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MANAGEMENT OF GINGIVAL HYPERPIGMENTATION USING DIODE LASER: A CASE REPORT AND REVIEW OF LITERATURE

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ABSTRACT

Gingiva is the most commonly pigmented oral tissue.[1] The color of the gingiva is described as ‘coral pink’, which is dependent on the vascular supply, the thickness and degree of keratinization of epithelium, presence of pigment such as melanin and exogenous factors (tobacco, colouring agents in foods etc.,).[1,2] An harmonious smile accounts for a perfect balance between the ‘pink’ and ‘white’ component of oral cavity.[3] Gingival hyperpigmentation does not pose any medical problem, but clinically it is presented as ‘black gum’, which poses a major esthetic problem in individuals, especially with a high smile line or gummy smile. It mainly affects the confidence, self-esteem and esthetics of an individual, which can also have a psychological impact on them. This leads to the increase in demand of cosmetic procedure for depigmentation of gingiva.[4,1] There are various treatment modalities for gingival depigmentation such as abrasion of the tissues with diamond bur, scraping with scalpel, electrosurgery, cryosurgery, gingivectomy with free gingival autografting, acellular dermal matrix allografts, and use of various types of lasers.[1] Lasers are the intense sources of non-ionizing electromagnetic radiation, having a specific and predictable wavelength. There are

several advantages of using lasers in periodontal therapy compared to the conventional methods for gingival depigmentation.[5]

KEYWORDS: Gingiva, Melanin, Depigmentation, Laser.[1,5]

INTRODUCTION

Gingival hyperpigmentation is defined as the discoloration of the gingiva due to lesions analogous with extrinsic as well as intrinsic factors. The five primary pigments melanin, melanoid, oxyhaemoglobin, reduced haemoglobin and carotene are the main causative factors of depigmentation.[6]

Oral pigmentation occurs in all human races. Physiologic pigmentation is perhaps genetically determined. But, according to Dummett, the degree of pigmentation is partially associated with chemical, mechanical and physical stimulation. In darker skinned individuals, oral pigmentation is greater, but there is no difference in the number of melanocytes between fair skinned and dark skinned individuals.[1]

Melanin is a non-haemoglobin derived brown pigment, produced by the melanocytes, which is considered an essential pigment that colors the tissues.[1,7] It appears as early as three hours after birth in the oral tissues and in some cases it is the only sign of pigmentation on the body (Dummett, 1946).[7]

Gingival hyperpigmentation is the condition caused by excessive melanin production by melanocytes mainly located in the basal and suprabasalcell layers of the gingival epithelium.[8]

Etiology: *Oral pigmentation can be classified as*

- **Physiologic oral pigmentation** - *melanin*
- **Pathologic oral pigmentation**

A) Exogenous

- Coloring agent in food.
- Tobacco.
- Metallic pigmentation.
- Amalgam tattoo.

B) Endogenous

- Addison's disease.
- Peutz Jeghers Syndrome.
- Albright Syndrome.[9]
- Jaundice (bilirubin).
- Hemochromatosis (iron).[2]

Pigmentation is most common in the anterior labial gingiva. In cases of pigmentation due to tobacco smoking, the intensity of gingival pigmentation is related to the duration of smoking and number of cigarettes smoked.[10]

Laser, an acronym for Light Amplification by Stimulated Emission of Raditaion, was first developed by Theodore Maiman in Los Angeles, in 1960, based on theories derived by Einstein in the early 1900s.[5] *Laser is a monochromatic, collimated, coherent, and intense beam of light produced by stimulated emission of radiation from a light source.*[11]

Stern and Sognnaes and Goldman et al. in 1964, applied ruby laser on enamel and dentine, describing their effects on these tissues. The first documented use of a laser in periodontal surgery was published in 1985. Among the many lasers available, high power lasers such as CO2, Nd:YAG and diode lasers can be used in periodontics because of their excellent soft tissue ablation and hemostatic characteristics.[5]

Case report

A 30 year old male patient reported to the department of periodontics, with the chief complains of dark black gums (Fig.1) and he wanted to get it corrected to enhance his aesthetics. On clinical examination gingival hyperpigmentation was noted in the anterior portion of maxillary gingiva. Patient was a known smoker since four years. Considering patient concern, gingival depigmentation was planned. Routine haematological findings were also assessed.[1]

Fig. 1: Pre-operative.

