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RESEARCH ARTICLE

GINGIVAL DEPIGMENTATION- AN ARRAY OF TREATMENT MODALITIES

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ABSTRACT

Gingival pigmentation has intrigued clinicians and researchers alike owing to its numerous etiologies of origin and the difficulties faced in its absolute elimination. It is defined as the discoloration of the gingiva due to lesions and conditions associated with numerous extrinsic and intrinsic factors. Melanin is the most commonly implicated pigment in gingival pigmentation. Numerous attempts have been made by various authors to classify gingival melanin pigmentation.

Over the years, with an increasing demand for esthetics, the treatment of pigmented lesions of the gingiva has gained significance. Although, gingival pigmentation is not a pathologic problem, patients usually request cosmetic therapy, particularly, if the pigmentation is visible during speech and smiling. Various methods, including gingivectomy, gingivectomy with free gingival autografts, electrosurgery, cryosurgery, chemotherapy with 90% phenol or 95% ethyl alcohol, abrasion with bur, semiconductor diode laser, and CO_2 lasers have been used with different degrees of success in the treatment of gingival pigmentation. More recent techniques involve the use of ascorbic acid and also Acellular Dermal Matrix allograft.

The present paper aims to highlight the conventional as well as more novel techniques for the treatment of gingival pigmentation and also lay emphasis upon the significance of each.

INTRODUCTION

Gingival pigmentation has intrigued clinicians and researchers alike owing to its numerous etiologies of origin and the difficulties faced in its absolute elimination. Gingival pigmentation has been defined as the discoloration of the gingiva due to lesions associated with extrinsic and intrinsic factors. Melanin is the most commonly implicated pigment in gingival pigmentation. The gingiva is the most frequently pigmented tissue in the oral cavity. Dummett and Barens implicated many systemic and local factors as causes of changes in oral pigmentation. [1] Various stimuli can result in increased production of melanin including trauma, radiation and medication. Physiologic pigmentation which is the main condition observed, probably is determined genetically. However, as Dummett suggested, the degree of pigmentation is related part to mechanical, chemical and physical stimulation. High levels of oral melanin pigmentation usually are observed in individuals of African, East Asian or Hispanic backgrounds. [2]

Post-inflammatory pigmentation, smoker's melanosis, drug related pigmentation are conditions frequently encountered by dentists. Intentional placement of tattoos within the oro-facial region is occasionally seen in clinical practice. [3]

Ever since esthetics has become a predominant aspect of our lives, the demand for gingival depigmentation has become common. Over the years, numerous techniques for gingival depigmentation have developed and subsequently evolved. The present paper intends to highlight the traditional as well as the novel approaches employed for the treatment of gingival depigmentation.

Physiology of Pigmentation:

The process of pigmentation comprises of three phases [4]

- Activation of melanocytes
- Synthesis of melanin
- Expression of melanin

1) The activation occurs on the stimulation of melanocytes by factors like stress hormones, sunlight etc. leading to production of chemical messengers like melanocyte stimulating hormone.

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2) In synthesis phase, melanocytes synthesize granules called melanosomes. This process occurs when the enzyme tyrosinase converts amino acid tyrosine into a molecule called dehydroxyphenylalanine (DOPA). Tyrosinase then converts DOPA into secondary chemical dopaquinone. After a series of reactions, dopaquinone is converted into either dark melanin (eumelanin) or light melanin (pheo-melanin)
3) In expression phase, melanosomes are transferred from the melanocytes to the keratinocytes which are the skin cells located above melanocytes in the epidermis. After this, melanin color eventually becomes visible on the surface of skin.

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. [5]

The degree of pigmentation depends on variety of factors especially the activity of melanocytes. Fair-skinned individuals are very likely to have non-pigmented gingiva, but in darker skinned persons, the chance of having pigmented gingiva is extremely high. The highest rate of gingival pigmentation has been observed in the area of incisors. The rate decreases considerably in the posterior region. [6]

Classification

Different systems have been proposed by different authors to classify melanin pigmentation. Dummett *et al*. classified pigmentation into primary oral, secondary oral, oral non melanin and oral melanoclasis. [2] Brocheriou categorized lesions into non-tumoral, non-melanin pigmented tumors, benign pigmented lesions and malignant melanoma. [7] Another system was put forward by Meleti who categorized pigmented lesions into melanin associated and non- melanin associated lesions. [8] An extensive classification was recently put forth by Kauzman *et al*. [1]

Need for depigmentation

Although gingival pigmentation is not a pathologic problem, patients usually request cosmetic therapy, particularly if the pigmentation is visible during speech and smiling. Demand for the cosmetic therapy of gingival melanin pigmentation has increased over the years. Aesthetics has become an essential concern of dentistry and clinicians are faced with achieving acceptable gingival esthetics as well as meeting functional and biological requisites. Gingival colour plays an integral role in the overall esthetics of an individual. Gingival hyperpigmentation that is of physiologic and ethnic origin often presents as a cosmetic problem and patients request for cosmetic correction.

