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ABSTRACT:
This double-blinded prospective study compared the efficiency of carbon dioxide (CO₂) and diode laser techniques to change the colour of the gingiva in the treatment of gingival hyperpigmentation by assessing the colour of the gingiva, gingival bleeding, operator’s difficulty, post-operative wound healing, pain and esthetic perception by the patient at 1 week, 2 week, 3 week and 4 week post-operatively. Ten patients (6 males, 4 females) were enrolled in the study. Gingival depigmentation was done from canine to canine in the upper anterior region. A total of 20 anterior segments were treated: 10 randomly to Carbon dioxide & Diode Laser group using Flip coin method. The results of this study showed that the degree of pigmentation at the end of 4th week was less in diode group with 20% of the patient showing no pigmentation compared to CO₂ group (10%). Regarding difficulty of the operator and pain and wound healing, there was no statistical significant difference between the diode and CO₂ group (p value=1,000 NS).

INTRODUCTION:
Gingival hyperpigmentation is seen as a genetic variation in some populations independent of their age and sex and termed as physiological or racial gingival pigmentation. Although pigmentation of the gingiva is a completely benign condition it is an esthetic problem in many individuals.
Various depigmentation techniques have been employed, such as scalpel surgery
gingivectomy (Dummet and Bolden 1963), cryosurgery, electrosurgery, chemical agents such as
90% phenol and 95% alcohol (Hirschfeld and Hirschfeld 1951), abrasion with diamond burs,
Nd:YAG laser, semiconductor diode laser and CO2 laser.

CO₂ laser (10,600 nm) wavelength is absorbed by water based tissues resulting in
vaporization of intra and extra cellular fluid & disintegration of cells. Collateral thermal damage
is less.

The 810-nm diode laser has energy and wavelength characteristics that specially target
the soft tissues. It has an affinity for hemoglobin and melanin; therefore it is more efficient and
better equipped to address deeper soft tissue problems.²⁰

MATERIALS AND METHODS:

This double-blinded study was conducted at Department of oral and maxillofacial
surgery, Rajas dental college and hospital, Tirunelveli from February 2013 to November 2015.

Ten patients requiring gingival depigmentation were selected from pool of a patients
reporting to The Rajas dental college. A signed informed consent was taken from all patients
willing to participate in this study. The patient was blinded about the type of laser used for
depigmentation of his/her gingiva.

Gingival depigmentation was done from canine to canine in the upper anterior region. A
total of 20 anterior segments were treated according to split-mouth technique: 10 randomly to
Carbon dioxide & Diode Laser group using Flip coin method.
Pre-operative photographs & Post-operative radiographs were obtained with a digital camera with standardized settings for grey, white, black and a cm scale with standard lighting and backdrop.

Macroscopic distribution and colour of the pigmentation of all surfaces were recorded in detail. A single surgeon performed the procedure in each segment using diode or CO\textsubscript{2} laser as allocated by the co-investigator.

The primary investigator who was blinded about the allocation of segment evaluated the primary or secondary parameters like colour of the gingiva, bleeding, difficulties of the operator, pain perception of patient and post-operative wound healing. The parameters were evaluated intra-operatively and post-operatively till 4\textsuperscript{th} week of follow-up.

**DIODE LASER:**

The Equipment used was AMD Diode laser Picasso, USA. The properly initiated tip of the diode laser unit (Picasso, AMD laser technologies, USA; wavelength 810 nm) angled at an external bevel of 45 degrees and at energy settings of 0.5-1.5 watts continuous wave (CW) with 400 \( \mu \)m strippable fiber was used with a power setting of 1.5 watts initially in pulsed wave mode (PW) set at 0.20 ms of pulse duration and 0.10 ms of pulse interval for the de-epithelialization procedure.

**CO\textsubscript{2} LASER:**

For CO\textsubscript{2} laser Equipment used is NovaPulse LX-20 SP surgical laser. The ablation was performed by a flexible fiber LuxarNovaPulse LX-20 SP surgical laser, the predecessor of LS-
The repeated A5 Super Pulse mode was applied at 3 watts, 20 Hz, 10 milliseconds, with a 0.8 mm spot size.

RESULTS AND STATISTICS:

The parameters assessed were colour of the gingiva, bleeding, difficulties of the operator, pain perception of patient and post-operative wound healing.

The collected patient data were tabulated and statistical analysis was performed. Microsoft Excel 2010 software to derive the mean and standard deviation and SPSS software version 21 was used for statistical analysis. Charts and graphic representations were obtained with the results

COLOUR ASSESSMENT:

To evaluate the primary parameter the colour of the gingiva, pre-operative photographs was taken one week before the procedure and post-operative photographs were taken at first, second, third, fourth week after the procedure of depigmentation.

DOPI was taken to evaluate pre-operative and post-operative colour assessments.

By the end of 1st and 2nd Week- both the study group had same results. By the end of 3rd and 4th Week degree of pigmentation was less in diode group than CO2 laser group.

