

Comparative evaluation of the effect of impregnated retraction cord versus laser on gingival attachment level and pain perception following retraction for subgingival margins - A prospective, split-mouth, controlled, clinical study

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Abstract

Aim: To evaluate and compare the effect of impregnated retraction cord vs Laser on gingival attachment level and pain perception following retraction for subgingival margins.

Settings and Design: Many methods for achieving and measuring the amount of gingival retraction in fixed prosthodontic work have been advocated. Though the gingival attachment level is crucial in Periodontology, the literature available regarding the effect of these retraction methods on the same is scarce. Hence, this clinical study was designed to compare the pain perception and amount of gingival recession when impregnated cord and laser were used for retraction.

Materials and Methods: In 40 subjects (age range of 20 to 40 years) with single missing maxillary incisor, the abutments were prepared with subgingival margins, to receive a full coverage metal-ceramic fixed dental prosthesis. The gingiva was retracted on one of the abutments with impregnated retraction cord and on the other with diode laser. Gingival attachment levels were compared at six sites per abutment using superimposition of digital scans, preoperative and four weeks after cementation of final prosthesis.

Statistical Analysis Used: Statistical analysis of the data for gingival recession was done using *t*-test. Pain perception was analysed with Chi-square test. Pain perception by patients following retraction was compared with VAS scale.

Results: The average values of gingival recession on buccal side were 0.61 mm and 0.38 mm and on the palatal side were 0.58 mm and 0.35 mm for impregnated retraction cord and laser respectively. The *P* values of <0.01 indicated a highly significant difference between the two groups. Intragroup comparison did not show significant differences between various sites. Pain and discomfort produced

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by cord method was moderate in comparison with mild/no pain with diode laser and the difference was highly significant.

Conclusion: Retraction cord produced more gingival recession than the diode laser, which was statistically highly significant on both buccal and palatal aspects of the teeth. Patients experience with diode laser technique was less painful in comparison with retraction cord method.

Keywords: Gingival retraction, laser, pain perception, recession

INTRODUCTION

Maintenance of periodontal health following the placement of a fixed partial denture or full crown is critical. The abutment teeth for a fixed dental prosthesis are prepared to have definite margins on which the prosthesis should precisely fit and seal the tooth. Therefore, accurately recording the prepared finish line is of utmost importance, which makes the impression-making procedure crucial for the success of the prosthesis to be fabricated.

Obtaining an accurate impression becomes complicated when the finish line partially or entirely lies below the level of the crest of the free gingival margin. Such scenarios necessitate retraction of the gingiva to enable capturing the details of the prepared margins accurately.^[1] The rationale behind gingival retraction is to temporarily displace the gingiva away from the tooth, which creates space for the impression material to flow into the widened gingival sulcus and record the finish line. This displacement, however, is only temporary and must not cause permanent or irreversible harm to the gingivodental integrity. Laufer *et al.* recommended that the horizontal space created following gingival retraction must be at least 0.2 mm at the level of the finish line to obtain an impression of satisfactory quality.^[2]

Gingival retraction can be achieved with a variety of methods, including mechanical, chemicommechanical, surgical, and Light Amplification by the Stimulated Emission of Radiation (LASER).^[3,4] While all the methods are able to achieve adequate retraction for the sake of impression-making, they also inevitably cause damage to the tissues during the procedure. Tissue with normal healing capacity will repair itself, while compromised tissue may result in gingival inflammation and recession.^[5]

The most prevalent method of gingival displacement is the use of retraction cords. They are supplied in three basic designs, namely twisted, knitted, and braided cords. Braided and knitted cords are preferred because of less chance of unwinding during placement. Cords impregnated with hemostatic agents such as aluminum chloride, epinephrine,

or ferric sulfate show less bleeding during retraction, with the former being most commonly used.^[6]

Studies have shown that the placement of cord into the sulcus for too long a time and pressure generated during cord placement may cause gingival recession.^[7] Many clinicians omit this procedure completely from the treatment due to the time required for the placement of cord and pain or discomfort caused to the patient during cord placement. Hence, the search for safer and efficient alternatives led to the development of cordless methods of gingival displacement. However, these methods remain unpredictable in achieving uniform retraction all around the teeth.

