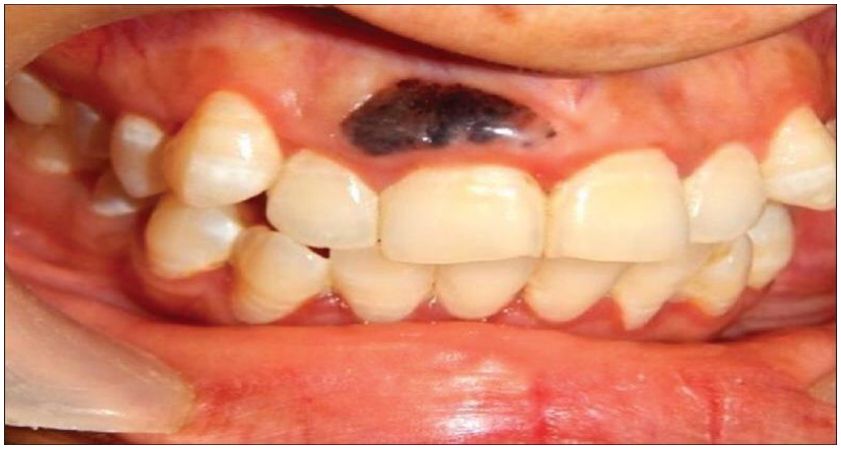


Figure 5: Pigmented nevi

Oral Melanoma

Melanoma is a cancer that arises from melanocytes, the cells responsible for producing melanin. These cells contain specialized structures called melanosomes, which house the enzyme tyrosinase, essential for converting amino acids into melanin. Melanocytes are located among the basal cells of the epidermis. Histologically, melanoma manifests as an abnormal mucosal epithelium characterized by the presence of large, atypical melanocytes and an abundance of melanin. Malignant melanoma of the oral mucosa affects both genders fairly equally, typically occurring in individuals over the age of 40 (Grinspan D et al., 1969). The palate is the most frequently affected site, representing approximately 40% of cases, followed by the gingiva, which accounts for around 30%, with other areas of the oral mucosa also potentially being involved. **(Symvoulakis EK et al.,2006)**

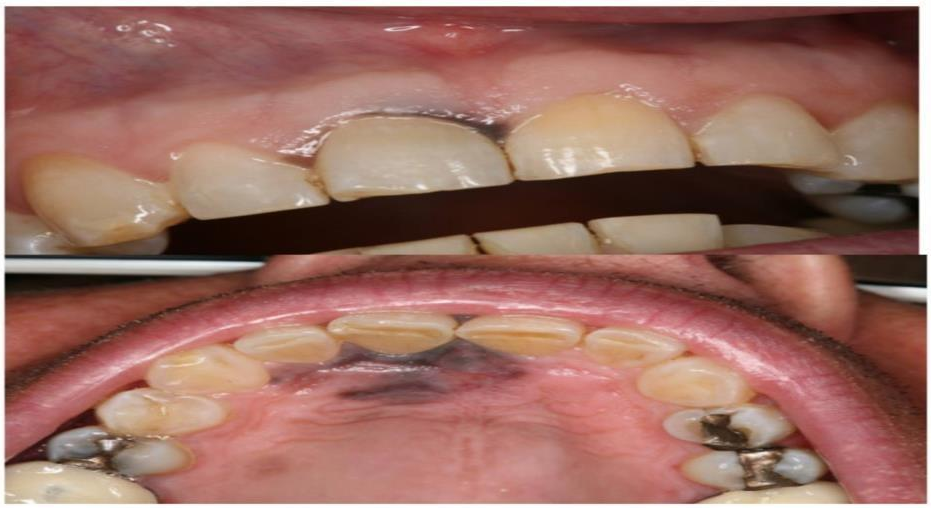


Figure 6 : Oral melanoma

1.2.1.2.6 Ecchymosis

Ecchymosis commonly known as bruises, frequently occur after injury. Traumatic ecchymosis is common on the lips **(Molenda MA etal.,2010)**

1.3.1.2.8 Petechiae

Petechiae are submucous or subcutaneous minute pinpoint hemorrhages. In most cases, the petechiae are identified on the soft palate, although any mucosal site may be affected **(Lynch B et al.,2003)**

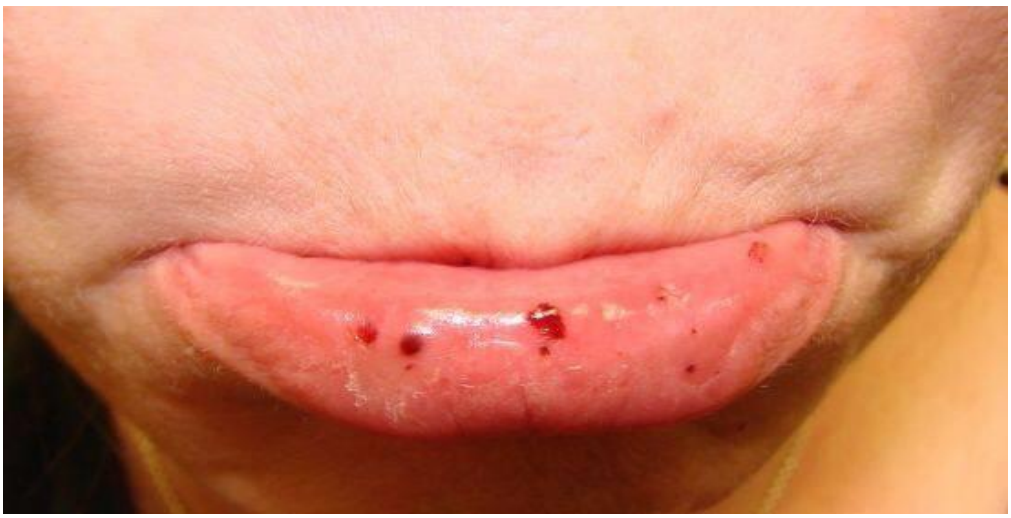


Figure 7: Petechiae

1.2.2 Exogenous pigmentation

1.2.2.1 Heavy Metal Pigmentation Elevated levels of heavy metals in the bloodstream, including lead, bismuth, mercury, silver, arsenic, and gold, are well-documented causes of discoloration in the oral mucosa. In adults, the primary source of these increased levels is often occupational exposure to heavy metal vapors (Neville BM et al., 2002). Specifically, lead exposure can lead to a distinct bluish-red or deep blue pigmentation along the gingival margin, known as the Burtonian line. Meanwhile, exposure to silver is associated with a violet line at the margins, frequently accompanied by a diffuse bluish-grey discoloration affecting the overall oral mucosa. **(Ten Bruggenkate CM et al.,1975)**

1.2.2.2 Drug-Related Discolorations

Various systemic medications have been associated with oral mucosal pigmentation, either by stimulating melanin production or by the deposition of the drug or its metabolites. Some of the most frequently implicated medications include antimalarials, hormones, oral contraceptives, phenothiazines, chemotherapeutic agents, amiodarone, and minocycline. Patients who are on these medications for an extended period should be regularly monitored for the emergence of oral

pigmentation. The hard palate, gingiva, and buccal mucosa are the areas most commonly affected (Sanjeevini H et al., 2012; Slominski A et al., 2004). Clinically, this discoloration appears flat and can be focal, multifocal, or diffuse, ranging in color from black and gray to blue and brown. It is particularly noteworthy that pigmentation confined to the hard palate is typically associated with antimalarials, which are frequently prescribed for conditions such as rheumatoid arthritis and systemic lupus erythematosus. **(Kopacova M et al.,2009)**

1.2.2.3 Amalgam Tattoo/Foreign Body Tattoo

Mucosal pigmentation can occur due to deposition of exogenous foreign materials such as dental amalgam, tattoo pigment, or graphite. This can occur during placement or removal of a restoration where fragments can enter through an abrasion, extraction site or the gingival sulcus. Amalgam tattoo can occur in anyone with a history of amalgam restorations. It presents as a flat discoloration which can be gray, blue, or black . The borders may be well-defined, irregular or diffuse. The majority of amalgam tattoos are 6 mm or less .The most common location is gingiva or alveolar mucosa however other sites including buccal mucosa and floor of mouth are often affected **(De Melo Filho MR et al.,2012).**

