Management of Gingival Hyperpigmentation Using Surgical Blade and Diode Laser Therapy: A Comparative Study

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Summary: Melanin, a nonhemoglobin-derived brown pigment, is the most common of the endogenous pigments and is produced by melanocytes present in the basal layer of the epithelium. Although melanin pigmentation of the gingiva is completely benign and does not present a medical problem, complaints of 'black gums' are common, particularly in patients having a very high smile line (gummy smile). Gingival hyperpigmentation is caused by excessive deposition of melanin located in the basal and suprabasal cell layers of the epithelium. Various depigmentation techniques have been employed, such as scalpel surgery, gingivectomy, gingivectomy with free gingival autografting, cryosurgery, electrosurgery, chemical agents such as 90% phenol and 95% alcohol, abrasion with diamond burs, Nd:YAG laser, semiconductor diode laser, and CO_2 laser.

The present case series describes two simple and effective surgical depigmentation techniques – scalpel blade surgery and semiconductor diode laser surgery – for gingival depigmentation, which have produced good results with patient satisfaction. The diode laser is a solid-state semiconductor laser that typically uses a combination of Gallium (Ga), Arsenide (Ar), and other elements, such as Aluminum (Al) and Indium (In), to change electrical energy into light energy. In this report, better results were achieved with semiconductor diode laser than conventional scalpel blade surgery.

Keywords: diode laser, hyperpigmentation, soft tissue laser, gingival, melanin.

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A smile expresses a feeling of joy, success, sensuality, affection, and courtesy, and can reflect self-confidence and kindness. The harmony of a smile is not only determined by the shape, position, and color of the teeth, but also by the gingival tissues. Gingival health and appearance are essential components of an attractive smile.

Melanin pigmentation of the gingiva occurs in all ethnicities.[3] The epithelium-melanin unit is formed by the melanocytes and keratinocytes. The melanocytes are dendritic cells unattached to the surrounding epithelial cells that behave as unicellular exocrine glands. Active melanocytes convert tyrosine to melanoprotein (melanin), which is transferred to the basal and prickle cell layers.[1] Gingival hyperpigmentation is seen as a genetic trait in some populations, and is more appropriately termed physiological or racial gingival pigmentation.[3] The prevalence of melanin pigmentation in different populations has been reported to vary between 0% to 89% with regard to ethnic factors and smoking habits.

Lasers have been used in dentistry since the beginning of the 1980s.[4] Semiconductor diode laser has been used for gingivectomy, frenectomy, incisional and excisional biopsy, soft tissue tuberosity reduction, op-

erculum removal, coagulation of graft donor site, and exposure of soft tissue covering osseointegrated implants.

The present case series describes two simple and effective surgical depigmentation techniques: scalpel blade surgery and semiconductor diode lasers.

CASE DESCRIPTION

Three patients who had physiological moderate to severe gingival melanin hyperpigmentation were selected. Inclusion criteria were the presence of moderate to severe melanin pigmentation of the maxillary labial gingiva. Exclusion criteria included systemic diseases associated with healing disturbances, pathologic gingival hyperpigmentation or disturbed wound healing (eg, uncontrolled diabetes, autoimmune disease etc.), pregnancy, smoking. The surgical procedure and follow up were explained in detail to the patients, who then signed a consent form.

Case 1

A 24-year-old female patient complaining of heavily pigmented gums visited the Department of Periodontics, Rural Dental College, Loni. The patient had a very high smile line that revealed the deeply pigmented gingiva from second premolar to second premolar. The pigmentation was unsightly, and hence, depigmentation procedures were planned.

The patient was given oral hygiene instructions, and underwent scaling. Gingival depigmentation was planned from second premolar to second premolar in the maxillary region. For the maxillary left quadrant, a scalpel blade was used, and for the maxillary right quadrant, semiconductor diode laser was used.

After adequate local anesthesia, maxillary left heavily pigmented gingival areas up to the second premolar were de-epithelized with a scalpel blade (no. 15) by the slicing method. Depigmentation was carried out from the mucogingival junction towards the tip of the interdental papilla. Care was taken to avoid pitting of gingival surface or to remove too much tissue. Care was also taken to remove all the remnants of melanin pigment as thoroughly as possible. However, some areas with very thin gingiva were left in order to avoid exposure of bone in the region of attached gingiva and to prevent gingival recession.