The most recent development in dentistry is the introduction of dental LASERS. These have been used as alternatives to many surgical procedures such as soft-tissue surgeries,^[8-10] periodontal,^[11,12] and peri-implant surgeries.^[13,14] Lasers of varying wavelengths have been employed for the purpose of gingival retraction, including diode, ND: YAG, ER: YAG, and CO₂ lasers.^[15] Diode lasers are the most commonly used soft-tissue lasers owing to their property of promoting hemostasis that produces a relatively bloodless field of surgery. These semiconductor lasers convert electrical energy into coherent light that produces a high-powered focused beam having the ability to generate the temperatures as high as 100°C–150°C, able to vaporize the tissues. Owing to its frequent application in cutting and coagulating oral mucosa, especially gingiva, it is known as “soft tissue laser.” When used at optimum power, diode lasers efficiently displace gingiva and cause local microhemostasis while causing minimal damage to the tissues.^[16] This, in turn, prevents seepage of blood into the sulcus, thereby keeping the area of the prepared margin dry, which enhances the quality of final impression. There are numerous studies on the amount of gingival retraction achieved with various methods.^[17-21] Several studies have compared the effect of different methods on periodontal health with respect to probing depth, plaque index, gingival bleeding index, and bleeding on probing.^[22,23] These studies have reported varying effects on the periodontium depending on the retraction methods used. However, the literature available regarding the effect of gingival retraction

methods on resulting gingival recession is very limited.^[24-26] Similarly, the level of discomfort or pain perception during retraction procedures has also been seldom studied.^[12,27,28] Research combining gingival retraction, gingival recession, and pain level is extremely rare.^[29,30] Hence, the present study aimed to evaluate and compare the effect of an impregnated gingival retraction cord and diode laser on gingival attachment level and pain perceived by patients following retraction for subgingival margins. The null hypothesis was that there is no difference in the gingival recession and pain perception for gingival retraction achieved by impregnated cord versus diode laser.

METHODS

The present, prospective, *in vivo* study was conducted in the institutional department of prosthodontics. The study population was selected by randomization from the outpatient department of prosthodontics wherein all the procedures were carried out by the same operator. The research protocol was approved by the Institutional Ethical Committee (GDCH/SS/EC/6692 dated September 16, 2019). The sample size was determined by using the mean and standard deviation (SD) values from the literature, and it was determined that approximately 39 sites per group should complete the trial at the endpoint follow-up.

Forty patients in the age group of 20–40 years having single missing maxillary incisor were included in the study. Only those who did not have any preexisting gingival recession on the abutment teeth and those who were not taking any medication which could affect the periodontal condition adversely were considered eligible for inclusion. Patients with poor periodontal condition, systemic diseases that can possibly affect periodontal health, and contraindications for the use of retraction cords or lasers, such as those with cardiac pacemakers, were excluded from the study.

Informed consent was obtained from the patients followed by a detailed case history. Intraoral periapical radiographs were taken to assess the periodontal health. The baseline gingival plaque level of the abutment tooth was recorded by using the index given by Quigley and Hein and Turesky.^[31] A disclosing agent (Alpha Plac by DPI, India) was used for scoring plaque on the labial, buccal, and lingual surfaces. The scoring system was as follows: 0 = no plaque; 1 = separate flecks of plaque at the cervical margin of the tooth; 2 = a thin continuous band of plaque at the cervical margin up to 1 mm; 3 = a band of plaque wider than 1 mm but covering $<1/3$ of crown; 4 = plaque covering at least $1/3$ but $<2/3$ of the crown; 5 = plaque covering $2/3$ or more of crown. Diagnostic impressions were

made digitally by an intraoral scanner (Medit i500 intraoral scanner, Dentium) to record the gingival position before tooth preparation. A set of impressions was also made in irreversible hydrocolloid and the casts were poured with dental stone. The wax mockup was done and an index was prepared for provisional restoration on the poured cast.