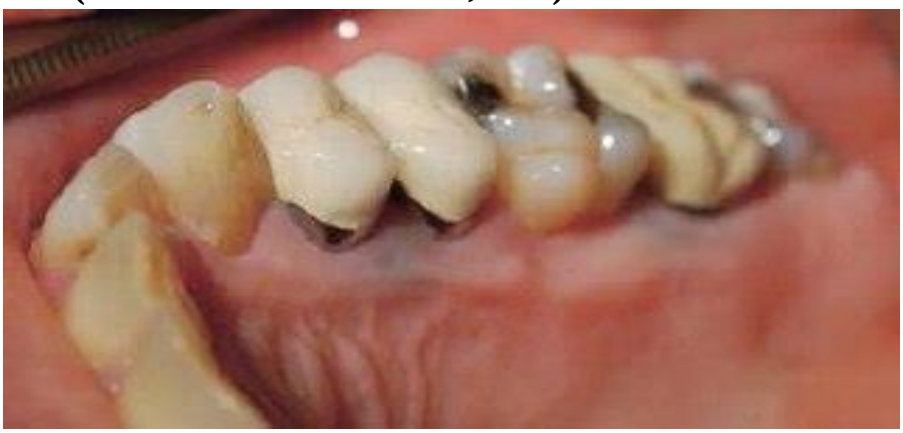


Figure 8: Amalgam tattoo

1.2.2.4 Smoker's Melanosis

Smoker's melanosis is a prevalent, benign, and reactive condition characterized by

increased pigmentation of the oral mucosa due to cigarette or pipe smoking. This phenomenon is believed to occur as a response to the harmful chemicals in tobacco smoke or the heat generated from smoking, which stimulates melanocytes to produce melanin as a protective measure (Prabhuji M et al., 2011; Antony VV and Khan R et al., 2013; Westerhof W, 2006; Lynch B et al., 2003). Typically seen in adults, smoker's melanosis has been reported in approximately 21.5% to 30% of smokers. The anterior labial mandibular gingiva is the most commonly affected area, although other sites such as the buccal mucosa, lips, hard palate, and tongue may also exhibit pigmentation. Generally, the condition presents with multiple brown macules that can vary in color from light brown to brown-black, depending on the duration and extent of tobacco use. **(Kwon JS et al.,2012)**

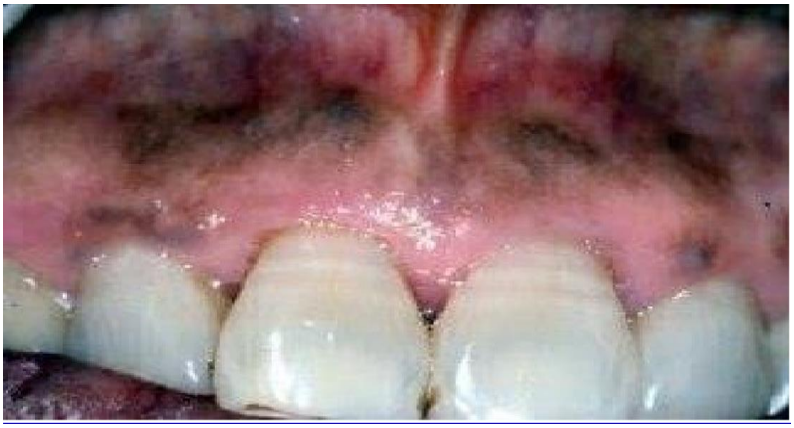


Figure 9: Smoker melanosis

1.3 EPIDEMIOLOGY :

Oral pigmentation occurs in all races of man though there range varies from one race to another. There were no significant differences in oral pigmentation between males and females. The intensity and distribution of racial pigmentation of the oral mucosa is variable, not only between races, but also between different individuals of the same race and within different areas of the same mouth. Physiologic pigmentation is probably genetically determined, but as Dummett suggested, the degree of pigmentation is partially related to mechanical, chemical, and physical

stimulation **(Dummett CO,1945)**In darker skinned people oral pigmentation increases, but there is no difference in the number of melanocytes between fair-skinned and dark-skinned individuals. The variation is related to differences in the activity of melanocytes **(Ozbayrak S et al.,2000)** Physiological pigmentation of the oral mucosa (mostly gingiva), is clinically manifested as multifocal or diffuse melanin pigmentation with variable amounts in different ethnic groups worldwide and it occurs in all races **(Dummett CO,1960).**

In Caucasians, most melanocytes have striated granules that are incompletely melanized and vary in size from 0.1 to 0.3 mm. But, the amount is insufficient to cause pigmentation (less than 10% demonstrate pigmentation). A high amount of melanin granules is found in individuals of African and East Asian ethinicity **(Fry L and Almeyda JR,1968)** .In dark-skinned and black individuals, an increased melanin production has long been known to be the result of genetically determined hyperactivity of melanocytes. Melanocytes of dark skinned and black individuals are uniformly highly reactive, whereas in light skinned individuals, melanocytes are highly variable in reactivity **(Kathariya R and Pradeep AR,2011).**

1.4 CLASSIFICATION:

Pigmented lesions of the oral cavity are of multiple origin.

Different classifications are used at this time:

1.4.1 Dummet et al. (1967)

- Primary oral melanin pigmentations
- Secondary oral melanin pigmentations
- Oral non-melanin pigmentations
- Oral melanoclasias.

(**Dummett CO, Barens G. Pigmentation 1967)**

1.4.2 Patil S et al. (2015) classified pigmented lesions into different groups

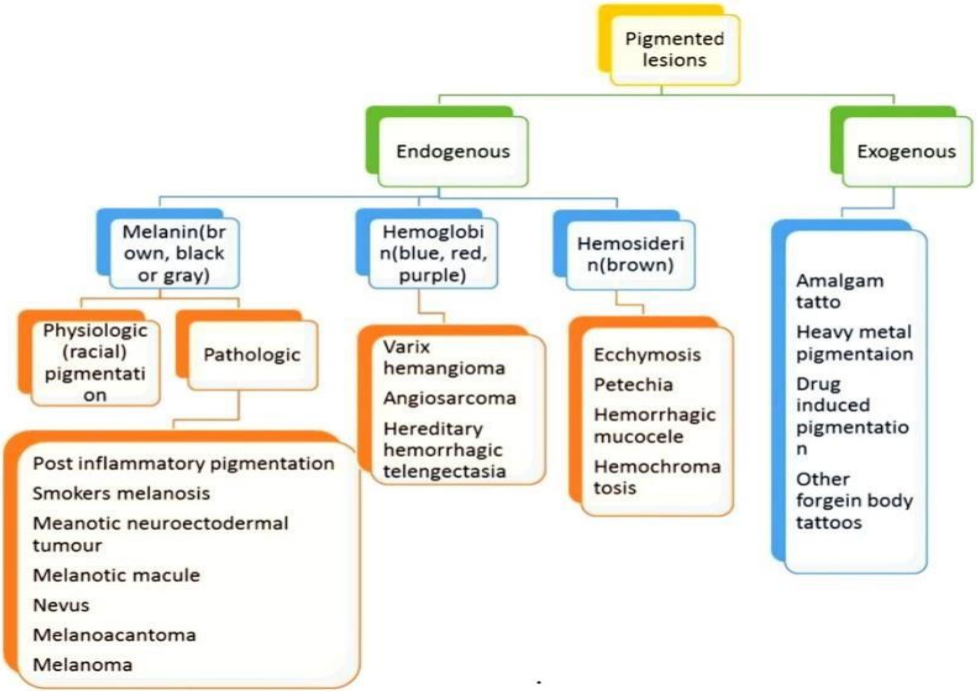


Figure 10: Classification of pigmented lesion (Patil S, et al -2015)

(Patil S, Raj T, Rao RS, Warnakulasuriya 2015)

1.5 REVIEW OF CURRENT INDICES :

Gingival pigmentation has three dimensions: etiology, distribution, and severity. The existing indices on gingival pigmentation are as follows:

1.5.1 Dummet proposed the oral pigmentation index (DOPI) :

Dummet proposed the oral pigmentation index (DOPI) assessment) in 1964. This index of oral pigmentation is the commonly used index due to its simplicity and ease of use. The gingivae of the maxillary and mandibular arches are each divided into 32 unit spaces, sixteen on the lingual aspect and sixteen on the buccal and labial surfaces. Each unit space approximates the area of the marginal gingiva, and extends from the gingival crest apically about 4 or 5 mm up to the level of the attached gingiva. The unit spaces correspond to the buccal and lingual gingival areas which

norm ally invest the human adult dentition. In cases in which there are either partially or completely edentulous areas, this division into 32 unit spaces is still maintained since the oral pigmentation is independent of the presence or absence of teeth.The method consists of assigning a numerical oral pigmentation estimate to each one of these 32 unit spaces.

