

Evaluation of re-pigmentation by using cryosurgery and diode laser: A clinical comparative split-mouth study

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ABSTRACT

Background: Aim: To compare the clinical outcome between diode laser and cryosurgery in the treatment of gingival melanin hyperpigmentation

Materials And Methods: A total of 15 patients with class II & III melanin pigmentation (Dummett et al 1964) were taken for the split-mouth study. Scaling and root planning was done. Patients with acceptable oral hygiene were taken up for the procedure. Depigmentation was performed in a split-mouth of each patient by using diode laser and cryosurgery, and the respective quadrants were selected by flip coin method. Postsurgical instructions were given. The clinical parameter such as the intensity of re-pigmentation was evaluated for the period of six months that is from 1 week, 1, 3, and 6 months. Pain was evaluated using a visual analog scale 24 hours and one week postoperatively. Results obtained were statistically analysed

Results: At 3 and 6 months, there was a statistically significant mean difference between the groups (intensity of repigmentation) $p=0.0166$ and $p=0.0061$ respectively, showing cryosurgery procedure significantly decreased the amount of repigmentation.

Conclusion: In conclusion, cryosurgery has proven to be more effective than laser for treating gingival hyperpigmentation. Additionally, cryosurgery has been proven to be a safer, more efficient treatment alternative that offers superior aesthetics, increased comfort, and less pain and delayed recurrence. However, further data analysis on these comparable methodologies is needed to guarantee the long-term forecast and efficacy of the depigmentation.

Keywords: Pigmentation, Cryosurgery, Diode laser.

INTRODUCTION

A person's smile serves as a kind of nonverbal communication. To enhance the self-confidence of an individual a beautiful smile is considered key. It is not just the position of the teeth but also the hue of the gingiva that contributes to a smile's unique appeal. Among different individuals the color of the gingiva is different and is associated with

Pigmentation of the skin. It might be light, dark, or even black in color¹. Coral pink" is a common description for gingival color. Gingival pigmentation can appear as a diffuse deep purplish discoloration or as striae, threads, or patches of irregularly shaped brown and light brown or black². The main factors on which the color of the gingiva primarily

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depends are Melanin. Carotene, reduced hemoglobin, and oxyhemoglobin are the prime pigments contributing to the normal color of the oral mucosa. Among all these pigments melanin pigment plays a vital role. Gingival depigmentation is a periodontal plastic surgery that involves removing pigment from the gingiva³.

A periodontal plastic surgery procedure called gingival depigmentation involves removing or reducing the hyperpigmentation through a variety of surgical techniques. Patients might undergo this depigmentation process if they place a high priority on better aesthetics. There are many procedures that can be used, including minimally invasive ones such as gingival abrasion and chemical methods of depigmentation, as well as scalpel surgery, diode lasers, cryosurgery, electrosurgery, and cryosurgery. The technique to be used should be determined by the user's preferences and clinical experiences.

In the year 1980, lasers were first used in dental procedures. Because of its capacity for targeted ablation, it has been among the most dependable and comfortable methods. The diode laser has garnered the most interest among all lasers due to its unique wavelength and energy properties that target soft tissues precisely. Additionally, it has a preference for hemoglobin and melanin, making it more effective and better suited to deal with issues with soft tissues. Depigmentation therapies, frenectomy, incisional and excisional biopsies, and gingivectomy have all been performed using the semiconductor diode laser⁵.

Cryosurgery is another efficient painless treatment of depigmentation. This technique uses freezing to destroy tissue. The physical and chemical changes brought on by freezing cause cell death and tissue damage. It is the gingival depigmentation technique that is most frequently acknowledged. It includes applying different substances, such as cryogen-like liquid nitrogen at very low temperatures, to freeze gingiva⁶. The effect of cryogen's ultra-low temperature on gingival tissue results in cryonecrosis, which helps to remove gingival pigmentation. It is a low-cost technique that has a quick healing time, improved long-term aesthetic results, and a low recurrence rate⁷. Cryosurgery is preferred over other depigmentation techniques because of its lack of discomfort, bleeding, and

scarring, ease of use in papillary areas, lack of need for sophisticated instruments, and application without regional anesthetic, sutures, or drugs. Relapse or gingival repigmentation, which is defined as the recurrence of pigmentation after a time of no clinical hyperpigmentation, is a major problem in the therapy of hyperpigmented gingiva. Recurrence typically varies depending on the methods utilized and the amount of time spent monitoring. The current study aims mainly to evaluate the repigmentation by using two different methodologies i.e by diode laser and cryosurgery⁸.