Abutment teeth were prepared using diamond point burs with subgingival margins to receive a conventional full coverage porcelain fused to metal three-unit fixed partial denture. The topical anesthetic gel was applied to the gingival tissue to be retracted. Randomization was performed by the coin flip method and one abutment tooth was randomly allocated for gingival retraction by a retraction cord impregnated with 25% aluminum chloride, while the other abutment tooth was automatically allotted to retraction by diode laser.

The laser retraction procedure was performed first with due consideration of laser protection protocols using Ezlase by Biolase USA 980 nm diode laser [Figure 1]. Before starting gingival troughing, the fiber optic tip was activated using articulating paper with power settings of 0.8 W–1.2 W in pulse mode to avoid tissue charring. Topical anesthesia was applied and the gingival troughing procedure was performed. The optic fiber tip was placed in a direction away from the prepared tooth and a small soft brushing motion was performed all around the prepared tooth, which removes the layer of sulcular epithelium and provides space for the impression material. High vacuum suction was used during the procedure to reduce the flesh odor caused due to the tissue burn by the laser.

The gingival retraction was then performed for the other abutment tooth using a knitted cord of size #00 (Medi-Pak 00 knitted retraction cord.) impregnated with aluminum chloride (Hemostat by Medicept). Double-ended blunt



Figure 1: Mesial abutment retraction done with cord and distal abutment with diode laser

cord packer was used to place the cord into the sulcus with all precautions to avoid laceration or trauma to the gingiva [Figure 1]. The cord was maintained in position for 10 min, and then, it was moistened with plain water and removed. Gingival bleeding after the removal of the cord was examined. Sulcus was washed with normal saline and dried with light air pressure from a three-way syringe. No injectable local anesthesia was used during either retraction procedure. The amount of pain produced by the gingival retraction cord impregnated with aluminum chloride and diode laser was recorded using the universal Visual Analog Scale (VAS). After gingival retraction, another digital impression was made for the fabrication of the definitive prosthesis [Figure 2].

The provisional denture was fabricated chairside with tooth-colored resin using the index and cemented with eugenol-free zinc oxide cement (NETC by Meta Biomed, Germany). Definitive prosthesis was fabricated, and final cementation was done using luting glass ionomer cement (GC Gold Label Luting and Lining Cement by GC Corporation Tokyo, Japan). Patients were instructed regarding the maintenance of oral hygiene and recalled after 4 weeks for re-evaluation. Again, the same plaque index score was recorded, and if a large amount of plaque accumulation compared to the baseline score was noted, then the patients were excluded from the study to rule out the plaque factor as being responsible for possible gingival recession. A total of eight patients were excluded from this study, and oral hygiene protocols were reinforced for them. An equal number of additional patients were enrolled.

The gingival attachment level at this point was compared to the baseline level by superimposing digital impression images focused on a point marked in the mid-buccal region

using Exocad 2.2 Valletta software (Darmstadt, Hessen, Germany). The distance between the two points was measured to provide the extent of alteration in the gingival levels [Figure 3]. Recession was recorded at six different points that is midbuccal, mesiobuccal, distobuccal, midpalatal, mesiopalatal, and distopalatal regions. The same procedure was carried out for both the abutment teeth in all the patients.

RESULTS

The amount of gingival recession was measured digitally with Exocad 2.2 Valletta software 4 weeks after the retraction by superimposing the digital scans for both the groups. All the data were entered into a computer by giving a coding system, proofed for entry errors and then subjected to statistical analysis. Data obtained were compiled on an MS Office Excel sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States) and subjected to statistical analysis using the Statistical Package for the Social Sciences software (SPSS v 26.0, IBM, Chicago, US). Descriptive statistics such as mean and SD for numerical data were depicted. Inter-group comparison (two groups) was done using a *t*-test. For all the statistical tests, $P < 0.05$ was considered statistically significant, keeping α error at 5% and β error at 20%, thus giving power to the study as 80%. * = statistically significant difference ($P < 0.05$) ** = statistically highly significant difference ($P < 0.01$) # = nonsignificant difference ($P > 0.05$) – for all tables.