MATERIAL AND METHODS

One week prior to the depigmentation procedure, initial phase therapy including scaling was performed. Diode laser with a wavelength of 445nm at 2W power was used. It works on a continuous wave mode with a flexible fiber-optic delivery system, in a continuous contact mode.[12] Special eyeglasses were worn by the doctor as well as the patient to fulfill laser safety rules. After a local infiltration of the area, the properly initiated tip of the diode laser was angled at an external bevel of 45 degrees.[13]

Pigmented area of gingiva was ablated using this laser device, by holding the tip of the laser in light contact with the tissue, and light sweeping brush strokes were performed. It was directed to the target tissue until blister formation occurred (Fig.2). Blistered gingiva was then scraped off with wet, saline-moistened gauze to remove the epithelium containing pigmentation. The overall procedure was performed in cervico-apical direction in all pigmented areas.[12]

Fig. 2: Blistered gingiva after ablation with laser.

Later, the surgical site was protected with non-eugenol based periodontal dressing “coe pak”to reduce the patient discomfort and postoperative instruction was given to the patient. Analgesic was prescribed for pain management and patient was recalled after 1 week for follow-up and removal of periodontal dressing.[1]

RESULTS

Healing of the surgical site was uneventful without any complication. Patient was recalled after 3 months for evaluation. On intra-oral examination, the gingiva appeared to be normal, pink healthy.

In the six-month followup visit, repigmentation was noted in the form of patches in certain areas, as the patient continued to smoke even after the procedure (Fig.3).[1]

Fig. 3: Six months post-operative.

DISSCUSION

Dummett described the distribution of melanin pigmentation in black individuals as:
Palate- 61%, Gingiva- 60%, Mucous membrane- 22% and Tongue- 15%.[2]

A study conducted by *Karthikeyan Murthykumar et al* to detect the association of skin color and gingival hyperpigmentation among south indian population, showed that there was significant association between skin color and gingival hyperpigmentation.[7]

Dummett-Gupta oral pigmentation index (DOPI) score scale of pigmentation is

0 - Pink–no pigmentation
1 - Light Brown–mild pigmentation
2 - Mixed Pink and Brown or Medium Brown
3 - Deep Brown–Blackish Brown.[14]

Different techniques of gingival depigmentation shows different results. Laser depigmentation offers less patient discomfort, as there is minimal bleeding, no post-operative pain and rapid post-operative healing.

Mechanism of action of laser: Einstein in his theory of stimulated emission predicted that excited atoms could convert stored energy into light in the process by which an incoming photon of a specific frequency can interact with an excited atomic electron, causing it to drop to a lower energy level. The generated energy transfers to electromagnetic field, creating a new photon. This process has two important characteristics. First, it is multiplicative, because one photon induces two photons. If these photons interact with other two excited atoms, this will yield a total of four photons. Second and most importantly, these two photons have identical properties such as, direction, phase, wavelength and polarization. This ability to "amplify" light in the presence of a sufficient number of excited atoms leads to "optical gain" that is the basis of the laser operation.[15]

Einstein further theorized the concept of quantum theory of physics and stated that an additional quantum of energy may be absorbed by the already energized atom and that would result in a release of two quanta. These released quanta are in the form of identical photons, traveling as a coherent wave. These photons when come in contact with other atoms in the surrounding, they energize them, resulting in the emission of more photons. This results in the amplification of light energy and thus producing a laser beam.[16]

Lasers used in dentistry vary from ultraviolet light (100-400nm), to infrared spectrum (750 nm-1 mm). The visible spectrum lies between these two wavelengths (400-750nm). Lasers commonly used in dentistry consist of a variety of wavelengths delivered as either a continuous, pulsed (gated), or running pulse waveform.[15]

In clinical dentistry, laser applications may involve "diode" group (wavelength range 405–1064 nm), mid-infra-red lasers (erbium, chromium: YSGG 2780 nm and erbium: YAG 2940 nm), and the far IR CO2 wavelength range of 9300–10,600 nm that can target tissue water.[17] Gingivectomy, gingivoplasty and frenectomy are the most popular procedures carried out using lasers. The CO2, diode and Nd:YAG lasers can treat melanin pigmentation effectively.[5]

Laser tissue interactions

When laser light comes in contact with oral tissues, one or more of these four possible interactions can occur, such as - absorption, reflection, transmission, or scattering (Fig.4).[18]