Statistically, in the 3rd (p value=0.047*) (Table4) and 4th (p value=0.047*) week, there was significant difference between the colour of the gingiva between the diode and CO2 group. Diode laser study group at the end of 3rd week the colour of the gingiva in 2(20%) of the patients had no pigmentation. 7(70%) of the patients had mild pigmentation and 1(10%) had
moderate pigmentation. In CO$_2$ laser study group 1(10%) of the patients had no pigmentation. 8(80%) of the patients had mild pigmentation and 1(10%) had moderate pigmentation.

**BLEEDING:**

Bleeding was assessed by the primary investigator intra-operatively and immediate post-operatively. Intra operatively both study group had same outcome. Immediate post-operatively diode laser shows lesser bleeding.

Statistically, there was no significant difference between both the groups during intra-operatively (p value=1.000$^{NS}$) but during immediate post-operative period there was marginally significant difference between the diode and co2 group (p value=0.0632$^{+}$).

**DIFFICULTY OF THE OPERATOR:**

Difficulty of the operator was assessed by the primary investigator intra-operatively using the Visual Analogue Scale. Both groups it was easy.

Statistically, there was no significant difference between both the groups in the difficulty of the operator (p value=1.000$^{NS}$)

**PAIN ASSESSMENT:**

Pain was assessed using Visual Analogue Scale, Intra-operatively Both the study group experienced no pain. Immediate post-operative & 1$^{st}$ post op day only 1 patient experienced mild pain in the immediate post operative period.

Statistically, there was no significant difference between the two groups in the perception of pain intra-operatively (p value=1.000$^{NS}$), immediate post-operatively (p value=1.000$^{NS}$),1$^{st}$ day post-operatively.
WOUND HEALING:

Wound healing was assessed by the primary investigator clinically on the first, second, third, fourth week post-operatively. It was evaluated by using healing index by Landry et al. During the 1st and 2nd week of post operative period CO₂ laser had better wound healing when compared to diode laser group but at the End of 3rd week and 4th week both the study group had excellent wound healing.

Statistically, At the end of 3rd (p value=1,000 NS) and 4th week (p value=1,000 NS), there was no significant difference between the two groups.

ASSESSMENT OF PATIENT OPINION ON ESTHETIC CHANGE:

Esthetic change was assessed by using Visual Analogue Scale. Diode laser group scored more satisfaction than CO₂ laser study group.

Statistically, at the end of 4th week, there was marginally significant difference between the CO₂ and diode group in the esthetic perception of the patient (p value=0.0632+).

DISCUSSION:

A total of 10 patients clinically diagnosed as having gingival pigmentation were included for this study. They were aged from 18-23. Mean age of male and female patients were 19.2 yrs and 20.5 yrs respectively. This was similar to the study done by Esen et al. In the present study among 10 patients, all the patients had heavy amount of pigmentation in the gingiva pre-operatively. This is similar to the study group include by Simsek Kaya et al in his study. According to his study the patients included had untreated bilateral melanin pigmentation in the
anterior portion of the upper and lower gingiva evaluated as severe according to modified Dummet et al.

In both the study group at the end of 1\textsuperscript{st} week the colour of the gingiva revealed no pigmentation in 2(20\%) of the patients and with mild pigmentation in 8(80\%) of the patients. Similar findings have been reported by many workers like M. BhanuMoorthy et al who observed that in 1\textsuperscript{st} week the gingiva was pink color comparable to nearby non-treated area and the healing was uneventful\textsuperscript{22}.

Diode laser study group at the end of 3\textsuperscript{rd} week the colour of the gingiva in 2(20\%) of the patients had no pigmentation. 7(70\%) of the patients had mild pigmentation and 1(10\%) had moderate pigmentation. In CO\textsubscript{2} laser study group 1(10\%) of the patients had no pigmentation. 8(80\%) of the patients had mild pigmentation and 1(10\%) had moderate pigmentation. Similar findings have been reported by many workers like Sanjeevini et al but the method was surgical stripping.\textsuperscript{10} PhimonAtsawasuwan et al clinical reports says that after ablating the epithelium with the Nd:YAG laser, the wound was covered with some dried and charred epidermis. The wound was almost healed completely within 3 weeks. The colour of ablated gingiva was dark pink in some areas.\textsuperscript{5}

In diode laser study group at the end of 4th week the colour of the gingiva in 2(20\%) of the patients had no pigmentation. 7(70\%) of the patients had mild pigmentation and 1(10\%) had moderate pigmentation. In CO\textsubscript{2} laser study group 1(10\%) of the patients had no pigmentation. 8(80\%) of the patients had mild pigmentation and 1(10\%) had moderate pigmentation. These results were in accordance with the results observed by SushmaLagdive et al did a comparative study among the study group all the persons and observed improvement in colour of the gingiva
at the end of 4th week. Anirban Chatterjee et al observed that four weeks after the operation, the gingiva was generalized pink in color and healthy in appearance.

In both the study group all the patients 10(100%) had moderate bleeding during the time of procedure being done. M Bhanu Murthy et al studies concluded that gingival depigmentation using diode laser had less intra operative bleeding when compared to scalpel techniques. Carlo Mairana et al clinical reports says that by using a superpulsed diode laser in oral surgery he got instant coagulation of the surgical site intraoperatively.