The assigned estimate is based upon the following scale: -

The scores are as follows:

Score 0 - No clinical pigmentation (pink-colored gingiva)

Score 1 - Mild clinical pigmentation (mild light brown color)

Score 2 - Moderate clinical pigmentation (medium brown or mixed pink and rown color)

Score 3 - Heavy clinical pigmentation (deep brown or bluish black color)

$$\text{DOPI assessment} = \frac{\text{Sum of assigned estimates of components}}{\text{32 unit spaces}}$$

The DOPI assessment is scaled according to following designations

0	No clinical pigmentation of the gingiva
0.031-0.97	Mild gingival pigmentation
1.0-1.9	Medium gingival pigmentation
2.0-3.0	Heavy gingival pigmentation

(Dummett CO, Gupta OP 1964.)(Raghu Raaman A, Pratebha B, Jananni M, Saravanakumar R. 2015)

1.5.2 Gingival pigmentation index :

- Score 0: Absence of pigmentation.

- Score 1: Spots of brown to black color or pigments.

- Score 2: Brown to black patches but not diffuse pigmentation.

- Score 3: Diffuse brown to black pigmentation, marginal, and attached gingiva.

(Singh V, Giliyar SB, Kumar S, Bhat M. 2012)

1.6 GINGIVAL DEPIGMENTATION :

Gingival depigmentation can be defined as a periodontal plastic surgical procedure whereby the gingival hyperpigmentation is removed by various techniques. **Malhotra S, Sharma N, Basavaraj P. 2014** Depigmentation isn't a clinical indication treatment of choice where esthetics is a concern and is desired by the patients. **Grover HS, Dadlani H, Bhardwaj A, Yadav A, Lal S.2014**

1.6.1 Gingival depigmentation techniques

Different procedures have been proposed for gingival depigmentation. Roshni & Nandakumar in 2005 classified different gingival depigmentation Methods

1.6.1.1 Methods used to remove the gingival pigmentation:

1.6.1.1.1 Scalpel surgical technique :

This procedure is also referred to as split-thickness epithelial excision (Kumar S, Bhat GS, Bhat KM, 2012) or surgical stripping (El-Shenawy H et al., 2017). The conventional scalpel technique involves surgically removing the gingival epithelium with a scalpel, allowing the exposed connective tissue to heal through secondary intention (Dummett CO, 1946). The new epithelial layer that forms is free of melanin pigmentation (Roshna T, Nandakumar K, 2005). It is crucial to ensure that no pigmented remnants remain in the denuded area (Prasad S et al., 2010). This scalpel method is cost-effective and does not require a comprehensive set of instruments (Sanjeevini H; Pudakalkatti P et al., 2012). Healing tends to be faster compared to other surgical methods. However, this technique can lead to bleeding during and

after the procedure, making it necessary to cover the surgical site with a periodontal dressing for 7 to 10 days. While the initial outcomes of the depigmentation process are promising, there is a risk of repigmentation. This may occur as active melanocytes from surrounding pigmented tissues migrate into the treated areas. Additionally, a thinner gingival biotype and narrow papillary spaces may render this technique unsuitable.As seen Figure11 **Bergamaschi O, Kon S, Doine AI, Ruben MP.1993**

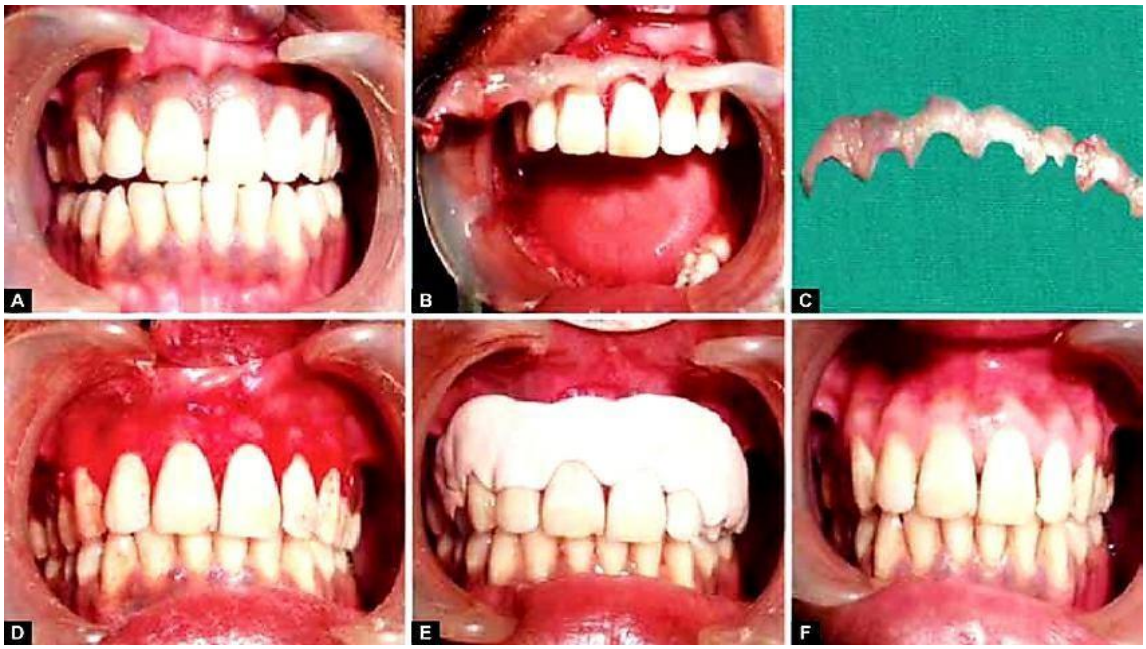


Figure 11 : Pre-operative view, b. Maxillary pigmentation removal using scalpel surgical technique, c. Immediately after depigmentation, d. Mandibular pigmentation removal, e. Immediately after depigmentation, f. After 3 month.