METHODS AND MATERIALS

Patient Sample

In this randomized clinical trial 15 patients who had esthetic concern of dark gingiva in the anterior teeth were selected with an age group between 18-30 years with esthetic complaint of dark gums on the maxillary anterior tooth were selected. The patients were selected from department of periodontics Sree sai dental college and research institute, Srikakulam. The institutional ethical committee has approved the study. Informed consent document was completed by all the patients which explained complete procedure in the protocol and what are all the benefits associated with proposed study. Coin toss method was used for randomization. The criteria for enrollment was Systemically healthy subjects, Subjects with physiologic hyperpigmentation of gums and who requests for their improvement of their gingival appearance, Subjects with presence of moderate to severe pigmentation (according to Dummett's (class II and class III) of the maxillary anterior region of the gingiva. Patients excluded were, Smokers, Associated syndromes with pathological pigmentation, Pregnant and lactating women, Medically compromised patients, Subjects with acute gingival and periodontal diseases, Subjects with thin gingival biotype and gingival recession

Measurement of clinical parameters

Oral pigmentation index (Dummett C.O 1964)

Visual analog scale

A split mouth approach was used by randomly assigning one side of the mouth to receive laser therapy and the other side to receive cryotherapy

based on the spin of the coin. For each patient, laser therapy was performed first followed by

cryosurgery and patients were followed at 1 month, 3 months and 6 months

Table 1: Comparison of Cryosurgery and Laser surgery with depigment scores (Dummet-Gupta oral pigmentation index DOPI) at different treatment time points by Mann-Whitney U test.

Treatment time points	Cryosurgery				Laser surgery				U-value	Z-value	p-value
	Mean	SD	Median	IQR	Mean	SD	Median	IQR			
Pre-op	2.67	0.49	3.00	0.50	2.67	0.49	3.00	0.50	72.0	0.0000	1.0000
1 week	0.08	0.29	0.00	0.00	0.08	0.29	0.00	0.00	72.0	0.0000	1.0000
1 month	0.42	0.67	0.00	0.50	0.75	0.45	1.00	0.38	46.5	-1.4434	0.1489
3 months	1.17	0.39	1.00	0.00	1.75	0.45	2.00	0.38	30.0	-2.3960	0.0166*
6 months	1.50	0.52	1.50	0.50	2.42	0.67	2.50	0.50	24.0	-2.7424	0.0061*

Table 2: Comparison of Cryosurgery and Laser surgery with depigment scores (Dummet-Gupta oral pigmentation index DOPI) at different treatment time points by Mann-Whitney U test.

Pre OP-1W	2.58	0.51	3.00	0.50	2.58	0.51	3.00	0.50	72.0	0.0289	0.9770
Pre OP-1M	2.25	0.75	2.00	0.50	1.92	0.79	2.00	0.88	55.0	0.9526	0.3408
Pre OP-3M	1.50	0.67	2.00	0.50	0.92	0.67	1.00	0.38	39.5	1.8475	0.0647
Pre OP-6M	1.17	0.83	1.00	0.88	0.25	0.87	0.00	0.50	33.5	2.1939	0.0282*

Table 3: Comparison of different treatment time points with depigmentation scores in Cryosurgery by Wilcoxon matched pairs test.

