

Comparison of Diode Lasers and Conventional Retraction Cord for Gingival Retraction: A Pilot Study

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ABSTRACT

Introduction: Gingival retraction is a crucial aspect of dental impression procedures, especially in fixed prosthodontics. It involves moving the gingival tissue away from the tooth surface to expose the preparation for recording both the prepared and unprepared surfaces. The accuracy of the marginal fit of a fixed prosthesis depends upon the location of the finish line, which is essential for maintaining the health of the periodontium.

Aim: The purpose of this study was to determine the efficacy of diode lasers as a method of gingival retraction in comparison to a conventional retraction method.

Materials and Methods: The present pilot study included a total of 10 healthy patients from the Department of Prosthodontics and Crown and Bridge at Rungta College of Dental Sciences and Research, Bhilai, Chhattisgarh, India, all of whom required a single-unit fixed prosthesis. Of the 10 patients, five underwent retraction using conventional means with a retraction cord, while

the other five patients received diode laser retraction before impression making. A comparative evaluation of the vertical dimension achieved was conducted for both techniques, focusing on the fit of the prosthesis and patient comfort. The data were tabulated in Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) Version 24 software. Independent t-tests and paired t-tests were employed for statistical analysis.

Results: The patients included in this study were between 20 and 50 years of age. The mean age of the patients was 35±2 years. The change in vertical dimension from before to after treatment was significantly greater in the laser group than in the retraction cord group ($p=0.014$).

Conclusion: Diode lasers proved to be more efficient, providing better vertical displacement and greater patient satisfaction compared to the procedure using retraction cords.

Keywords: Dental impression, Tooth Preparation, Marginal fit

INTRODUCTION

The accuracy of the marginal fit of a fixed prosthesis mainly depends on the detection of the finish line of the tooth to be restored. This is achieved by making an impression of the finish line, which, if subgingival, can be exposed through the retraction of the gingiva itself. This gingival retraction must occur both apically and laterally to allow accurate registration of all the details of the finish line using impression materials or intraoral scanners. A minimum lateral displacement of approximately 0.2 mm is necessary to enable the impression material to flow within the sulcus with proper dimensional accuracy [1]. Furthermore, retraction procedures must be carried out in a manner that does not damage the basal cell layer and connective tissue cells, in order to avoid tissue alterations and shrinkage of the gingiva [1].

There are various gingival retraction systems available. Mechanical systems include retraction cords or pastes, as well as chemo mechanical systems that utilise cords impregnated with haemostatic solutions. Surgical procedures encompass gingivectomy or electrosurgery, which are based on the use of electrotomes, and laser surgery, which involves diode lasers, Neodymium-doped Yttrium-Aluminium-Garnet (Nd:YAG), erbium-doped Yttrium-Aluminium-Garnet (Er:YAG), Erbium, Chromium-Doped Yttrium-Scandium-Gallium-Garnet (Er,Cr:YSGG), and CO₂ laser systems [2-4]. The success of fixed prosthodontic restorations is largely dependent on the long-term health and stability of the surrounding periodontal structures [5,6].

In the market, over 125 gingival retraction cords are available in various colours, sizes, and formulations. A gingival retraction agent should be effective for its intended purpose, harmless both locally and systemically, and its effects should be spontaneously reversible,

wearing off quickly and leaving no lasting tissue displacement [7]. Periodontal probe transparency is a non-invasive method for measuring the gingival phenotype and is a highly reproducible technique, achieving 85% agreement between records. The traditional gingival retraction cord approach may damage the healthy epithelial lining, potentially leading to postoperative gingival recession. The suggested duration for inserting the cord into the sulcus is between five to fifteen minutes after tooth preparation. Gingival recession may occur if the cord is inserted too firmly or if it is left in place for too long. In addition to pain and bleeding, it has been shown that medications in the cords may cause gingival inflammation. Therefore, methods that do not utilise retraction cords have been proposed [2].

Lasers represent a recent advancement in various dental procedures, including prosthodontics. Soft-tissue lasers may be used as an alternative to traditional retraction methods because they provide appropriate retraction and haemostasis while requiring less time to perform and causing no discomfort to the patient [2]. Lasers operate using a high powered focused beam based on photo-ablation, which causes tissue vapourisation at temperatures of 100-150°C, thereby incising tissues without haemorrhage and promoting rapid healing with minimal inflammation and pain [1].