1.6.1.1.2 Gingival Abrasion :

The technique first documented by Ginwalla et al. in 1966 involves the removal of pigmented gingival epithelium through superficial abrasion with grit football-shaped or doughnut-shaped coarse diamond burs operated in a low-speed handpiece (Ginwalla TM, Gomes BC, Varma BR, 1966). According to Kumar et al. (2012), it is essential to carefully control the speed and pressure of the handpiece to prevent

unintended tissue abrasions or pitting. This approach is relatively non-invasive and cost-effective, requiring no specialized instruments. However, it does come with several drawbacks, including technique sensitivity, prolonged treatment time, post-treatment discomfort, the need for placement of periodontal dressing, and a high recurrence rate (Kumar S, Bhat GS, Bhat KM, 2012). If excessive speed or pressure is applied, there is a risk of exposing the underlying alveolar bone. To achieve optimal results, practitioners should use minimal pressure and feather-light brushing strokes while ensuring copious saline irrigation and avoiding prolonged contact of the bur in any one spot.. As we seen in Figure 12 **Deepak P, Sunil S, Mishra R.Sheshdri 2005**

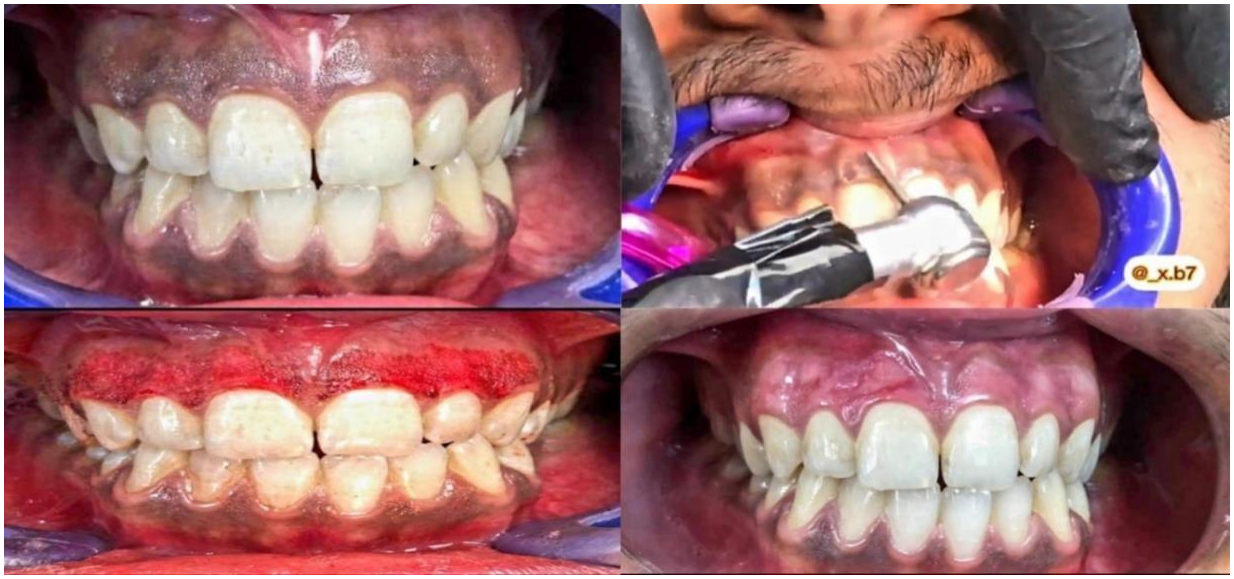


Figure 12: a. Pre-operative, b. Gingiva depigmentation by bur abrasion, c. 3 Months post-operative view

1.6.1.1.3 Electro-surgery :

Electrosurgery utilizes high-frequency electrical energy within the radio transmission frequency range, applied directly to tissue to produce specific histological effects. As the electrical current flows through the tissue, the resistance impedes its passage, generating heat that vaporizes the water within the tissue, resulting in either cutting or coagulation. According to Prasad et al. (2010), this

method effectively controls bleeding, allows for precise contouring of tissues, minimizes patient discomfort, reduces scar formation, and shortens chair time. However, Sanjeevini et al. (2012) noted that pain and discomfort during the initial healing phase tend to be higher with this technique. Additionally, Bergamaschi et al. (1993) highlighted that electrosurgery demands greater expertise compared to traditional scalpel surgery. It is crucial to avoid prolonged or repeated application of current to the tissue, as this can lead to heat buildup and unintended damage. Care must also be taken to prevent contact with the periosteum, alveolar bone, or vital teeth during the procedure. As we seen in Figure 13 **Ginwalla, Gomes, Varma 1966**

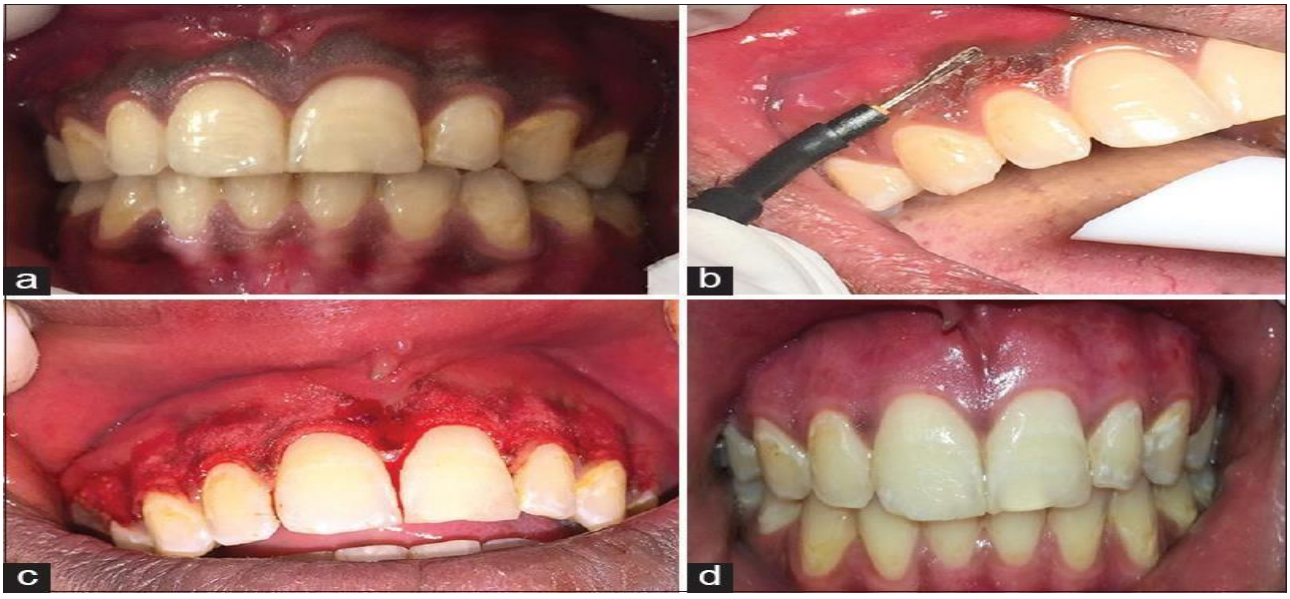
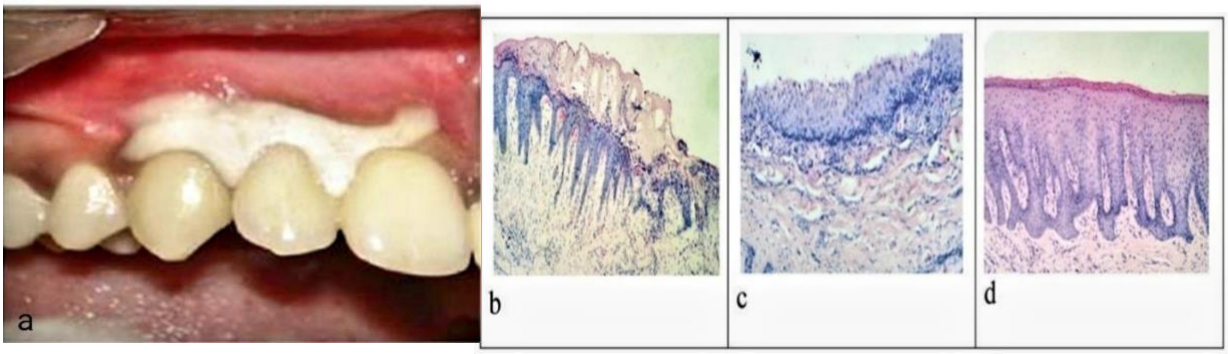


Fig 13 : Gingival depigmentation by electrocautery. (a) Preoperative; (b) use of loop electrode; (c) after de-epithelialization; (d) postoperative - 6 months