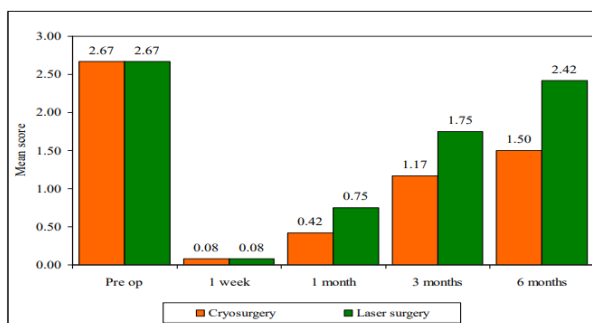
Groups	Changes from	Mean Diff.	SD Diff.	% of change	Z-value	p-value	Friedman ANOVA	P-value
Cryosurgery	Pre OP-1Week	2.58	0.51	96.87	3.0594	0.0022*	43.3018	0.0001*
	Pre OP-1Month	2.25	0.75	84.37	3.0594	0.0022*		
	Pre OP-3Months	1.50	0.67	56.25	2.9341	0.0033*		
	Pre OP- 6Months	1.17	0.83	43.75	2.6656	0.0077*		

Table 4: Comparison of 24 hours and 1week VAS scores by Wilcoxon matched pairs test.

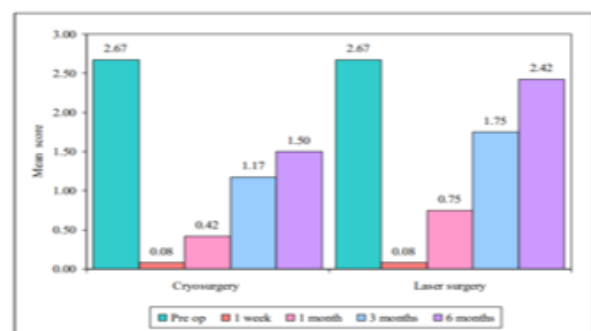
VAS at	Mean	SD	Mean Diff.	SD Diff.	% of change	Z-value	P-value
24 hors	0.58	0.67					
1 week	0.33	0.65	0.25	0.97	42.86	0.8401	0.4008



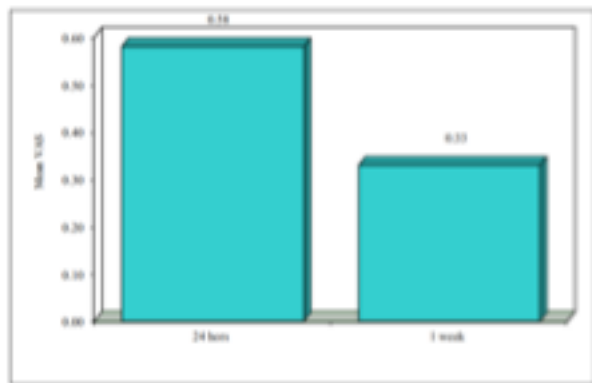
Fig 1: In the above picture 1st quadrant cryosurgery was done and second quadrant laser was done. 1st pic preoperative, 2nd pic laser surgery, 3rd-cryosurgery, 4th- icicle formation, 5th- immediate post op 6th- 1 week post op, 7th 1 month post op, 8th pic-3 months post op, 9th pic-6 months post op.



Graph 1: Comparison of Cryosurgery and Laser surgery with mean scores at different treatment time points



Graph 2: Comparison of different treatment time points with Gingival pigmentation scores in the Test group and Control group.



Graph 3: Pain at 24hrs and 1 week.

Surgical Procedure

LASER PROCEDURE

Under local anaesthesia, a semiconductor diode laser with a wave length of 810 nm was used to depigment the first quadrant between the central incisor and the canine. On all of the pigmented region, the laser point was moved in an apico-cervical direction while being held in the contact mode. To improve visibility, the area that had been exposed to radiation underwent thorough saline irrigation and was cleaned with damp sterile gauze. To reduce pain at the operated site, a periodontal dressing was placed over the ablated area

CRYOSURGERY SITE:

Under local anesthesia cryosurgery procedure was performed. To improve thermal conductivity water soluble lubricant was applied between the probe and the gingival tissues. The maxillary anteriors underwent gingival cryosurgery in parts, with each section measuring 3×3 and being subjected to a gas expansion cryoprobe with nitrous oxide, the cryoprobe was cooled to -70 C to -90 C for 30 sec for depigmentation. As soon as the the cryoprobe was removed the tissue was frozen solid, there was an appearance of ball of ice thawing of this ball of ice occurred from periphery to center. The frozen site thawed completely within 1 minute and the procedure was carried out to the adjacent part. Analgesic was prescribed to the patient for 3 days post operatively.