The mean values of gingival margin recession after 4 weeks using impregnated gingival retraction cord method (Group 1) on the buccal side in the midbuccal, mesiobuccal, and distobuccal area were 0.61 mm, 0.59 mm, and 0.62 mm, respectively. Similarly, on palatal aspect,

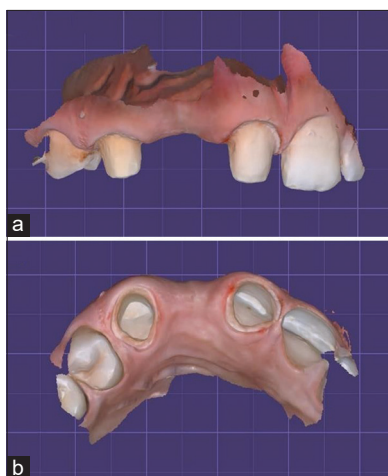


Figure 2: Digital impression after retraction (a) frontal aspect (b) occlusal aspect

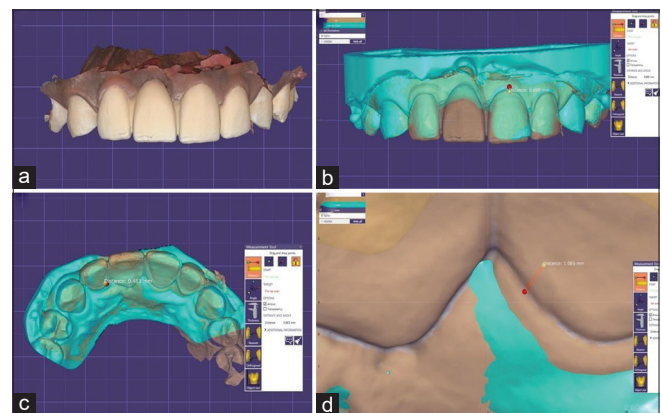


Figure 3: (a) Digital impression 4 weeks after final prosthesis delivery; superimposition of digital impressions before tooth preparation and after final prosthesis delivery (b) frontal aspect and (c) occlusal aspect; (d) Measurement of the difference in the gingival margin in the superimposed image

the mean values in the midpalatal, mesiopalatal, and distopalatal area were 0.55 mm, 0.59 mm, and 0.60 mm, respectively [Table 1].

The mean values of gingival margin recession after 4 weeks using the diode laser method (Group 2) for retraction on the buccal side in the midbuccal, mesiobuccal, and distobuccal area were 0.33 mm, 0.37 mm, and 0.39 mm, respectively. On the palatal aspect, the mean values in the midpalatal, mesiopalatal, and distopalatal area were 0.33 mm, 0.35 mm, and 0.36 mm, respectively.

The average values of gingival recession on the buccal side were found to be 0.61 mm and 0.38 mm and on the palatal side were found to be 0.58 mm and 0.35 mm for Group 1 and Group 2, respectively.

There was a statistically highly significant difference seen for the values of gingival recession between the groups ($P < 0.01$) for all the six regions, and also, the average of scores in the buccal and palatal segments with lower values was recorded for laser. However, a comparison of the intra-group P values showed no significant difference in gingival recession before and after retraction by either method.

For the perception of pain during retraction procedure, $n = 32$ of the patients experienced pain of moderate intensity with impregnated cord, while only $n = 4$ patients experienced moderate pain after retraction by laser [Table 2]. $N = 8$ patients in the retraction cord group and $n = 28$ patients in the laser group, respectively, experienced mild pain. No pain was experienced by eight patients in which retraction was performed by laser, while none of the patients in the retraction cord group experienced a completely painless procedure. Table 2 shows the pain perception comparison between males and females during retraction by either method. The difference between individuals experiencing all three intensities of pain was statistically highly significant ($P < 0.01$), with a greater number of individuals experiencing moderate pain in the retraction cord group and mild/no pain in the laser group. Table 3 shows the comparison of pain perception by patients between retraction cords and diode laser.

