

Treatment of Gingival Physiologic Pigmentation in Adolescents by Liquid Nitrogen Cryosurgery: 24-Month Follow-up



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Although gingival pigmentation is physiologic in most cases, esthetic concerns regarding "black gums" are common among adolescents. Numerous procedures have been suggested to treat this problem. The aim of this study was to evaluate the efficacy of cryosurgery with liquid nitrogen for the removal of physiologic gingival pigmentation (PGP) in adolescents. Melanin pigmentation of the anterior segments in 15 patients was treated using liquid nitrogen. Standard digital photographs were taken preoperatively and at 3, 12, and 24 months postoperatively. Photographs were analyzed digitally and showed significant differences in gingival color between the preoperative and postoperative follow-ups. Cryosurgery successfully removed PGP in adolescents. (Int J Periodontics Restorative Dent 2012;32:e142 –e146.)

The gingiva is the part of the oral mucosa that covers the alveolar bone processes and surrounds the teeth.¹ Like the skin, the gingiva may become pigmented for endogenous or exogenous reasons. Physiologic gingival pigmentation (PGP) is the most common type of gingival pigmentation and results from excessive melanin deposition. The color of melanin-pigmented gingiva varies from light to dark brown or black.² This phenomenon is usually physiologic, although pathologic disorders (eg, Albright syndrome, malignant melanoma, antimalarial therapy, Peutz-Jeghers syndrome, trauma, hemochromatosis, chronic pulmonary disease, and racial pigmentations) also serve as etiologic factors for oral melanin pigmentation.³

Melanocytes are dendritic cells that are located primarily in the basal and suprabasal epithelial layers.^{2,3} They are unattached to the epithelial cells and behave like unicellular exocrine glands.³ Physiologic pigmentation is usually a result of the higher activity of melanocytes rather than an increase in their number² and results in symmetric pigmentation with

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an unaltered gingival architecture. Pigmentation is seen in all races and ages without gender predilection.^{4,5} However, high levels of oral melanin pigmentation are normally observed in African, East Asian, Mediterranean, and Hispanic populations.^{2,3,6,7}

Although PGP is a normal condition in most cases, complaints of "black gums" resulting from esthetic concerns are particularly common among adolescents.²⁻⁵ Different treatment methods have been suggested for melanin pigmentation, including gingivectomy,^{8,9} free gingival autografts,^{5,7,10} acellular dermal matrix allografts,¹¹ electrosurgery,⁵ cryosurgery,^{2,4,12} abrasion with a diamond bur,^{5,13} and treatment with an Er:Yag laser,^{14,15} CO₂ laser,^{3,16-18} and semiconductor diode laser.¹⁹ Cryosurgery using liquid nitrogen has been suggested as an easy and effective method to treat PGP.²⁰ Cryosurgery does not require sutures or surgical packing and is associated with no bleeding during or after treatment, no surgical defects, minimal scar formation, no risk of secondary infection, and minimal damage to the adjacent tissues.^{2,4,12,20}

To date, no known study has been published assessing PGP treatment in adolescent patients. Therefore, the aim of this study was to evaluate the effect of cryosurgery with liquid nitrogen on the treatment of gingival pigmentation in adolescents.

Method and materials

Fifteen adolescent patients (9 girls, 6 boys; age range, 11 to 14 years)

who had been referred to the Mashhad Dental School with the chief complaint of melanin pigmentation were selected for inclusion in this study. The ethical committee of Mashhad University of Medical Sciences, Masshad, Iran, approved this study (code no. 286261). All patients and their guardians provided written informed consent prior to participation.

Treatment procedure

Both the maxilla and mandible were isolated using suction and cotton rolls. Hyperpigmented areas were anesthetized topically with lidocaine spray (Xylocaine 10% spray, Astra Pharmaceutical). The PGP areas were divided into 2-cm segments, with each segment treated separately. Liquid nitrogen was applied to PGP areas using a cotton swab (4 mm in diameter) with a forward and backward rolling technique. A "freezing" appearance was observed after application of liquid nitrogen for approximately 20 seconds. This procedure was repeated three times for every segment. To obtain better results and remove the residual PGP, the same course of treatment was repeated after 2 weeks.