Etimation of Pain Intensity Following Surgery All patients were asked to define their pain level by using visual analog scale (VAS) which was assessed at one week after the procedure. VAS consists of

equal units from 0 to 10, score 0 was presented as no pain, score 1-3 as slight pain, score 4-6 as moderate pain and score 7-10 as severe pain.

Statistical Analysis Carried Out

Mean plus standard deviation was used to express descriptive statistics. Data were statistically analysed using comparative and nonparametric methods. The statistical interference was obtained by using the Mann-Whitney U test and Wilcoxon matched pairs test. The Mann-Whitney U test has been used to examine the intergroup comparison of repigmentation. Wilcoxon matched pairs test was used to compare intragroup comparison of repigmentation (one week,1,3,6,9 months postoperatively) and pain at 24 hours and 1-week postoperatively. A significance level of 0.05 was assumed.

Demographic variables:

- **GENDER:** out of 12 patients 9 were female and 3 were males
- **Age:** age of the subjects who participated in the study ranged from 19 to 27 years, with a mean age of 21.5 years

RESULTS

The study included 15 patients with esthetic complaints of excessive gingival pigmentation in the anterior tooth region. 12 patients in the study have completed the 6 months follow-up with 3 dropping out

Repigmentation: The mean melanin pigmentation scores of cryosurgery and laser-treated area at the baseline were 2.67. This has decreased to 0.08 after 1-week post operatively in both groups (table 2). In cryosurgery-treated areas, the mean melanin pigmentation scores after 1 week, 1 month 3 months, and 6 months postoperatively were 0.08, 0.42,1.17, and 1.50 respectively. A gradual increase in the mean pigmentation score was noted at every time interval. The mean melanin pigmentation, scores of laser-treated sites 1 week, one month, three, and six months postoperatively were 0.08,0.75,1.75, and 2.42 respectively. These ratings indicated that the pigmentation gradually increased over time, which is what was observed In inter-group comparisons, at each time interval, the

melanin pigmentation in the two locations differed from the baseline. At one week following surgery, the difference was "2.58," which subsequently decreased in laser-treated areas over the course of one, three, and six months to 1.92, 0.92 and 0.25, respectively. The difference in melanin pigmentation score between cryosurgery-treated areas has been decreased from one week to six months. At one week, one, three, and six months, there was a difference from the starting point of 2.58, 2.25, 1.50, and 1.17, respectively. The difference between one week and six months after surgery was smaller, indicating that repigmentation has steadily risen but has not yet fully recovered in both locations by the end of six months. At 3 and 6 months, there was a statistically significant mean difference between the groups $p=0.0166$ and $p=0.0061$ respectively, showing cryosurgery procedure significantly decreased the amount of repigmentation. When intra-group scores for melanin pigmentation were evaluated between baseline and one week, one, three, and six months after surgery in both cryosurgery and diode laser groups, there were significant differences. At one month and six months, repigmentation was less pronounced in the cryosurgery-treated area compared to laser, whereas at three months and six months after surgery, repigmentation was comparably quicker in the laser-treated area. Pain: The mean pain scores were evaluated at 24 hours and 1 week postoperatively. The pain levels were higher on the first day following surgery, but they gradually decreased towards the end of the first week. By the end of the day, the average pain score was 0.58 and by the end of the week, it was 0.33.

DISCUSSION

The best smile is one that makes you happy. It is influenced by the teeth's color, shape, and placement in addition to the tissues' properties in the gingiva. The gingival tissue color in many patients has aesthetic concerns. Individual preferences and perspectives on gingival pigmentation were revealed in the study conducted by Dummett⁸ which showed that "pink gums" were the most desired. Healthy gingiva ranges in color from light or pale pink to dark color. The darker color is linked to more profound melanin, which is found deeper in the connective tissues, while the lighter color is linked to superficial melanin, which is present on the skin's surface. According to

Dummett, the degree of epithelial keratinization, the degree of melanogenesis, the vascularity of the gingival tissues, and other factors all affect the color. Individual differences exist in gingival pigmentation.