1.6.1.1.4 Cryosurgery :



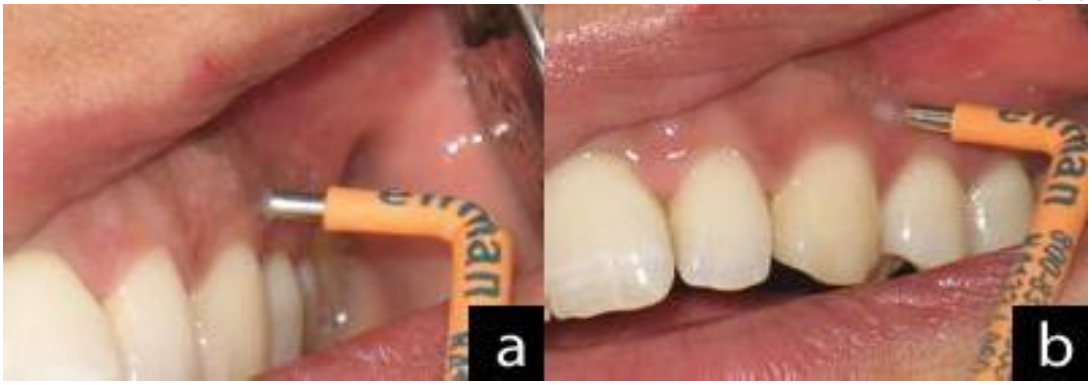
Cryosurgery is a highly regarded technique for gingival depigmentation, as noted by Kumar et al. (2013). This method involves freezing the gingiva using a cryogenic substance, such as liquid nitrogen, at extremely low temperatures. According to Moneim et al. (2017), exposure to these ultralow temperatures induces cryonecrosis of the epithelial tissue, effectively removing pigmentation from the gums.One of the significant advantages of cryosurgery is its cost-effectiveness, along with providing long-lasting aesthetic results, quick healing, and a low rate of recurrence. It offers several benefits compared to other depigmentation methods, including minimal bleeding, reduced pain, absence of scarring, and the ability to perform the procedure without the need for regional anesthesia, sutures, or complex instruments. Additionally, the ease of applying cryogen in sensitive areas like the interdental papillae makes it a preferred choice for many practitioners (Kumar et al., 2013). However, the technique does have some drawbacks. Prasad et al. (2010) highlight challenges such as post-operative swelling and difficulty in controlling the depth of penetration. Cryotherapy can also produce direct effects like cell dehydration, enzyme inhibition, protein denaturation, and cell death due to thermal shock. Additionally, it induces indirect effects, such as alterations in blood vessels and immune response, which contribute to the same end results in tissue cell death.. As we seen in Figure 14 **Shirazi ARS, Taghavi AM, Khorakian F. 2010**

Figure14:Depigmentation by cryosurgical technique. b. 8 hours following freezing showing epithelial degeneration. c. Specimen after 24 h showing loss of rete pegs. d. Clinical resemblance after a week of application of cryogen.

1.6.1.1.5 Radiosurgery :

The most advanced form of electro-surgery involves the removal of soft tissue using radio frequency energy. This method utilizes electromagnetic energy within frequencies ranging from 3.0 MHz to 4.0 MHz, with 4.0 MHz being identified as the optimal frequency. One of the key benefits of radiosurgery is its effectiveness in achieving coagulation in areas that typically experience significant bleeding during

procedures. Research has indicated that this 4 MHz radio wave technology results in less thermal damage and promotes quicker healing compared to traditional scalpels and lasers (Sherman J, Gürkan A, Arikan F. 2009). However, a notable drawback of this technique is the necessity for at least two treatment sessions within a two-week timeframe (Herschfeld I, Herschfeld L. 1951). Moreover, radiosurgery can



effectively depigment papillary areas, enhancing its application in soft tissue procedures.As shown in Figure 16 **Kumar S, Bhat GS, Bhat KM. 2012**

Fig 15 : a , b Application of the tapping electrode to the pigmented gingiva

1.6.1.1.6 Chemical Gingival Peeling :

This treatment method involves the use of a chemical peeling agent to eliminate the overlying gingival epithelium. Various chemical agents are accessible, including phenols, salicylic acid, glycolic acid, and trichloroacetic acid (Dummett CO, 1946). Among these, phenols and alcohols are the most frequently utilized. In research conducted by Hirschfield and Hirschfield in 1951, tissue pigmentation in the gingiva was removed by destroying the tissue down to and just below the basal layer of the mucous membranes using a combination of 90% phenol and 95% alcohol. However, all participants experienced repigmentation and relapse shortly after the treatment (Herschfeld L, 1951). Since phenols can lead to cardiac arrhythmias, careful cardiac monitoring is essential (Kathariya R, Pradeep AR, 2011). The inability to regulate the depth of penetration and the extent of tissue destruction are significant drawbacks of this method, leading to its decline in use and making it unacceptable to both icians and patients.. As seen in Figure 17

Fig 16 : Chemical Gingival peeling

1.6.1.1.7 Ascorbic Acid :

Ascorbic acid, commonly known as Vitamin C, shows promise in treating gingival melanin pigmentation. It acts by inhibiting melanin production through the suppression of tyrosinase activity, which is crucial for melanin biosynthesis (Shimada Y, Tai H, Tanaka A, Ikezawa-Suzuki I, Takagi K, Yoshida Y, et al., 2009). Additionally, ascorbic acid reduces the formation of dopaquinone, a precursor in the melanin synthesis pathway, thereby further inhibiting melanin production. Research by Sheel et al. has demonstrated that the local application of ascorbic acid following a depigmentation procedure can delay the repigmentation of the gingiva. As Seen in Figure **18 Kathariya ,Pradeep 2011**

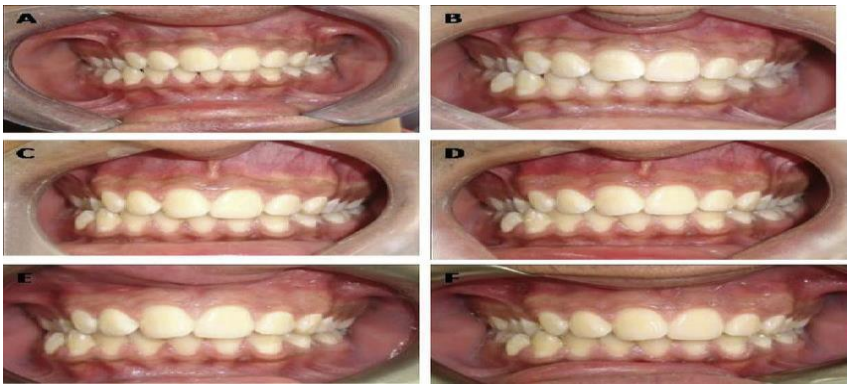


Fig 17 : The stages of vitamin C depigmentation; A: pre-operative, B: after 1st visit, C: after 2nd visit, D: after 3rd visit, E: after 1 month and F: after 9 months follow up

1.6.1.2 Methods Used To Mask The Gingival Pigmentation:

1.6.1.2.1 Free Gingival Graft :

In this approach, a free gingival autograft, which is unpigmented and sourced from the patient's palate, is transplanted to the designated recipient site (Tamizi M, Taheri M, 1996). Instead of removing the pigmented gingival area, this method serves to conceal it (Malhotra S, Sharma N, Basavaraj P, 2014). However, this technique has several drawbacks, including the need for two surgical sites, post-operative discomfort from pain, sensitivity in the technique, and a "ghost-like" appearance at the treated site due to hypopigmentation.. As Shown in Figure 19 **Sanjeevini H, Pudakalkatti P,2012.**