In diode laser study group in the immediate post operative period 2(20%) of the patients had slight bleeding and 8(80%) had moderate bleeding. In CO₂ laser study group all the patients 10(100%) had moderate bleeding. Rashmi Hegde et al reported that CO₂ laser was the least time consuming and that they experienced no bleeding. Sanjeevini et al commented that scalpel surgery causes unpleasant bleeding during and after the procedure and it is necessary to cover the surgical site with periodontal dressing for 7-10 days.

The difficulty of the operator for doing the procedure was easy in all the patients 10(100%) in both the techniques. Simşek Kaya et al and Amit Bhardwaj et al observed that from the operator’s point of view, the laser technique was easier and faster to perform than the epithelial excision technique.

Regarding pain perception in intraoperative period both the study group 10(100%) had no pain. The findings are similar to the findings of Manal M. Azzeh et al who observed that all patients reported absence of pain intraoperatively (without the use of topical or local anesthesia), immediately postoperatively, and after 4 days.

Wound healing at the end of 1st week was good in 2(20%) of the patients and was very good in 8(80%) of the patients in diode laser study group. In CO₂ laser group the wound healing
was very good in all the patients 10(100%)Ameet Mani evaluated the wound healing based on the following scores. A. Complete epithelization, B. Incomplete epithelization, C. Ulcer, D. Tissue defect or necrosis.

According to his findings during immediate postoperative period grade C was scored by diode laser method, At the end of 1st week the wound healing scored grade B. Carlo Mairana et al in a clinical report observed that just one week postoperatively, wound healing looked good. The epithelium defect due to the operation was already covered by newly formed tissue.42

All the patients in both the study group had excellent wound healing at the end of 4th week. Geethi Gupta and M Bhanu Moorthy et al observed that healing of laser wounds is slower than healing of scalpel wounds, and a sterile inflammatory reaction occurs after lasering.22

Amit Bhardwaj et al observed that both the procedures scalpel technique and diode laser, evaluation on 30 days revealed restoration of normal features of the gingiva without any scar formation. Thus, the healing of the depigmented gingiva was uneventful irrespective of the techniques used.25 Geethi Gupta et al observed that compared to scalpel surgery, diode laser showed delayed healing. No adverse events were noted at 1 week and 1 month post operatively with either of the techniques.7 Basser Ali Abdullah et al observed that the use of diode laser is associated with delayed healing compared with Er Cr YSGG.50

All the patients 10(100%) had beautiful aesthetics in diode laser study group. In CO2 laser study group 2(20%) had better aesthetics and 8(80%) had beautiful aesthetic appearances. These results were in accordance with the results observed by Esen et al.52 In his study the final esthetic outcome—a considerable improvement—was pleasant for all the patients. In contradictory, patient
perception on appearance of gingiva in the study of Desai Urmi was 90% in the laser group after a period of 3 months.43

Amit Bhardwaj et al proved that the laser procedure was more acceptable to the patient as the procedure took less time and was more comfortable as the area did not require injecting local anesthesia and absence of post-operative pain and hemorrhage.29

**SUMMARY AND CONCLUSION:**

Growing aesthetic need requires the removal of hyperpigmented areas to create pleasant and confident smile which altogether alter personality of an individual. From our study we come to the conclusion that on comparing both the group diode laser study group had better outcome than CO2 laser study group.

**REFERENCES:**


7. Atif Kazmi Laser hair removal with an 800nm diode laser- a retrospective study of 1000 women with skin types II to VI 2002 the Lumenis group of companies.


20. Göksel S, Çimen, Ek Kaya, DDS, PhD, a Günüç Yapıcı Yavuz, DDS, b Muhammed A. Sümbüllü, DDS, PhD, c Dündar Ertuğrul Dayı, DDS, PhD, d Erzurum, Turkey A comparison of diode laser and


MATERIAL AND METHODS PHOTOS:

![Material and Methods Photos]

STATISTICS CHART:
Immediate postoperative bleeding

- Slight bleeding
- Moderate bleeding

Difficulty of the operator

- Easy
- Difficult
### Pain perception intraoperatively

<table>
<thead>
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<tbody>
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<td>10</td>
</tr>
<tr>
<td><strong>CO2</strong></td>
<td>10</td>
</tr>
</tbody>
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- **No pain** (Yellow bars)
- **With pain** (Red bars)

### Wound healing at the end of 2nd week

<table>
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<th>No of patients</th>
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</thead>
<tbody>
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<td><strong>Diode</strong></td>
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</tr>
<tr>
<td><strong>CO2</strong></td>
<td>6</td>
</tr>
</tbody>
</table>

- **Very good** (Dark grey bars)
- **Excellent** (Pink bars)
Wound healing at the end of 4th week

Aesthetic opinion of the patient

PATIENT PHOTOS CHART:
CASE 1: ALAGURAJA 18/M

POST OPERATIVE

IMMEDIATE POST - OP

1st WEEK

2nd WEEK

3rd WEEK

4th WEEK

1st DAY