To date, data concerning the lateral and vertical displacement of the gingiva remain scarce and often controversial due to differing research protocols and the limited number of available studies [8-10]. Nevertheless, further in vitro or in vivo studies, along with randomised controlled trials, are necessary to define the clinical indications, identify the best laser system for gingival retraction, establish the pre-setting protocols, and assess their effectiveness compared to other retraction systems. Thus, the present study

aimed to illuminate the use and comparison of laser systems and retraction cords for gingival retraction procedures necessary for exposing sub-gingival finish lines prior to impression making for fixed dental prostheses.

MATERIALS AND METHODS

The present pilot study was conducted in the Department of Prosthodontics and Crown and Bridge at Rungta College of Dental Sciences and Research, Bhilai, Chhattisgarh, India, from January to March 2024. Ethical approval was obtained from the institutional ethical committee (Ref no. RCDSR/IEC/MDS/2024/S-8). Informed consent was obtained from all study participants.

Inclusion criteria:

- Male and female patients aged between 20 and 50 years;
- Patients with a root canal treated tooth in any arch;
- Patients with sound and periodontally stable abutment teeth;
- Patients with a thick gingival biotype;
- Patients must be willing to participate in the study.

Exclusion criteria:

- Patients younger than 20 years or older than 50 years;
- Patients with systemic disorders or compromised periodontal health status;
- Patients with a history of smoking, alcohol, or drug abuse.

Study Procedure

The study included a total of 10 healthy patients requiring a single unit fixed prosthesis who were willing to participate. Tooth preparation was completed for all 10 patients. For the procedure of gingival retraction, the patients were divided into two groups using a simple random sampling method. Out of the 10 patients, five were selected for retraction through conventional means using retraction cord, while the other five patients underwent the procedure using a laser retraction system. The depth of the gingival sulcus was compared for all the patients using both methods.

For retraction using a laser system: Post-endodontic restoration was performed on the teeth, which required a fixed prosthesis for the affected teeth; therefore, tooth preparation was carried out for the concerned teeth. This was a short study that focused solely on posterior teeth, as they provided a well-defined finish line and a larger surface area compared to anterior teeth. After tooth preparation, gingival retraction was performed using the laser system. The laser system employed was the Cheese™ Mini Dental Diode Gigaa Laser System (Wuhan, China), which is a diode laser. Laser devices have preset parameters based on the specific type of dental procedure to be performed.

Following are the parameters of the laser system [1]:

Power: 0.7 W

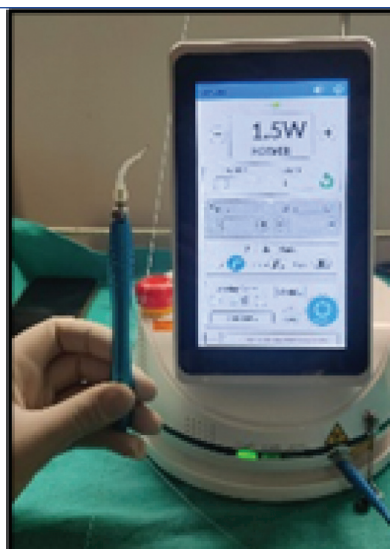
Frequency: 25 Hz

Fiber tip diameter: 400 µm

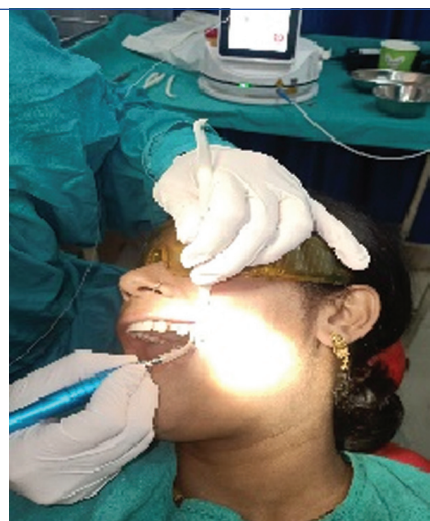
Mode: continuous mode

The fibre tip was inserted to a depth of 1.0 to 1.5 mm into the crevicular sulcus with a circular movement around the tooth. The depth of the gingival sulcus was measured using a periodontal probe before and after gingival retraction. Following this, impressions of the maxillary and mandibular arches were made. The impression of the affected arch was taken with elastomeric impression material [Table/Fig-1-6].