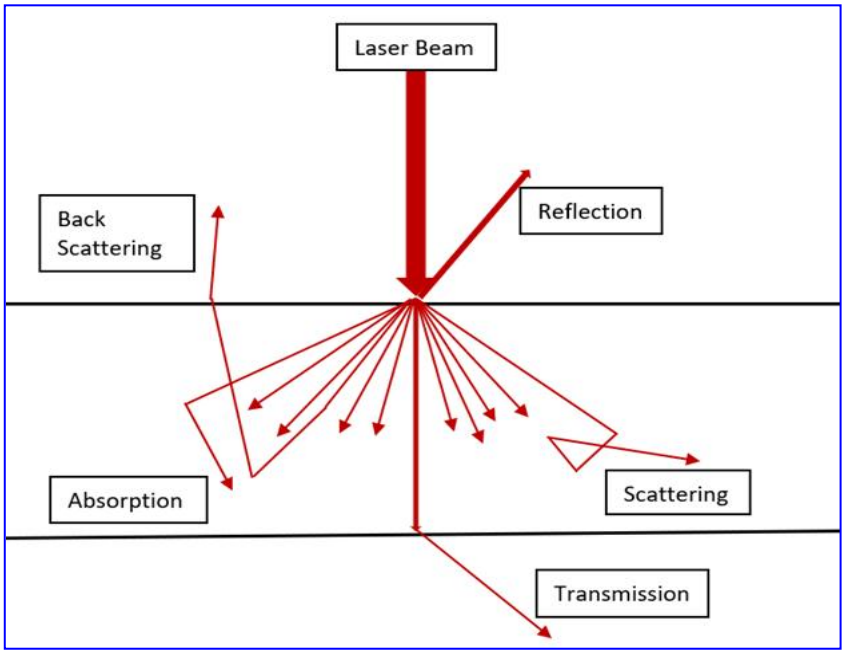

Fig. 4: Laser tissue interactions.[18]

The recurrence of pigmentation is the major problem that can be encountered after depigmentation treatments.[13] Repigmentation refers to the clinical reappearance of gingival pigmentation following a period of clinical depigmentation. Repigmentation has been documented to occur following the procedure of depigmentation, within 24 days to 8-year long period. A study by *Perlmutter et al. (1986)* showed that gingival surgical procedures performed solely for cosmetic reasons offer no permanent results.[1]

Several hypotheses have been put forward: the nature of the technique used, the race of the patient, and the recolonization of the treated surfaces with active melanocytes from adjacent tissues. *Ginwalla et al* suggested that, it can also be attributed to residual melanocytes left during the operation, which can start to synthesize melanin once they are activated.[13]

The patient's ethnicity and tobacco consumption are two other factors mentioned in the literature that could promote pigmentation recurrence. *Esen et al.* observed a recurrence in 2 out of 10 patients, both smokers, in whom they performed gum depigmentation.[13]

Hardianti M. Haryo, et al compared some of the depigmentation techniques towards recurrence of gingival hyperpigmentation. Although it hurts and requires more suturing than laser therapy, treatments using conventional scalpel technique for gingival depigmentation were observed to have a good result because they rarely cause gingival recurrence. Moreover, scalpel is still a gold standard to treat gingival hyperpigmentation.[8]

Lasers offers several advantages. High rate of patient acceptance is one of the greatest advantages of laser use. Other advantages includes little chance for mechanical trauma, minimal scarring, hemostasis, less postoperative swelling, a reduction in bacterial population at the surgical site, less need for suturing, faster healing, and less postoperative pain. Photo physical characteristics of lasers, produces detoxification and bactericidal effects on the human body. Thus, in periodontal therapy, laser treatment may serve as an alternative or adjunctive therapy to mechanical approaches.[5]

CONCLUSION

The future of lasers in dentistry is promising, and new applications and procedures are being developed. It is most important for the dental practitioner to become familiar with those principles of lasers and then choose the proper laser for the intended clinical application.[5]

Diode laser provides the longest-term stability in treatment. Smoking negatively affects the longevity of gingival depigmentation.[19] Hence, smoking cessation may be mandatory to avoid repigmentation.[13] In summary, the application of lasers has been recognized as an adjunctive or alternative approach in gingival depigmentation, offering more patient compliance and comfort.[5]

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