A semiconductor diode surgical laser unit (ezlase, Biolase Technology; Irvine, CA, USA; wavelength 800 to 980 nm) was used for depigmentation of the maxillary right anterior gingiva up to the second premolar. As there is no need for anesthesia, only topical lignocane spray was used. Laser ablation started from the mucogingival junction toward the free gingival margin, including papillae. The motion of ablation was performed as light brushing strokes and the tip was kept in motion all the time.[11] Remnants of the ablated tissue were removed using sterile gauze dampened with saline solution. This procedure was repeated until the desired depth of tissue removal was achieved. A smaller laser tip of size 300 μm was used at the gingival margin and interdental papilla in order to achieve better control.[6]

Laser safety

Safety glasses were worn by the operator, patient, and assistant. Highly reflective instruments or instruments with mirrored surfaces were avoided, as there could be reflection of the laser beam. Care was taken to avoid using laser in presence of explosive gases.

Cases 2 and 3

Two patients, a 22-year-old and a 30-year-old male, reported to our department complaining of the same problem. Both patients exhibited a moderate type of pigmentation. After scaling, depigmentation was done in the maxillary right quadrant with the semiconductor diode laser and the left quadrant with a scalpel blade (no. 15). A periodontal pack dressing and oral hygiene instructions were given to each patient. The pack was removed after 1 week, and patients were recalled for postoperative visits on a weekly basis for 3 weeks.

Clinical Evaluation

Clinical parameters, such as bleeding, wound healing, gingival color, pain and difficulty of procedure were evaluated immediately after and then at 1-, 2-, and 3-week intervals. A list of clinical observations and patient responses prepared by Ishii et al[14] and Kawashima et al[15] was used for evaluation. Each parameter was evaluated as A, B, C, or D as described in Table 1.

The visual analog scale (VAS) was used to evaluate the subjective pain level experienced by each patient. It consists of horizontal line 100 mm long, starting at the left end with the descriptor "no pain" and ending at the

Table 1 Clinical Evaluation Scores

Evaluation	Score
Bleeding	A. none, B. slight, C. moderate, D. severe
Color	A. improvement, B. slight improvement, C. no change, D. deterioration
Pain	A. none, B. slight, C. moderate, D. severe
Difficulty of procedure	A. very easy, B. easy, C. difficult, D. impossible
Wound healing	A. complete epithelization, B. incomplete epithelization, C. ulcer, D. tissue defect or necrosis

Table 2 Clinical evaluation of scalpel blade technique

Evaluation	Patient 1	Patient 2	Patient 3
Bleeding			
Immediate	D	D	C
1 week	B	B	B
2 weeks	A	A	A
3 weeks	A	A	A
Color			
Immediate	A	A	A
1 week	A	A	A
2 weeks	A	A	A
3 weeks	A	A	A
Pain			
Immediate	–	–	–
1 week	B	B	B
2 weeks	A	A	A
3 weeks	A	A	A
Wound healing			
Immediate	–	–	–
1 week	B	C	B
2 weeks	A	A	A
3 weeks	A	A	A
Difficulty	B	C	B

right end with "unbearable pain." Patients were asked to mark the severity of the pain. The distance of this point, in millimeters, from the left end of the scale was recorded and used as the VAS score. If the score was 0 – no pain, scores between 0.1 and 3.0 were recorded as slight pain, 3.1 to 6.0 was considered as moderate pain, and scores of 6.1 to 10 were recorded as severe pain.

RESULTS

Table 1 presents the clinical evaluation for each parameter. Figures 1 to 3 depict the representative clinical cases. Because the patient was under anesthesia, no evaluation of pain or discomfort was made during and immediately after the surgery. At the scalpel blade depigmentation site, bleeding occurred (Table 2). There

CASE 1

Fig 1a Case 1, preoperative view.

Fig 1b Case 1, immediately postoperatively, with blade.

Fig 1c Case 1, immediately postoperatively, with laser.

Fig 1d Case 1, 1 week postoperatively.

Fig 1e Case 1, 2 weeks postoperatively.

Fig 1f Case 1, 3 weeks postoperatively.

Fig 1g Case 1, 3 weeks postoperatively.

CASE 2

Fig 2a Case 2, preoperative view.

Fig 2b Case 2, immediately postoperatively.

Fig 2c Case 2, 1 week postoperatively.

Fig 2d Case 2, 2 weeks postoperatively.

Fig 2e Case 2, 3 weeks postoperatively.

CASE 3

Fig 3a Case 3, preoperative view.

Fig 3b Case 3, immediately postoperatively.

Fig 3c Case 3, immediately postoperatively.

Fig 3d Case 3, 1 week postoperatively.

Fig 3e Case 3, 2 weeks postoperatively.

Fig 3f Case 3, 3 weeks postoperatively.

was no bleeding at the lased depigmentation areas in any patient, as shown in Table 3. Compared to scalpel blade depigmentation, diode laser depigmentation showed delayed healing. Pertaining to sites operated on with the scalpel blade, 2 patients complained of moderate pain and 1 patient complained severe pain on the VAS. In contrast, sites treated with diode laser were rated as only slightly or not painful.

