

Comparison of the clinical efficacy of 940nm diode laser-assisted in-office bleaching technique with led light for vital teeth: A split mouth randomized controlled clinical trial

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ABSTRACT

Introduction

Tooth bleaching is a significant component of aesthetic dentistry since it is contemplated to be one of the most conservative alternatives for treatment of tooth discoloration. The longing to have whiter teeth and the bleaching technique have been reported since the mid-nineteenth century. Patients' awareness of options accessible for changing the colour of natural dentition has generated a rise in public demand. Bleaching improves the shade of teeth, and is additionally the most economical treatment alternative.

Methodology

Split mouth study design was planned and the mouth was split into 2 groups (either right or left)- Group A: 38% hydrogen peroxide was used in combination with LED (Light Emitting Diode) lamp. Group B: 38% hydrogen peroxide was used in combination with 940nm Diode Laser.

The shades were evaluated immediately after the bleaching process. Vita classical brightness scale was utilized to measure tooth shade. Shade was evaluated before and after the treatment. A Visual Analogue Scale (VAS) was used to measure dentin hypersensitivity. Score 0 means no pain and score 10 represents the worst pain.

Result

The Laser bleaching group indicated significantly superior results, had significantly less sensitivity compared to LED bleaching.

Conclusion

The Diode laser can be considered an effective treatment option for bleaching. Both laser-assisted and LED bleaching techniques were fit for modifying tooth colour change, yet laser bleaching was considered more useful. The diminished time period needed to accomplish the outcomes might prompt high patient compliance and satisfaction.

Introduction

In modern dentistry, advancements are occurring at an outstanding rate with the approach of new materials and innovations. The utilization of lasers in dental practice is one such technique which has encountered explosive amelioration.¹

Tooth discoloration may influence image of an individual which may be compromised; thus, tooth bleaching provides both aesthetic as well as psychological benefits.²

Laser bleaching was officially started in 1996. Power bleaching by lasers was popularized in order to enhance the bleaching process.³ Laser bleaching is thought about as more efficacious, seeing as controlled temperature rise of the bleaching agent can be achieved which provides a higher overall output of intrinsic radicals by photochemical activation which leads to their better absorption into the hard tissues of the tooth. This collectively recedes adverse pulpal reactions by decreasing the thermal activation of the bleaching agents.

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Health and beauty have become associated with lightening teeth and, as a result, desirable to patients. One of the most conservative choice for the treatment of discoloured tooth is tooth bleaching. In today's world, at-home and in-office bleaching techniques are the two main bleaching approaches widely used.

M'Quillen in 1867 first described In-office bleaching, also known as professional bleaching.⁴ Pyrozone containing 25% hydrogen peroxide (HP), in 1895 was the first monetarily accessible available bleaching product.⁵

Due to increased fascination by a patient to whiten their teeth in a limited time period, in-office bleaching procedure has become the mainstream one. There are endless advantages of in office bleaching over the at-home technique.

Currently practice of In-office bleaching incorporates high concentration of HP in unification with light sources for heating the HP and hence propel the release of oxygen free radicals which in turn wipes out stain molecules from dental enamel.⁶ The term "power bleaching is described when physical heating of HP is done with light source".⁷ Power bleaching enforcing light source leads to significantly greater absorption of light by the gel in the presence of auxiliary pigment in the bleaching gel.

Due to the light absorption, there will be escalation of temperature of the gel photothermally which acts as a barrier on the tooth surface and diminishes the heat reaching the pulp chamber, thus leading to diminished tooth sensitivity.⁶ The mechanism of action is still not completely disentangled in regards to tooth sensitivity and may be induced either by pulp irritation due to HP penetration to dental pulp or heat generation during light activation.⁸

Advantages of In-Office bleaching:

Fastened bleaching procedure, As procedure is under professional, Risk factor is eliminated, Tooth sensitivity is reduced.

Disadvantages of In-Office bleaching:

This procedure is more expensive than other bleaching procedures, Results can be unpredictable and depend on the factors like age, type of stains etc.

The aim of the study was to evaluate and compare clinically the efficacy of an in-office bleaching system with a diode laser-activated bleaching system for tooth whitening, and to assess subsequent dentin hypersensitivity (DH).

Materials and method

The study was approved by the Institutional Ethics Committee of the institution (Protocol No.: IEC212122019 Version No. 001). CTRI registration was obtained for the study (Registration No: CTRI/2021/01/030368). 12 patients were selected for this randomized, blind and split mouth clinical study.

The patients were included according to the following - Patient's age of 18 years and above, patients willing to participate, patients with good oral hygiene and presence of vital teeth counting from the first premolar of one side to other of both the maxillary and mandibular arches. Patients having teeth with non-vital pulp, active carious lesions, previous bleached teeth, smokers, pregnant or lactating females, medically compromised adults, mentally challenged adults, gingival irritation or periodontal disease and tooth sensitivity were excluded from this study.