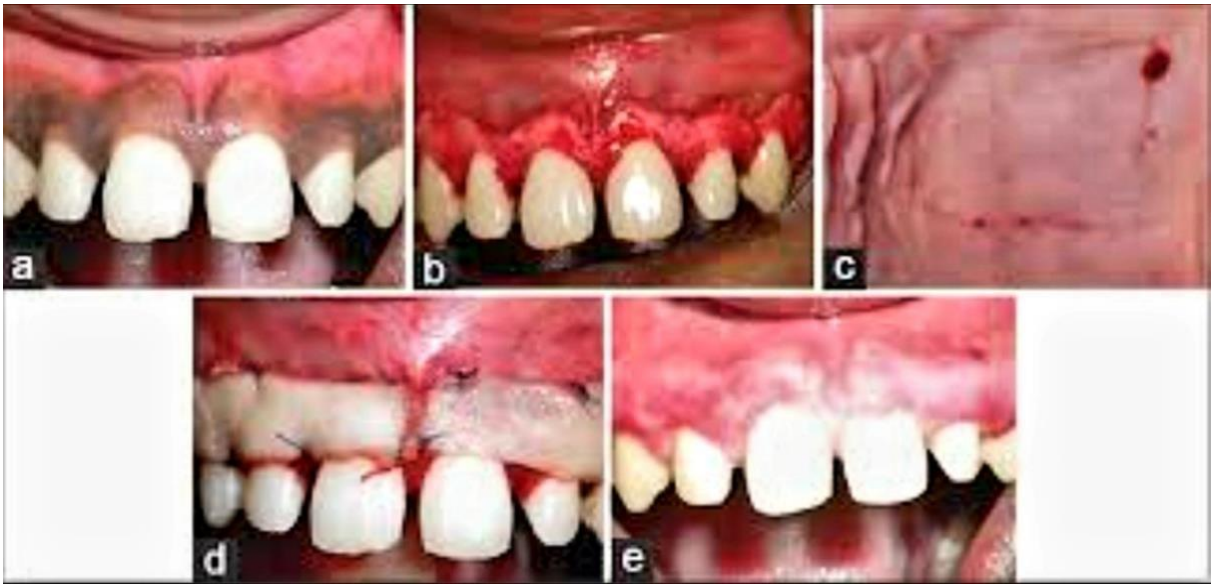


Fig 18 a: pre-operative b: Immediate post-operative view c: autograft from patient's palate d: sutured with recipient site e: after 6 months follow up

1.6.1.2.2 Acellular dermal matrix allograft : (ADMA)

It ADMA can serve as a safe alternative to free gingival autografts for managing gingival hyperpigmentation (Novous AB, Jr, Pontes CC, Souza SL, Grisi MF, Taba

M, 2002). This method offers several advantages, including the elimination of a second surgical site for donor grafting, reduced post-operative complications, access to an unlimited supply of graft material, and superior aesthetic outcomes compared to free gingival grafts. Nonetheless, it is important to note that ADMA is technique-sensitive, more costly, and necessitates a certain level of clinical expertise. as we can seen in Figure 20 **Kathariya R, Pradeep AR. 2011**.

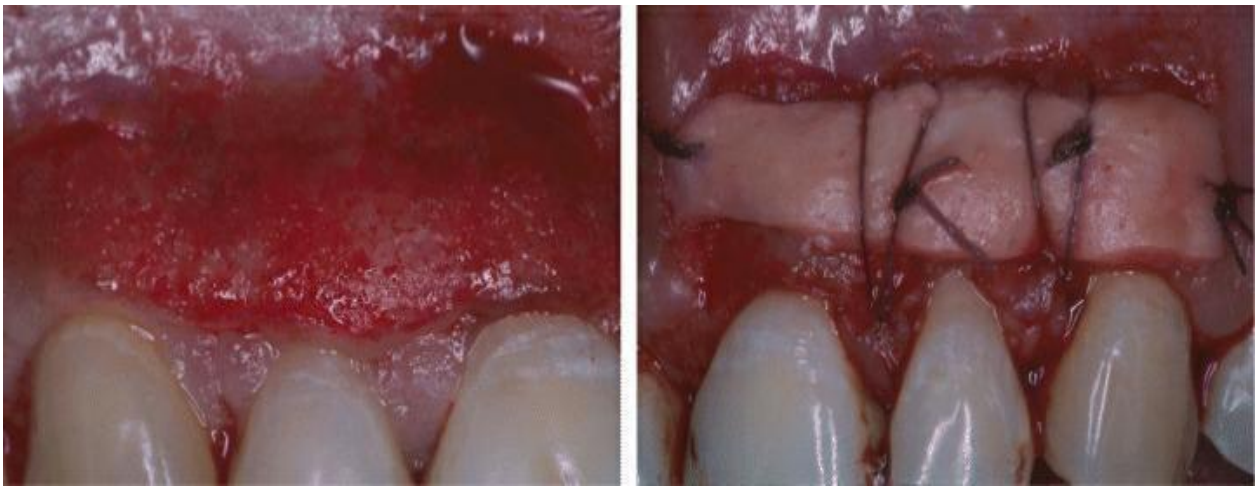


Fig 19 : Acellular dermal matrix allograft (ADMA)

1.6.2 Criteria for Selection of Technique

The formulation of a treatment plan and the choice of technique are significantly influenced by factors such as the patient's skin tone, the degree of gingival pigmentation, the lip line, the curvature of the upper lip, aesthetic concerns, and the patient's expectations regarding the outcome (Malhotra, Sharma, Basavaraj, 2014). It is essential that the chosen procedure is straightforward, cost-effective, and comfortable for both the clinician and the patient, ensuring minimal pain and tissue loss (Dummett CO, 1946). Careful attention is required to avoid damage to soft tissues and neighboring teeth; improper techniques or accidental applications can lead to gingival recession and harm to the attachment apparatus and underlying bone. enamel**.**

1.7 Lasers :

Laser treatment offers numerous applications in periodontal surgery, and when compared to conventional surgical techniques, it demonstrates several advantages: it minimizes side effects and reduces tissue damage, promoting better healing; it can enhance patient comfort; it facilitates hemostasis and coagulation, making it particularly valuable for patients with medical disabilities; and certain procedures can only be carried out with local anesthesia.

Laser ablation for gingival depigmentation is recognized as an effective, comfortable, and reliable method, as noted by Prabhuji et al. (2011). This technique typically suffices to eliminate pigmented areas without the need for any periodontal dressing, as stated by Javali et al. (2011). It is associated with reduced pain and discomfort due to the formation of a protein coagulum. Furthermore, laser ablation allows for a clean and dry surgical field, resulting in stable outcomes (Simsek Kaya et al., 2012). Additionally, laser light has the capability to seal free nerve endings, reducing sensitivity during the procedure (Nagati et al., 2017).However, there are drawbacks associated with this technique, including delayed wound healing, potential thermal damage, deep tissue penetration, and relatively high costs (Kumar et al., 2012). Various types of lasers have been employed for gingival depigmentation, including carbon dioxide (10,600 nm), diode (810 nm), and neodymium:yttrium-aluminum-garnet (Nd:YAG, 1,064 nm) lasers.

The diode laser, which has emerged in dentistry in recent years, is a solid-state semiconductor laser that converts electrical energy into light energy. It is easily delivered through a flexible quartz fiber optic handpiece, and the energy is absorbed by pigmented tissue, making it an effective hemostatic agent (Prabhuji et al., 2011). This method also enhances visibility at the surgical site, resulting in better post-operative comfort compared to traditional surgical scraping techniques (Nagati et al., 2017).