The degree of pigmentation depends on variety of factors especially the activity of melanocytes. Fair-skinned individuals are very likely to have non-pigmented gingiva, but in darker skinned persons, the chance of having pigmented gingiva is extremely high. The highest rate of gingival pigmentation has been observed in the area of incisors. The rate decreases considerably in the posterior region.

First and foremost indication for depigmentation is patient's demand for improved esthetics. Also, before proceeding for any specific depigmentation modality, careful assessment of the skin colour, particularly colour of the face and lips should be evaluated to achieve harmony between colour of the gingival tissues and colour of the face.

Various methods, including gingivectomy, [9] gingivectomy with free gingival autografts, [10] electrosurgery, [11] cryosurgery, [12, 13] chemotherapy with 90% phenol or 95% ethyl alcohol, [14] abrasion with bur, [15] semiconductor diode laser, [16] and CO_2 lasers, [17] have been used with different degrees of success.

Gingival depigmentation

Gingival depigmentation is a periodontal plastic procedure whereby the gingival hyperpigmentation is removed or reduced by various techniques. Historically, several procedures have been used to correct depigmentation including mechanical, surgical, chemical, electrosurgical and cryosurgical means. The different techniques employed for gingival hyperpigmentation were classified by Azzeh M. [18]

I. Methods aimed at removing the pigmented layer are:
A. Abrasion technique using long, round diamond bur
B. Surgical methods of depigmentation
1. Scalpel surgical technique
2. Cryosurgery
3. Electrosurgery
C. Chemical methods of depigmentation using 90% phenol and 95% ethanol
D. Lasers
1. CO_2 lasers
2. Diode lasers
3. Neodymium doped ; Al :Yttrium Garnet (Nd: YAG) laser
4. Erbium –doped ;Yttrium :Al Garnet (Er: YAG) laser
5. Er, Cr: YSGG laser

II. Methods aimed at masking the pigmented gingiva with grafts from less pigmented area are:
A. Free Gingival Graft
B. Sub-epithelial connective tissue graft
C. Acellular Dermal Matrix (ADM) allograft

Methods aimed at removing pigmentation

Abrasion technique

Putter *et al*. were among the pioneer researchers who described gingival abrasion using a round bur. [19] This is a comparatively safe and an aggressive method that is both easily used and readily repeated, if requested to eradicate any residual or re-pigmented area. This involves removing the epithelium of pigmented area with a high speed handpiece and diamond bur with copious water lavage. Care must be exercised to use feather light brushing strokes to remove the pigmented area without holding the bur in one place. All the remnants of

melanin pigment or the pigmented area of epithelium should be completely removed to prevent possible relapse of the problem. [20]

Scalpel surgical technique

Under infiltration anaesthesia, blade number 15 with BP handle is used to scrape the epithelium with underlying pigment layer carefully. This raw surface is irrigated with saline solution. Once bleeding stops, the exposed depigmented surface is covered with Coe-pak for one week. Almas K reported that healing period for scalpel wounds is faster than other techniques. [21] Scalpel surgery causes unpleasant bleeding during and after the operation and it is necessary to cover the connective tissue with pack for 7-10 days.

Cryosurgery

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. [22] 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 keratinoytes 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 -4^0C to -7^0C where cell death can occur. Superficial gingival cryosurgery has demonstrated healing by complete regeneration. In this method, topical anaesthesia with 4% xylocaine spray is used to minimize discomfort for 1-2 minutes. The method used for treatment is direct application of liquid N_2 (-196^0C) 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 tetrafluoroethane is another frequently used gas which serves as an inexpensive, easy to use, store and transport cryosurgery agent. [23] Sheetra *et al*. performed cryosurgery in maxillary anterior region by exposing it to a gas expansion cryoprobe using nitrous oxide. The cryoprobe was cooled to temperature of -70^0C to -90^0C and applied to the tissue for 30 seconds. 30 minutes after freezing, the tissue was indistinguishable from the adjacent gingiva. [24]

Electrosurgery

It is the application of a high frequency electric current to biological tissues in order to cut, coagulate, dessicate or fulgurate tissue. Its benefits include the ability .to make precise cuts with limited blood loss. It involves the passage of radiowaves at the frequency of 1.5 to 4.5 MHz. A loop electrode is used for de-epithelizing the gingiva. Light brushing strokes are used and tip is kept in motion. Keeping the tip at one place may lead to heat buildup and destroy all tissue. Then a periodontal dressing is placed over the wound area. [11]

Chemical methods

Hirschfeld and Hirschfeld used phenol (90%) and alcohol (95%) to remove area of pigmentation in oral cavity. [14] In this, the area to be depigmented is isolated using cotton rolls and dried using cotton or air. A small pledget of cotton, grasped with cotton pliers is dipped in 90% phenol and lightly blotted, and then applied carefully to pigmented area. After 20 seconds have passed, phenol is neutralized with 95% alcohol and patient then rinses with water. After drying the area, the procedure is repeated. Within 24 hours, cauterized tissue sloughs off leaving behind a painless bright red area, which heals completely within a week to 10 days. The mucous membrane appears normal in colour and texture with no evidence of pigmented condition.