Table 1: Vita shade scores: Conventional bleach Vs Laser assisted bleach

	Mean Difference in shade (n=12)			
	Mean	SE	95% C.I. for difference	p
Before bleach	0.00	0.00	-	-
After bleach	1.25	0.25	0.45 to 2.05	0.00
Change in shade*	-1.25	0.25	-2.18 to -0.32	0.01

* Negative sign indicates that change in shade is greater with Laser assisted bleach

Wilcoxon test used for paired comparisons



Figure 1: A) pre operative shade of teeth. B) bleaching gel applied on teeth. C) LED bleaching light application on the 2nd and 3rd quadrant D) Laser light application on 1st and 4th quadrant

Laser system adopted in this study was a diode laser of 940 nm wavelength (Epic 10, Biolase Technology, Irvine, CA, USA). 7 W intensity laser was delivered at CW mode through whitening handpiece which was in accordance with the manufacturer instructions. The area

of laser irradiation from the head of this handpiece was 2.8 cm² as it is designed to cover half arch starting from central incisor to 1st premolar teeth.

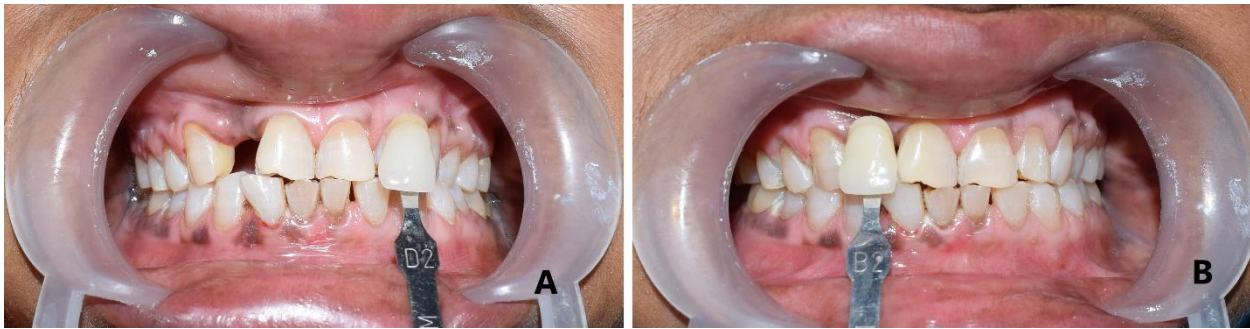


Figure 2: A) Post operative shade of 2nd and 3rd quadrant. B) Post operative shade of 1st and 4th quadrant.

Before starting the procedure, medical and dental history of the patients were recorded and informed written consent was taken. Non-glycerin-based pumice and a slow-speed rotary rubber cup was used to clean patients' teeth. Subsequently, on the marginal gingiva, liquid dam is applied which was then light cured from 1 cm distance.

Segregation into 2 quadrants (upper and lower) of 5 teeth each was done on both the right and left side of the mouth. A thin coating of bleaching gel of approximately 2 mm was enforced onto both the 2 quadrants. Split mouth study design was planned and the mouth was split into 2 groups (either right or left) –

In Group A: 38% hydrogen peroxide was used in combination with a LED (Light Emitting Diode) lamp.

The gel was painted onto the buccal surfaces of the teeth. Then LED light irradiation was done for 10 mins. The gel was wiped clean from the buccal surfaces after 10 min and then water was used to rinse the mouth. The process was repeated two times so that the total bleaching time was 20 min.

In Group B: 38% hydrogen peroxide was used in combination with a 940nm Diode Laser (irradiation time 2 minutes/quadrant). The buccal surfaces of the teeth were painted with the gel. The laser energy application was performed using bleaching handpiece recommended by the manufacturer.

The gel was left in place for 10 min. Then, high-volume suction was used to remove it, which was succeeded by cleansed with an air and water spray to get rid of any

residual gel superseded by wiping off with wet gauze to erase the access material. The barrier dam was removed after the completion of treatment. The laser wavelength-specific protection goggles were worn by the treating dental specialist, associate, and patient, all the while, the laser irradiation was carried out. [Figure 1]

Vita classical brightness scale was utilized to measure tooth shade in compliance with instructions given by manufacturer. The assessment of the shades was carried out by a subsequent examiner and the degree of accordance was acquired utilizing Kappa test. Indirect sunlight, between 10:00 am and noon time was when the measurements were done at for standardization. The Vita scale is composed of 16 brightness degrees, C4 being the darkest and B1 the brightest. These shades were then converted to scores 1 to 16 with score 1 representing the brightest shade as per the technique of Gurgan et al.¹¹ The same qualified evaluator utilized a vita classic shade guide to register the primary (baseline) and final (post-bleaching) color of the assessed teeth. The assessment of color was done immediately after the bleaching process.