The CO2 laser is noted for causing minimal damage to the periosteum and

underlying bone, while effectively removing thin layers of epithelium (Prasad and Agrawal, 2010). The YAG laser has demonstrated optimal use by leaving minimal thermal damage, making it one of the preferred choices in laser applications for this purpose.. Shown Figure15

Nd:YAG lasers, with a wavelength of 1064 nm, are highly effective in treating pigmentation due to their strong absorption by melanin. They target pigmented lesions like melasma and lentigines while minimizing damage to surrounding tissues. The laser's deep penetration allows for effective treatment of lesions located in the dermis, which can be more challenging for superficial therapies. Additionally, Nd:YAG lasers are associated with less bleeding and postoperative discomfort compared to traditional methods, making them a preferred option for practitioners. Their bactericidal properties also help manage potential infections during and after treatment. Overall, Nd:YAG lasers are a valuable tool in modern dermatology for addressing pigmentation issues with minimal side effects.(Johnson, et al. 2021)

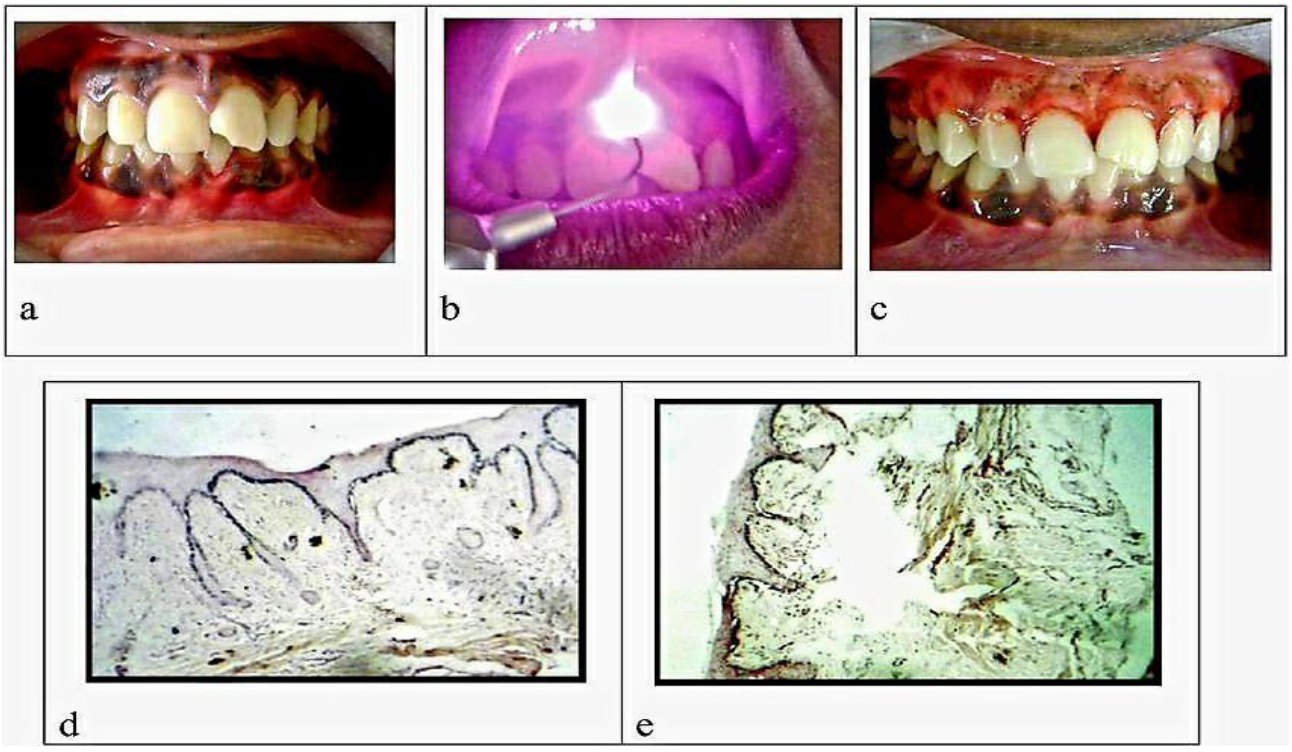


Figure 20 : a. Pre-operative situation, b. Use of the FOX diode laser to treat

gingival pigmentation, c. Immediate post-operative view. d:Postoperative biopsy specimen form Er: YAG treated site showed basal cells with moderate staining positivity (50–75%), whereas (Fig. 5e) showed biopsy from CO2 treated sites showed mild to moderate staining (<50%) positivity

1.8 comparing laser and Traditional method

Electrosurgery is noted for its advanced ability to disrupt melanin cells based on Oringer's 'exploding cell theory' (1975), which suggests that electrical energy causes molecular disintegration of melanin cells in both the basal and suprabasal layers. This dissipation can hinder the migration of melanin cells from surrounding regions. However, in the current study, no significant difference in the recurrence of pigmentation was found between scalpel and electrosurgical techniques.

Bakhshi et al. 9 highlighted several advantages associated with laser use, such as eliminating the need for periodontal dressings, promoting a shorter healing period, and resulting in minimal or no pain. However, regarding postoperative pain, some researchers found that diode lasers resulted in lower discomfort after procedures. In contrast, the Er:YAG laser is noted for causing less pain due to its superficial penetration, which results in minimal thermal damage and reduced tissue necrosis

As with any surgical intervention, effective hemorrhage control is crucial, as emphasized in the literature. Gholami et al. 12 found that the Er,Cr:YSGG laser offers superior coagulation effects and can be useful for controlling bleeding during clinical procedures. Bakhshi et al. 9 supported these findings, noting that this type of laser allowed for slight and manageable bleeding, particularly when dealing with deeper pigmentation due to its ablation capabilities. On this note, the diode laser may present advantages, as it aids in sealing blood vessels, thereby

enhancing hemostasis in the surgical area

Research highlights the importance of managing hemorrhage during surgical procedures. Gholami et al. demonstrated that the Er,Cr:YSGG laser is effective for coagulation and assists in controlling bleeding during clinical applications. Similarly, Bakhshi et al. found that this laser type led to minimal controllable bleeding, especially in cases with deeper melanocyte pigmentation due to its ablation ability. In contrast, diode lasers may offer advantages by sealing blood vessels, promoting better hemostasis during surgery.
When it comes to immediate aesthetic results, Bakhshi et al. reported that diode lasers were more effective than Er:YAG lasers in diminishing melanin pigmentation. Both lasers eliminate melanocytes in the basal layer of the oral epithelium, as noted by Altayeb et al. Agha & Manaf further supported these findings, explaining that melanin has a stronger absorption response to diode wavelengths compared to Er:YAG lasers. This results in a procedure that is less traumatic, quicker, and more effective, with full epithelialization of the gums observed within a week due to the photobiomodulation process.
The recurrence of pigmentation and long-term stability are significant concerns in the literature, as they occur with conventional methods, especially after long-term preservation. Recurrence is often linked to the migration of melanocytes from untreated adjacent areas or remnants left at the surgical site. Mahajan et al. observed that laser treatments effectively reduced this recurrence by ablating melanocytes, a benefit not seen with traditional techniques.
Altayeb et al. noted that diode laser treatment results in better long-term stability, aligning with Gholami et al.'s findings. Nammour et al. compared the durability of aesthetic outcomes between diode, CO2, and Er:YAG lasers, indicating that diode lasers provided the longest stability post-treatment, whereas Er:YAG lasers had the shortest duration before pigmentation returned. These conclusions

support the results from various other studies. laser therapy, particularly using diode lasers, has proven to effectively address gingival pigmentation issues in both short and long terms. The laser's high affinity for melanin and hemoglobin, coupled with its non-interaction with oral hard tissues, renders it a safe option for gingival depigmentation. The main drawbacks include the high cost of laser equipment and the necessity for precise application, as improper use can lead to complications like gingival recession and irreversible cosmetic changes.

Some limitations in the studies reviewed include variations in sample sizes and follow-up durations, indicating a need for more standardized and longer-term randomized controlled trials to enhance data comparison and scientific robustness.

Case Study

A 23-year-old male patient visited the Department of Periodontology, complaining of dark gums. History revealed that it was present since childhood suggestive of physiological melanin pigmentation. Patient was systemically healthy without any habits. Patient's oral hygiene was good. Patient was explained about the treatment options available and the possibility of repigmentation after certain period. Laser Depigmentation: Utilizing a diode laser, this technique offers precise targeting of the pigmented tissue with minimal collateral damage. The patient was informed that laser treatment typically results in less postoperative discomfort, reduced inflammation, and quicker healing.