Only a few studies were reported comparing the outcome of diode laser and cryosurgery. In the present study, patients reported an unpleasant smell due to tissue burning on the laser side and a sensation of sensitivity while triggering the cryogun on the cryosurgery site. A 30-month follow-up case report was published in which clinical repigmentation after cryosurgery treatment has not occurred during 30 months follow-up treatment⁹. A similar result was obtained in the use of tetrafluoroethane as a cryogen in 1-year follow-up period. A split-mouth study using a surgical scalpel and cryosurgery with tetrafluoroethane cryosurgery was conducted which reported recurrence rate was higher after scalpel treatment. In a 2013 study, they compared TFE and diode lasers. The cryosurgical method by TFE was determined to be more tolerable, to cause less discomfort, and to be less painful than diode lasers the authors after they employed a questionnaire to assess the perception of pain¹⁰. A case series reported that TFE can effectively destroy the gingival epithelium without harming the underlying connective tissue after histologically evaluating and correlating the effectiveness of the treatment for gingival depigmentation¹¹. Clinically, the results were more pleasing in terms of color, healing, and longevity. In a study, Tal et al did not notice repigmentation 20 months after employing cryosurgery to depigment the gingiva. Additionally, Perlmutter and Tal reported gingival repigmentation that happened 7 years after the surgery. This result correlates with the result of Yeh CJ where there was displayed no repigmentation after a two-year follow-up period¹². Another study has evaluated the recurrence of pigmentation comparing treatment by liquid nitrogen and cryoprobe they reported no clinical pigmentation recurrence after 18 months. Similarly, a case report was published in which cryosurgery with a nitrous oxide gas expansion probe at -700C was used which reported no clinical repigmentation in the treated area for 30 months.

In our study following cryosurgery, there was no post-operative pain hemorrhage infection or recession but contrary to our study a case study by

Ozcan et al reported Infection, bleeding, recession, and pain have all been documented as consequences of cryosurgical operations¹⁵. However in a case report quadrant, wise comparison of four different treatment modalities scalpel, electrocautery, laser and cryosurgery was published which reported inadequate removal of pigmentation was seen in cryosurgery site, Because the effects of this therapy take time to manifest, insufficient cryotherapy dosage may be to blame for the poor elimination of pigmentation shown in the area treated¹⁶.

In a recent study, 3 laser wavelengths of laser (YSGG2780, DIODE 940, and 445 nm) were compared and the study reported a better outcome of the 2780nm laser followed by 940nm and 445nm¹⁷. The findings show that the procedure took less time when using a diode than when using an erbium group laser. The reason is given that laser tissue interaction experiments show that melanin absorbs a high amount of the diode wavelengths, while melanin absorbs a much lower amount of the erbium laser beam¹⁸. A Randomized Split Mouth study evaluated repigmentation between scalpel and laser but failed to show any statistically significant result¹⁸ and The operator's assessment of the procedure's difficulties revealed that the laser approach was simpler to use than the conventional method because there was less bleeding during the procedure¹⁸. Another investigation comparing the effectiveness of the 980 nm diode laser with the 2940 nm Er: YAG laser in gingival depigmentation was carried out, but the results of this study were not statistically significant¹⁹.

Cryosurgery's key benefits included not requiring anesthetic, virtually no bleeding, which reduced or eliminated the possibility of postoperative infection, and quick recovery. Due to the inability to see changes right away after treatment, this procedure also has drawbacks in that residual pigments could be left behind. This can result in regions that aren't exposed to the cold. This result is consistent with the research by Chin-Jyh Yeh, who recommended a second round of cryosurgery after a week to get rid of any leftover pigments. The temperature reached at the tip of the cryoprobe, the cryodose, the number of cycles at which pressure is applied, and the type of tissue treated all have an impact on how much and how deeply the underlying tissue is

destroyed. The patient's skin tone has been cited as one of the causes of gingival depigmentation's early recurrence. Darker-coloured persons are thought to experience recurrence earlier than lighter-skinned people.

CONCLUSION

The present study aimed to evaluate the clinical outcome of depigmentation of gingiva with cryosurgery and laser. The mean pain value decreased from 24 hours to 1-week postoperatively. Repigmentation has appeared in both procedures. Cryosurgery treated sites showed recurrence a bit slower than the laser treated sites and the mean value was statistically significant.

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