All patients were satisfied with the esthetically significant improvement in gingival color.

DISCUSSION

Pigmented gingival tissue often forces patients to seek cosmetic treatment. Several treatment modalities have been suggested in the literature, ranging from a simple slicing method to free gingival grafts or "push back" operation, where alveolar bone may be exposed, leading to bone loss, secondary healing, discomfort and pain.[7]

The semiconductor diode laser is emitted in continuous-wave or gated-pulsed modes, and is usually operated in a contact method using a flexible fiber optic delivery system. Laser light at 800 to 980 nm is poorly absorbed in water, but highly absorbed in hemoglobin and other pigments.[13] Since the diode basically does not interact with dental hard tissues, the laser is an excellent soft tissue surgical laser, indicated for cutting and coagulating gingiva and oral mucosa, and for soft tissue curettage or sulcular debridement. The diode laser exhibits thermal effects using the "hot-tip" effect caused by heat accumulation at the end of the fiber, and produces a relatively thick coagulation layer on the treated surface. The usage is quite similar to electrocauterization. Tissue penetration of a diode laser is less than that of the Nd:YAG laser, while the rate of heat generation is higher. The advantages of diode lasers are the smaller size of the units as well as the lower financial costs. Diode laser did not produce any deleterious effect on the root surface. Thus, it is generally consid-

Table 3 Clinical evaluation of diode laser technique

Evaluation	Patient 1	Patient 2	Patient 3
Bleeding			
Immediate	A	A	A
1 week	A	A	A
2 weeks	A	A	A
3 weeks	A	A	A
Color			
Immediate	A	A	A
1 week	A	A	A
2 weeks	A	A	A
3 weeks	A	A	A
Pain			
Immediate	–	–	–
1 week	A	A	A
2 weeks	A	A	A
3 weeks	A	A	A
Wound healing			
Immediate	–	–	–
1 week	B	B	A
2 weeks	A	A	A
3 weeks	A	A	A
Difficulty	A	A	A

ered that diode laser surgery can be performed safely in close proximity to dental hard tissue.

The healing period of scalpel wounds is shorter than with diode laser. However, scalpel surgery causes unpleasant bleeding during and after the operation and it is necessary to cover the exposed lamina propria with a periodontal pack for 7 to 10 days. The diode laser causes minimal damage to the periosteum and bone under the gingiva being treated, and it has the unique property of being able to remove a thin layer of epithelium cleanly. Although healing of laser wounds is slower than healing of scalpel wounds, a sterile inflammatory reaction occurs after lasering.[11] Blood vessels in the surrounding tissue up to a diameter of 0.5 mm are sealed; thus, the primary advantage is hemostasis and a relatively dry operating field.

The usual mechanisms of diode laser that lead to ablation or decomposition of biological materials are photochemical, thermal, or plasma mediated. Thermal ablation means that the energy delivered by the laser interacts with irradiated material by an absorption process, yielding a temperature rise there.[10] As the temperature increases at the surgical site, the soft tissues are subjected to warming (37 to 60°C), protein denaturization, coagulation (> 60°C), welding (70 to 90°C), vaporization (100 to 150°C), and carbonization (> 200°C).[2] The rapid rise in intracellular temperature and pressure leads to cellular rupture, as well as release of vapor and cellular debris, termed the laser plume.[8] Moritz et al[9] showed in an in vitro and in vivo study the bactericidal effect of diode laser.[9] They found that an extraordinarily high reduction of bacteria could be achieved. It creates locally sterile conditions, resulting in a reduction of bacteremia concomitant with operation. It is also postulated that low output power laser mediates an analgesic effect related to depressed nerve transmission in dentinal hypersensitivity.

The advantages of laser use include:

1. A relatively bloodless surgical and postsurgical course
2. The ability to coagulate, vaporize, or cut tissues
3. Sterilization of the wound site
4. Minimal swelling and scarring

5. Little mechanical trauma
6. Reduction of surgical time
7. High patient acceptance
8. Less postoperative pain, which may be due to the protein coagulum that is formed on the wound surface, thereby acting as a biological dressing and sealing the ends of the sensory nerves
9. Smaller size of the units as well as the lower financial costs.

CONCLUSION

Growing esthetic concerns require the removal of unsightly pigmented gingival areas to create a pleasant and confident smile, which altogether may alter the personality of an individual. This could be easily attained by using any of the above mentioned methods. The application of diode laser appears to be a safe and effective alternative procedure for the treatment of gingival melanin pigmentation. Its benefits include ease of usage, effectiveness in the treatment of superficial benign pigmented lesions, convenience in dental clinics, and decreased trauma for the patient. The patients were satisfied with the outcome, which is the ultimate goal of any therapy.

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