Material and method

Scalpel (Traditional)Materials:

• Sterile surgical scalpel (Blade No. 15)

• Local anesthesia (Lidocaine 2%)

• Gauze, cotton rolls, and saline

• Surgical instruments (tissue forceps, suction)

• Periodontal dressing (if used)

Diode Laser Materials:

• Diode laser device (e.g., 980 nm wavelength)

• Topical or local anesthesia (Lidocaine 2%)

• Sterile cotton rolls and gauze

• Protective eyewear for operator and patient

• Saline solution for irrigation

Scalpel (Traditional)Method:

• The area was isolated and anesthetized.

• Pigmented epithelium was excised using a scalpel.

• Bleeding was controlled with pressure and irrigation.

• In some cases, periodontal dressing was applied.

• Post-op instructions given, follow-up at 1 and 2 weeks.

Diode Laser Method:

• The gingiva was isolated and anesthetized.

• The diode laser was set to [e.g., 1 W, continuous mode].

• Laser was applied in a sweeping motion over pigmented areas until the pigmentation disappeared.

• Minimal bleeding occurred due to laser coagulation.

• Post-op instructions given, follow-up at 1 and 2 weeks..

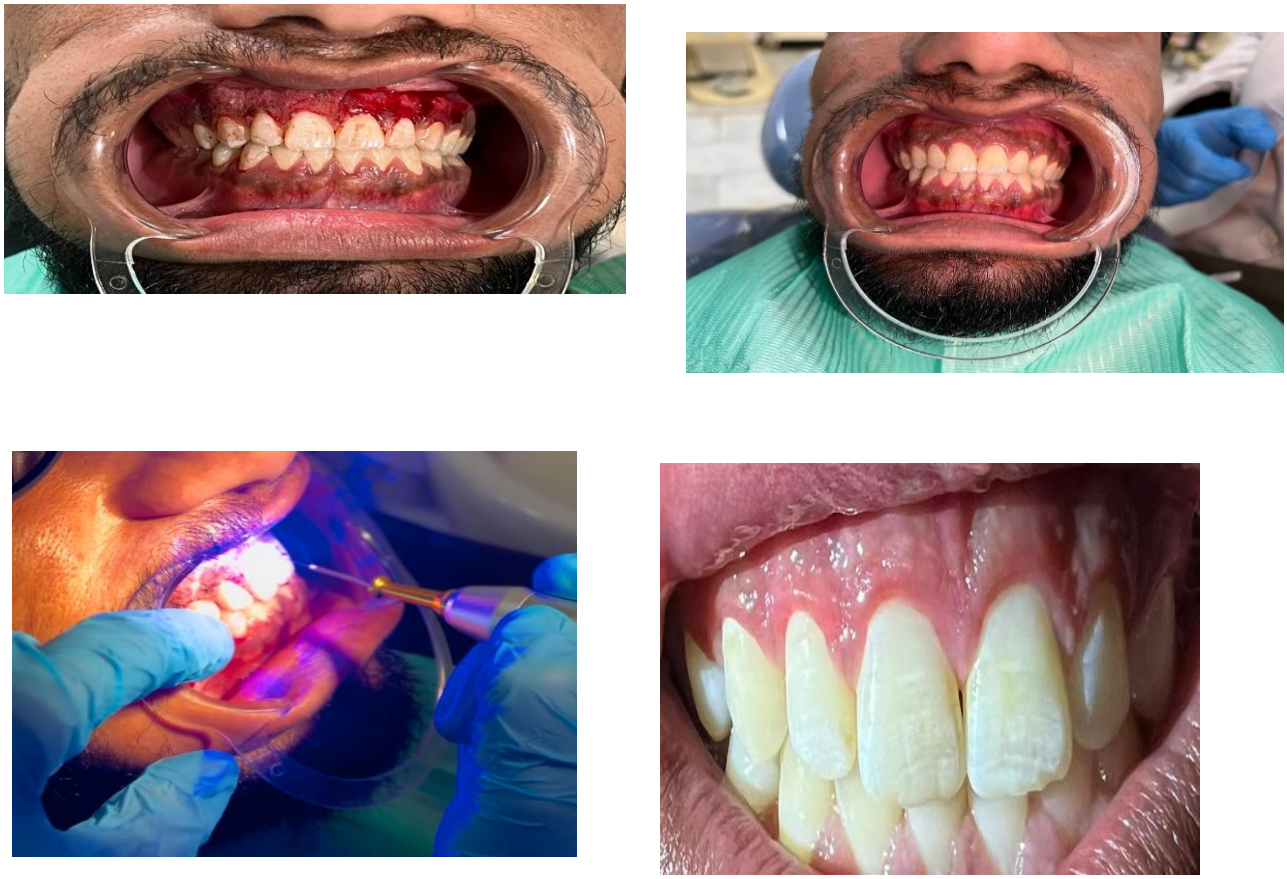


Figure (21): Preoperative (a) case I: Preoperative, (b) depigmentation using laser technique,

C during operative d) Fallow up

Result

Criteria	Laser Treatment	Traditional Methods
Pain	Minimal	More discomfort
Bleeding	Rare	Common
Healing Time	Faster	Slower
Recurrence	Less likely	May occur
Scarring	Rare	Possible
Precision	High	Moderate

Discussion

Gingival depigmentation has gained prominence as a vital procedure in cosmetic dentistry, particularly for patients seeking aesthetic improvements in their smiles. This study aimed to compare traditional surgical methods with laser-assisted techniques for gingival depigmentation, focusing on efficacy, safety, patient satisfaction, and postoperative outcomes.

Traditional methods of gingival depigmentation, such as scalpel excision and cryotherapy, have been the standard approaches for many years. These techniques involve the physical removal of hyperpigmented tissue, which can effectively reduce pigmentation. However, they often come with disadvantages, including longer recovery times, increased postoperative discomfort, and potential complications such as bleeding and infection. Patients frequently report anxiety regarding the invasiveness of these procedures, which can affect their overall satisfaction.

In contrast, laser-assisted gingival depigmentation has emerged as a promising alternative. The precision of lasers allows for targeted removal of pigmented tissue while minimizing damage to surrounding healthy gingival structures. Our findings indicate that patients who underwent laser treatment experienced significantly less postoperative discomfort and a faster recovery period compared to those treated with traditional methods. This aligns with previous studies that have highlighted the advantages of laser technology in periodontal procedures, emphasizing its ability to achieve hemostasis and reduce inflammation.

Patient satisfaction is a critical component of any dental procedure. In our cohort, those who received laser treatment reported higher levels of satisfaction regarding both the aesthetic outcomes and the overall experience of the procedure. The enhanced aesthetic results can be attributed to the precision of laser techniques,

which provide smoother and more uniform gingival contours post-treatment. Additionally, the reduced risk of scarring associated with laser methods contributes to improved aesthetic outcomes.

Safety is another essential aspect of this discussion. While both methods are generally safe when performed by trained professionals, the laser techniques showed a lower incidence of complications such as infection and excessive bleeding. The ability of lasers to sterilize the treatment area during the procedure further reduces the risk of postoperative complications. Despite the advantages of laser-assisted depigmentation, it is essential to consider the limitations and potential drawbacks. The initial costs associated with laser equipment can be a barrier for some dental practices, potentially limiting access for patients seeking this treatment option. Additionally, not all practitioners may be trained or experienced in laser techniques, which can affect the availability of this method in certain regions.

Future research should aim to establish long-term outcomes associated with both traditional and laser techniques for gingival depigmentation. Longitudinal studies assessing pigmentation recurrence rates, patient satisfaction over time, and cost-effectiveness will provide valuable insights for clinicians and patients alike. Furthermore, exploring variations in laser parameters and their impact on outcomes could refine procedural protocols and enhance clinical practice.

Conclusion

Health and appearance of gingiva are important parts of a smile

The gingiva is considered the most frequently pigmented tissue in the oral cavity.

Gingival pigmentation is a discoloration of the gingiva due to a variety of conditions associated with several Endogenous and exogenous etiologic feature

Laser more effect and comfort than traditional method

Laser offers multiple advantages: faster healing, less discomfort, and aesthetic results

Traditional methods still useful and accessible

Choice depends on case, equipment availability, and clinician expertise

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