To measure DH, a visual analog scale (VAS) was used. Patients were asked to define their level of DH by using a VAS. VAS beginning from 0 to 10 was explained and handed over to the patients. The score of 0 represents no pain and the score of 10 represents the worst pain.⁹ The pain scores were recorded during the treatment and after completion of the treatment. Data from the VAS were recorded by calculating in millimeters the distance between zero point and the sign set apart by the patient on the 10-cm line.

Statistical Analysis

To compare shades before and after treatment, between both dental bleaching modalities, the bleaching efficacy (improvement in teeth shade) and the pain scores (VAS) were compared between the two groups (Laser-assisted and LED-assisted) using Wilcoxon signed-rank test. Within group changes in the teeth shade were analysed using the Friedman test (repeat measures). All testing were done using two-sided tests at alpha 0.05 (95% confidence level).

Result

After compiling the results of the study, we found most of the patients gave a VAS score of 7-8 in case of conventional bleaching system, with a significant improvement in tooth whitening; whereas in the case of laser bleaching, the VAS score was recorded in the range of 1-2, with similar significant improvement in tooth whitening [Figure 2]. Wilcoxon test was used for paired comparisons between laser bleaching and LED light bleaching based on Vita classic shade guide. The change in the shade was statistically different ($P = 0.01$). Both the treatment modalities were effective in changing the shade of the teeth.

Discussion

Numerous techniques have been introduced in dentistry for teeth bleaching which have undergone constant reformation. Varied numbers of adverse effects on dental hard tissues have been found regarding oxidizing agents that are engaged in tooth whitening.^{12,13} On the other hand, less change in microhardness of enamel is seen with laser tooth bleaching and laser bleaching does not culminate in much temperature elevation.¹⁴

Bleaching agents of various brands with various concentrations are available in the market. In this study Pola Office bleaching kit was used and it has given the most promising outcome. Along 35% hydrogen peroxide Pola office consists of potassium nitrate, so the patient's post-operative sensitivity is reduced.

In spite of the fact that tooth sensitivity is reversible after power bleaching procedure, it remains a main side effect that may keep going for about 2 weeks after completion of treatment and which can lead to mental and physical inconvenience.¹⁰ This clinical study was carried out to evaluate the efficacy of HP bleaching gel activated by 940 nm diode laser, at the same time analyzing the potential side effect of tooth sensitivity and calculating the shade change.

The present study of laser-assisted dental bleaching was carried out to compare and analyze the short-term efficacy with regards to conventional treatment. Both treatments executed were effective in achieving whitening. In fact, it was discovered that laser-assisted bleaching enhanced results to a greater extent than the conventional system when administered for a period of 8 mins only.

In regards to at-home and in-office treatments various tooth bleaching protocols have been described.^{15,16} Highly concentrated HP protocols (35–38%), could be applied in one or multiple cycles/sessions for a variable duration of time in contact with the tooth surface.¹⁵⁻¹⁷ However, in the literature the adverse effects from these bleaching agents have widely portrayed.¹⁵⁻¹⁷ In a recent study it was seen mild changes in enamel surface micromorphology was noticed when the enamel was bleached with 38% HP,¹⁸ and other studies have showed a decrease in the enamel mineral content.¹⁹

Here, the put forth treatment modality displayed to be more competent than the conventional one. It was observed over a minimal time of exposure on the dental surface for the 38% HP gel (8 min, 4 cycles) for laser treatment. The mean change in shade was at a minimum of one shade value lower for maxillary and mandibular quadrants, when the laser assisted system was used rather than the conventional treatment.

HP of high concentrations (25–35%) produce enough radicals quickly which are capable of reacting with tooth pigments.²⁰ On the other hand, we have established that 38% HP for dental bleaching has revealed improved results when 940-nm diode laser is used immediately after tooth bleaching (Table 1).

Upon finishing the treatment scarcely any patients reported sensitivity in the areas where the treatment was carried out. There were no complaints regarding sensitivity or discomfort reported after 48 hrs.

Results achieved in the current study regarding tooth sensitivity come into consent to Gurgan et al¹¹ and Calderini et al²¹ who recorded low scores using 980 nm diode lasers.

Conclusion

Inside the restrictions of this investigation, we conclude that diode laser tooth bleaching is a feasible treatment modality, as it dispenses rapid and competent results of bleaching without inducing any thermal injury. Improved patient compliance and satisfaction is observed when truncated time setting is employing power tooth bleaching.

Emphatic results have been seen in a short-term post-bleaching assessment by the new protocol of 940 nm diode laser tooth whitening.

For decreasing tooth sensitivity resulting from high concentration HP bleaching gel a 940 nm diode laser is an appropriate auxiliary tool.

A reduction of bleaching gel tooth contact time by more than three times can be seen with laser power bleaching as compared to conventional protocols with the same bleaching efficiency.

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