DISCUSSION

The present study compared the gingival recession and amount of pain resulting from gingival retraction obtained by using an impregnated retraction cord versus diode laser. This study was designed as an *in vivo* split-mouth comparative study since this design is closer to the actual

Table 1: Comparison of amount of gingival recession 4 weeks after gingival retraction using retraction cord impregnated with aluminum chloride (Group 1) and 980 nm diode laser (Group 2)

Group (n=40 each)	n	Mean (mm)	SD	SEM	t	P value of t-test
Midbuccal						
1	40	0.61	0.24	0.037	5.43	0.000**
2	40	0.36	0.16	0.026		
Mesiobuccal						
1	40	0.59	0.21	0.033	5.47	0.000**
2	40	0.37	0.14	0.023		
Distobuccal						
1	40	0.62	0.20	0.032	5.88	0.000**
2	40	0.39	0.13	0.021		
Midpalatal						
1	40	0.55	0.21	0.033	5.58	0.000**
2	40	0.33	0.13	0.021		
Mesiopalatal						
1	40	0.59	0.19	0.031	6.13	0.000**
2	40	0.35	0.15	0.024		
Distopalatal						
1	40	0.60	0.19	0.030	6.32	0.000**
2	40	0.36	0.14	0.020		
Buccal average						
1	40	0.61	0.21	0.03	5.82	0.000**
2	40	0.38	0.14	0.02		
Palatal average						
1	40	0.58	0.19	0.03	6.47	0.000**
2	40	0.35	0.12	0.02		

**Statistically highly significant difference ($P < 0.01$). SD: Standard deviation, SEM: Standard error of the mean

Table 2: Comparison of pain perception by Visual Analog Scale score in male and female patients during retraction by cord and diode laser method

Intensity of pain	Males (n=40)		Female (n=40)	
	Cord (n=20)	Laser (n=20)	Cord (n=20)	Laser (n=20)
No pain	0	4	0	4
Mild	3	16	5	12
Moderate	17	0	15	4
Severe	0	0	0	0
Very severe	0	0	0	0
Worst possible	0	0	0	0

Table 3: Comparison of pain perception by patients between retraction cord and diode laser

Pain	Count (n) (%)	
	Retraction cord	Laser
No pain	0	8 (20)
Mild	8 (20)	28 (70)
Moderate	32 (80)	4 (10)

clinical scenario, as both the procedures are compared in the same oral environment.^[32]

Among the various methods of retraction, the chemico-mechanical method is the most commonly used. This involves the use of cord impregnated with a hemostatic agent to control the bleeding often caused during the cord placement. As maintaining the integrity of

periodontal tissues is crucial for the success of any fixed prosthesis, the use of methods that cause minimal trauma to the surrounding tissues is desirable. Surgical gingival retraction by rotary diamond point can lead to trauma to the epithelial attachment, which may cause gingival recession. The electrosurgical method of gingival retraction cannot be used in patients with a cardiac pacemaker.^[33] Since the physical placement of the cord can lead to more trauma to surrounding soft tissues, some cordless materials such as expasyl, gingitrac, and magic foam have also been used for gingival displacement.^[34] Although these materials exert less pressure and generally cause less bleeding and damage, achieving uniform retraction becomes difficult.

Lasers have been shown to achieve local hemostasis while being relatively safe to use.^[15] The diode wavelengths are highly absorbed in hemoglobin and melanin and have little absorption in the dental hard tissue.^[35] This gives the diode laser the ability to act selectively, and precisely cut, coagulate, ablate or vaporize the areas around dental structures, causing less damage to the tissues. A diode laser removes the superficial layer of sulcular epithelium, salvaging the basal layer and connective tissue.^[36] Leaving the basement membrane intact further prevents the blood vessels from getting exposed and reduces bleeding to a significant extent. This mechanism prevents shrinkage of gingival tissue, thus, causing minimum soft-tissue damage while significantly improving postoperative healing.

Although a plethora of research is available pertaining to the amount of retraction achieved,^[17-21] other parameters, such as the effect of a gingival retraction method on periodontal health, including the effect on gingival recession and pain perception by patients, have not been studied adequately.^[37] Most of the available studies for comparing gingival recession after retraction use preoperative and postoperative impressions poured in stone or a fixed reference point marked on resin blocks fabricated preoperatively.^[29,38] These methods can introduce the errors during impression-making, pouring of the models as well as during measurement. Digital impressions obtained by an intraoral scanner can minimize these errors.^[39,40] The digital superimposition of images is an easy and reliable method to determine the degree of change pre- and postintervention. Hence, this method was selected to calculate the recession on the abutments.