Image acquisition and analysis

Standard digital photographs were taken preoperatively and at 3, 12, and 24 months postoperatively. For each photograph, the patient sat on a unique vertically positioned den-

tal seat with the head positioned upright and the lips and cheeks opened using a mouth opener (Sunny Orthodontic). A digital camera (Canon, Ixus 800IS; macro and flash set to "on") mounted on a tripod was used to take all photographs with the same resolution (6.5 megapixel), magnification (4× optical zoom), and distance (30 cm from each patient).

After taking all pre- and post-operative photographs, a blinded examiner traced and measured the PGP areas of all images using image-analyzing software (ImageJ 1.42q, National Institutes of Health). The ImageJ software calculates the darkness value of an image (range, 0 [pure dark] to 255 [pure white]). The mean PGP darkness values of each of the four visits were compared.

Statistical analysis

The results were analyzed using SPSS 15 for Windows (IBM) and repeated-measures analysis of variance. Statistical significance of differences was defined at the level $P < .05$.

Results

No bleeding or pain occurred in any patient during treatment. Minimal reddish erythema was observed after cryosurgery. After 2 weeks, the gingival color was ideal for all patients. No postoperative scar formation, pain, or other complication

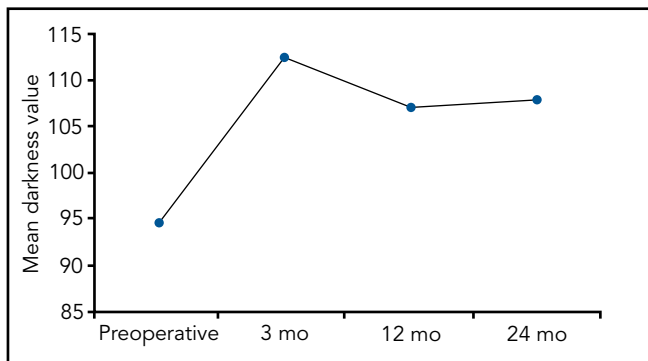


Fig 1 Mean darkness values of the PGP areas of patients throughout treatment.



Fig 2a (left) Frontal view of a patient before treatment. Note the highly pigmented gingival areas.



Fig 2b (right) Appearance of the gingiva at the 24-month follow-up. Note the improved esthetics.

was seen during this period. All patients were followed for 1 year, but four patients (26.7%) did not return for the 24-month follow-up.

Figure 1 shows the mean gingival darkness values at all pre- and postoperative follow-up appointments. Significant differences were found between the preoperative gingival color and the gingival color at 3, 12, and 24 months postoperatively ($P = .000, .007, \text{ and } .001$, respectively). Some recurrence was observed after 12 months; however, there was no significant difference between the results obtained at the three postoperative follow-up sessions ($P > .05$), indicating that there was no significant recurrence. After 24 months, all patients were satisfied with their treatment results (Figs 2a and 2b).

Discussion

PGP is common in many races, and patient complaints are mostly related to esthetics.^{2,4,5} Although different treatment methods have been examined for PGP, all have focused on treating adults, with no studies examining PGP treatment in adolescents. Table 1 shows the results of the major studies on PGP treatments conducted in the last 25 years. In this study, the authors present what they believe to be the first examination of PGP treatment in adolescents with a 24-month follow-up.

Since treatment of physiologic pigmentation is for esthetic purposes only, the best technique should be safe, painless, and low-cost. Cryosurgery with liquid nitrogen

is inexpensive and requires no special equipment.^{4,20} Other techniques, such as laser treatment and surgery, require sophisticated equipment that not only increase the treatment cost but also require special skills. Although Mokeem¹³ previously reported that cryosurgery is complicated and suggested gingival abrasion to be easy, abrasion is an invasive method that requires anesthesia and results in pain and a long recovery period.