Laser

It is an acronym for light amplification by stimulated emission of radiation. Lasers used for depigmentation include: [25]

1. CO_2
2. Diode
3. Nd:YAG
4. Er:YAG
5. Er,Cr:Yt

CO_2 LASER

It is a gas active medium laser that incorporates a sealed tube containing a gas mixture with CO_2 molecules pumped via electrical discharge current. With the Co_2 laser, the rapid rise in intracellular temperature and pressure leads to cellular rupture as well as release of vapour and cellular debris termed the laser plume. Charr formation occurs more rapidly in the continuous wave mode than the gated mode. [17] Sharon *et al*. tested the efficacy of CO_2 laser. It was found to be effective in eliminating the pigmented areas in all tissues treated and no recurrence of melanin was detected in either the oral mucosa or gingiva. [26] Esen *et al*. described the treatment of gingival melanin pigmentation and reported ablation of the hyperpigmented gingiva with minimal carbonization and almost no bleeding. [27, 28]

Diode laser

It is a solid state semi-conductor laser that typically uses a combination of gallium and other elements eg. Aluminium and indium to change electrical energy into light energy. An excellent soft tissue tissue laser, it has been found to be effective in removing melanin pigmentation. [28]

Er: YAG laser

A mechanism of biological tissue ablated with Er:YAG laser has been proposed, based on optical properties of its emission wavelength. Because its wavelength corresponds to the absorption coefficient of water, laser irradiation transforms within tissue into steam producing thermomechanical microexplosions. The Er:YAG laser is able to remove excessive melanin by ablating tissue in the suprabasal and basal layers of epithelium. [19]

Tal *et al*. in their study in 10 patients with pigmented gingival

used Er: YAG laser. The brush technique was applied until the gingival surface appeared clinically free of pigmentation. The esthetic results were pleasing and healing was reported to be uneventful. [29] Rosa *et al*. performed similar procedures in 5 patients and reported fast epithelization with a healthy appearance at the end of one week. By the end of one month complete healing was observed. [30]

Er,Cr, YSGG

This employs hydrokinetic energy for oral hard tissue cutting. For soft tissue cutting, the process is tissue vaporization with adjustable air and water coolant to minimize collateral thermal damage to surrounding tissue. Advantages of Erbium laser are minimal thermal injury, patient comfort during procedure and faster wound healing. [31]

Berk *et al*. reported a case where treatment of gingival hyperpigmentation by Er, Cr: YSGG laser radiation in a defocused mode was found to be a safe and effective procedure. Post-operative patient satisfaction in terms of esthetics and pain was excellent. The gingival healed uneventfully and completely regenerated with no infection, pain, swelling or scarring. No repigmentation occurred in patients after six months. [6]

Ascorbic Acid

As an inhibitor of melanin formation, ascorbic acid has been used to treat melanin pigmentation. Shimada *et al*. investigated the effects of ascorbic acid on melanin formation in B-16 mouse melanoma cells and three dimensional human skin models. 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. [32]

Methods aimed at masking the pigmented gingival with graft from less pigmented areas

Free gingival graft (FGG)

Tamizi and Taheri used FGG to treat gingival hyperpigmentation in 10 patients where two areas in each patient were grafted. In all, 10 patients where recipient site received full thickness bed preparation, no evidence of repigmentation was found after 4.5 years. Of the 10 areas that received partial thickness bed preparation only one exhibited repigmentation after one year. [10] Russo also described a case of palatal gingival auto graft to convert a large amalgam tattoo covering labial gingiva and extending into the alveolar mucosa of inter-maxillary incisor region. [33]

Sub-epithelial connective tissue graft

Langer *et al*. first described the sub-epithelial connective tissue graft as technique for coverage of exposed root surfaces with highly esthetic treatment outcomes. [34] Philips GE described the use of sub-epithelial connective tissue graft in a patient with localized pigmented lesion involving the marginal gingiva, attached gingiva and alveolar mucosa. It was reported that treatment of a localized pigmented lesion that has a clinical appearance, dental history and radiographic appearance consistent with an amalgam or graphite tattoo with a connective tissue graft at the time of excision can result in a high esthetic outcome and eliminate the need for an additional surgical procedure in future. [35]

Acellular Dermal Matrix (ADM) Allograft

It has been reported to be a substitution for autogenous gingival graft in order to increase attached gingiva, provide root coverage in gingival recession, and increase gingival thickness in edentulous areas, act as a barrier membrane in guided bone regeneration and along with immediate implants. [36] In a comparative evaluation by Pontes *et al*. 15 patients with bilateral gingival pigmentation were treated using ADM when a partial thickness flap was raised and ADM was adapted and sutured. On the opposite site, oral epithelium was removed using diamond bur. At the end of one year, minimal repigmentation was noted from ADM group while significant was seen in abrasion site. [37]

CONCLUSION

Ever increasing demand for a pleasing personality has made people conscious of the broad black zone of pigmentation on the facial aspects of gingiva, which may be evident during speech and facial expressions. Attention has been drawn to the fact that such an unsightly gingival pigmentation may have lasting effects on the emotional well being of many individuals. Hence, it is imperative to identify the etiology of pigmentation and provide a definitive treatment for the same.

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