For retraction through retraction cord: After tooth preparation, gingival retraction was performed using a retraction cord with the single cord technique. The retraction cord used was size #2, which was selected according to the teeth involved. The retraction cord employed in this procedure was a knitted retraction cord with a



[Table/Fig-1]: Diode laser system.



[Table/Fig-2]: Laser used intra-orally.



[Table/Fig-3]: Tooth preparation done (concerned teeth 24 and 26).



[Table/Fig-4]: Crown surfaces after retraction through Laser system



[Table/Fig-5]: Elastomeric impression.



[Table/Fig-10]: Gingival sulcus Depth measured.



[Table/Fig-6]: Preoperative (36).



[Table/Fig-11]: Impression made.

haemostatic solution (25% buffered aluminium chloride solution). The retraction cord was dipped in the haemostatic solution and placed into the gingival sulcus with the aid of an instrument cord packer for a duration of three to four minutes. The depth of the gingival sulcus was measured using a periodontal probe before and after gingival retraction. After the removal of the retraction cord, an impression of the maxillary and mandibular arches was made. The impression of the affected arch was taken with elastomeric impression material [Table/Fig-7-11].

Outcome measure: The depth of the gingival sulcus before and after gingival retraction using the techniques of laser and retraction cord systems was measured with a periodontal probe, and a comparative analysis was conducted.

STATISTICAL ANALYSIS

The data were tabulated in Microsoft Excel and analysed using SPSS V.24 software. The variables are presented with the mean and standard deviation. Independent t-tests and paired t-tests were used for the statistical analysis. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Patients included in this study were between 20 and 50 years of age. The mean age of the patients was 35 ± 2 years. The sulcus depth before treatment was similar in both groups, with no statistically significant difference ($p=0.466$) [Table/Fig-12]. The mean sulcus depth after retraction using the laser system 2.18 ± 0.61 mm was significantly greater than the sulcus depth achieved with the retraction cord 1.59 ± 0.36 mm ($p=0.035$). This indicates that greater retraction was achieved through the laser system compared to the conventional retraction cord [Table/Fig-13].

Parameter	Group	Mean	SD	p-value
Sulcus depth before treatment	Laser	1.48	0.33	0.466
	Retraction Cord	1.30	0.41	

[Table/Fig-12]: Comparison of sulcus depth (mm) before treatment.



[Table/Fig-7]: Tooth preparation done (36).



[Table/Fig-8,9]: Gingival retraction with retraction cord (lingual and buccal view). (Images from left to right)

The change in sulcus depth from before to after treatment was greater in the laser group than in the retraction cord group ($p=0.014$) [Table/Fig-14].

Parameter	Group	Mean	SD	p-value
Sulcus depth after treatment	Laser	2.18	0.61	0.035
	Retraction cord	1.59	0.36	

[Table/Fig-13]: Comparison of sulcus depth (mm) after treatment.

Parameter	Group	Mean	SD	p-value
Change in sulcus depth	Laser	0.70	0.35	0.014
	Retraction cord	0.29	0.12	

[Table/Fig-14]: Comparison of change in sulcus depth (mm) from before to after treatment.

DISCUSSION

Laser technologies have proved to be efficient systems for gingival retraction and appear to be safe when used for thick gingival biotypes. Laser systems that are efficient in gingival retraction allow for better intraoperative haemostatic control and greater patient comfort than other gingival retraction procedures. Through this study, it was observed that the vertical displacement of the gingiva using the laser system was significantly greater than that achieved with the retraction cord. This, in turn, resulted in a better fit for the prosthesis.