Some nonsignificant recurrence was observed after 24 months, similar to previous studies at 20 to 30 months after cryosurgery (Table 1).^{2,12} Previous studies on Er:Yag laser therapy revealed no relapse after 3 months and slight recurrence after 6 months.^{14,15} Nakamura et al¹⁷ observed no relapse

Table 1 Major studies of PGP treatments conducted in the last 25 years

Study	Method of treatment	Success rate	Follow-up duration	Sample size	Age of patients
Yeh ⁴	Cryosurgery with liquid nitrogen	No recurrence	3 mo to 2 y	20 patients	Adult
Deepak et al ⁵	Bur abrasion, gingival graft, and electrosurgery	Mild recurrence in abrasion	3 mo	3 patients	Adult
Tal et al ¹²	Cryosurgery with liquid nitrogen	No recurrence	20 mo	1 patient	Adult
Arikan and Gürkan ²	Cryosurgery with TFE	No recurrence	30 mo	20 patients	Adult
Phillips and John ¹⁰	Connective tissue graft		2 mo	1 patient	Adult
Tamizi and Taheri ⁷	Full- and partial-thickness gingival autograft	Full-thickness: no recurrence after 4.5 y Partial-thickness: recurrence after 1 y	4.5 y	10 patients	Adult
Pontes et al ¹¹	Gingival autograft with ADM compared with bur abrasion	ADM: recurrence in 8 cases Abrasion: recurrence in all cases	12 mo	15 patients	Adult
Bergamaschi et al ⁸	Gingivectomy	Recurrence after 1.5 y (n = 2) and 3 y (n = 3)	5 mo	5 patients	Adult
Mokeem ¹³	Abrasion with diamond bur	No recurrence	18 mo	3 patients	Adult
Esen et al ³	CO ₂ laser	Mild recurrence in 2 cases	24 mo	10 patients	Adult
Tal et al ¹⁴	Erbium laser	No recurrence	3 mo	5 patients	Adult

TFE = tetrafluoroethane; ADM = acellular dermal matrix.

12 months after treatment with a CO₂ laser, although some relapse was observed at 24 months in 4 of 7 patients. A similar study reported some relapse 24 months after CO₂ laser therapy in 2 of 10 patients.³ Although one study reported no relapse 3 years after gingivectomy,⁹ another reported abnormal gingival coloring after 3 years in 3 of 5 patients with the same treatment.⁸ In the case of full-thickness graft surgery, no relapse was found after 4.5 years.⁷ Mokeem¹³ did not observe any relapse at 18 months after use of the abrasion technique.

Complete relapse was reported in all cases following depigmentation with a diamond bur; in cases treated with allografts, only slight repigmentation was seen.¹¹

Esen et al³ and Tal et al¹⁴ emphasized the necessity of anesthesia before laser therapy, and, of course, gingivectomy, graft surgery, and abrasion all require complete anesthesia. Indeed, the only technique that does not require anesthesia to remove the PGP is cryosurgery.^{4,5,20} The main difficulty of liquid nitrogen use is maintenance since it needs special storage boxes.

Cryosurgery is a safe method that does not require specific safety measures for the patient, dentist, or assistant. Laser therapy requires eye protection against the smoke and vapors originating from the laser,²¹ while the vapors produced during cryosurgery are innocuous.² Furthermore, direct application of liquid nitrogen does not cause special concern for the adjacent tissues. Lasers can destroy or damage the gingiva, enamel, or periosteum.²² Surgery, gingivectomy, and abrasion probably damage the underlying bones and adjacent tissues and

lead to keratinized tissue loss and other postoperative complications.

Of the available PGP treatments, cryosurgery is the option least associated with bleeding and does not cause swelling, pain, or scars.^{4,20} In laser therapy, pain and itching may be present in the first week after treatment.^{14,15} Risk of bleeding, pain, swelling, infection, and the need for sutures and periodontal dressing are more common after invasive methods such as graft surgery and gingivectomy. However, cryosurgery is the only technique that should be repeated 2 weeks after the first treatment, which may be considered a disadvantage. Other methods require only one treatment session.

Conclusions

Treatment with liquid nitrogen cryosurgery for PGP removal in adolescents is a successful and inexpensive method that requires less equipment than other treatment methods. No pain or bleeding was observed, and the treatment did not require anesthesia or periodontal dressing. Like other treatment methods, this method showed a mild but nonsignificant relapse after 1 year. This should be mentioned to the patient before treatment.

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