Diode lasers are increasingly employed for periodontal and peri-implant procedures, as well as other soft-tissue dentistry treatments. Diode laser retraction can be used for gingival retraction since it offers sufficient vertical displacement of the tissues, as concluded in a study by Sorrentino R et al., 2022 [1]. The diode laser produces greater lateral gingival displacement than magic foam cord. Furthermore, it appears to be a faster, more comfortable, and simpler gingival retraction system compared to both magic foam cord and retraction cord [1]. Similarly, in the present study, retraction was also found to be better with the laser when compared to the retraction cord. Good haemostasis and patient comfort are two of the many ways in which laser surgery improves upon traditional treatment methods [1]. Additionally, the laser technique is less aggressive to the periodontal tissues compared to conventional methods [8].

The amount of gingival retraction obtained through the diode laser retraction system was greater than the minimum required retraction of 0.2 mm and was closer to the thickness of the sulcular epithelium [2,3]. This conclusion was reached in a study conducted on twenty subjects by Ch VK et al., (2013) [3]. Nevertheless, the laser retraction system has drawbacks due to lateral heat production, which may result in necrosis of the alveolar crest, leading to recession and the exposure of restorative margins [4].

Melilli D et al., (2018) compared two systems used for conditioning the gingival sulcus and exposing the finish line before the final impression for a fixed denture. They concluded that the amount of gingival retraction was similar for both gingival retraction cords and the diode laser technique. However, the diode laser had the advantages of being simpler to use, requiring less time, and being more comfortable for the patient than retraction cords [9]. Tao X et al., (2018) conducted a study aimed at comparing the two most common methods for gingival troughing: presaturated cord and lasers (including diode, Nd:YAG, and Er:YAG). The presaturated cord resulted in significantly greater ($p < 0.05$) gingival recession compared to lasers and narrower gingival sulci. The Er:YAG laser resulted in the quickest and most uneventful wound healing when compared to the diode and Nd:YAG lasers [10].

Abdelhamid AA et al., (2022) carried out a study comparing the amount of tissue displacement, both laterally and vertically, between the gingival retraction cord technique and the diode laser technique. They concluded that laser troughing resulted in not only a greater amount of vertical retraction but also more lateral retraction. There was a significant difference in patient satisfaction between the two

groups, with laser troughing yielding better results. Laser troughing was found to be more satisfactory for the patient and produced less pain [11].

Marsch A et al., (2013) described the use of a diode laser for gingival troughing in conservative and prosthetic dentistry. This case report illustrates the successful use of the SIROLaser Advance/Xtend for gingival troughing to visualise preparation margins. Using a diode laser considerably facilitates and accelerates workflow, as demonstrated with examples of digital and analog impression-taking. In conservative dentistry, for subgingival cavities, laser gingival troughing can also have a favourable effect on treatment success. In addition to modelling the surrounding periodontium, a particular advantage of using the laser is the resulting (virtually) bloodless, dry field. This aspect is important for conservative treatment, as the majority of available adhesives require an absolutely dry, bloodless surface to achieve their full potential [12].

In recent advances, many non-invasive retraction systems have become available, such as retraction capsules, retraction pastes, magic foam cords, and retraction strips [13,14]. Non-invasive retraction systems provide more effective and convenient retraction than conventional retraction cords. Thimmappa M et al., (2018) stated that MeroCel strips provided a greater amount of lateral and vertical gingival retraction than the ultrapack cord and magic foam cord investigated in the study [15].

Limitation(s)

The limitations of this study included the fact that it was not performed in the aesthetic zone. There were no gender-specific criteria for patient selection, and only the gingival sulcus depth was compared. Postoperative haemostasis and minor mechanical trauma during the procedure were not taken into consideration. These criteria will be addressed in Phase II of this study.

CONCLUSION(S)

Laser systems provide better vertical gingival displacement than retraction cords. The gingival displacement obtained through the diode laser system exceeded 0.2 mm, which is the minimum requirement. Diode laser devices for gingival retraction have proven to be more efficient and secure compared to gingival retraction cords, as they provide sufficient gingival sulcular displacement, are more convenient for the operator to use, and yield greater patient satisfaction. When used on individuals with healthy, thick gingiva, there is less discomfort and less tissue loss compared to the retraction cord technique.

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