The general agreement so far is that displacement cords may cause discomfort, postoperative inflammation of the tissue, and bleeding.^[5] About 2 mm of keratinized tissue and about 1 mm of attached gingiva are desirable around teeth to maintain periodontal health, even though a minimum

amount of keratinized tissue is not needed to prevent attachment loss when optimal plaque control is present.^[41]

The average value of gingival margin recession in the present study on the buccal side was statistically higher in the abutments retracted using cord than in the abutments retracted using diode laser in all the subjects. The findings were similar for the palatal aspect. These differences were statistically highly significant. However, this may not be clinically significant when the above periodontal conditions are fulfilled. The mean values did not exhibit statistically significant differences for various regions, i.e., midbuccal, mesiobuccal, distobuccal, midpalatal, mesiopalatal, and distopalatal of the abutment retracted using either method.

Steffken and Vahidi studied six patients for gingival recession following retraction with cord and laser methods.^[24] They recorded the measurements before displacement of the gingiva and at the time of cementation, 1 week, 3 weeks, and 8 weeks after cementation of the definitive crowns and concluded that there is no significant difference in gingival recession using either method of retraction. Their findings are in contradiction to those found in the present study, probably due to the use of the double cord technique in their study. Kazakova *et al.* compared the single-cord technique, retraction paste Expasyl, retraction paste Astringent and three surgical techniques, including ceramic bur rotary curettage, Er:YAG laser troughing, and diode laser troughing. They noted that all retraction methods, except for ceramic bur rotary curettage, led to clinically insignificant levels of gingival recession.^[26] Tamim *et al.* conducted a systematic review and concluded that lasers resulted in either less or comparable gingival recession and less pain when compared with conventional retraction methods.^[30] Tao *et al.*, in 2018, also noted that the conventional cord technique and laser both achieve minimum retraction required satisfactorily but retraction achieved with lasers was wider, more comfortable to the patient and caused less gingival recession postoperatively than cord technique. They also noted that the gingival recession decreased over a period of 4 weeks indicating that the recession at baseline and at 1-week period was clinically not significant.^[25] The conclusions drawn in all these studies were similar to our study.

Pain being a subjective symptom cannot be calculated accurately. Among various methods to measure pain, the VAS has been universally accepted to analyze and compare pain perception.^[42] Since pain threshold varies from person to person, both the retraction procedures were performed on different abutment teeth in the same patient to avoid bias.

In this pain assessment of 40 patients based on the VAS chart, the data did not reveal any gender predilection for more pain perception during retraction by either method, as shown in Table 2. It was found that 32 (80%) patients complained of moderate pain and 8 (20%) patients complained of mild pain in the retraction cord technique. In the retraction using the laser technique, 8 (20%) patients complained of no pain, 28 (70%) patients complained of mild pain, and only 4 (10%) patients complained of moderate pain. The pain level was significantly lower in patients in which retraction was achieved by using diode laser. Our results are in corroboration with previous studies wherein pain associated with cord retraction was found to be higher compared to laser.^[29,43,44]

The difference in pain levels can be attributed to the microtrauma caused to the blood vessels in the gingival connective tissue. On the other hand, diode lasers spare the basal layer of the epithelium as well as the basement membrane, thereby preventing the nerves and vessels in the underlying connective tissue from getting exposed. Therefore, they have the advantage of causing less bleeding and pain, leading to better acceptance among patients.^[45] The coagulation of superficial layers and blood levels achieved by lasers further contribute to accelerating the wound healing process.^[35,46] Patients experienced less pain/discomfort with laser than the cord technique. The statistically highly significant difference between the groups pertaining to gingival recession and pain perception indicated that the null hypothesis was rejected.

Limitations of the study and future scope

The forces used for pushing the cord into the sulcus cannot be well-controlled and uniform for all the cases. This reduces the reliability of assessment in gingiva retracted by cord as the force would vary, thereby possibly affecting the recorded outcomes. This constitutes one of the limitations of the present study. Another limitation was the possibility of results being confounded by the variables that could affect gingival recession, such as tobacco-related habits, parafunctional habits, and hormones.^[47] While the Quigley and Hein and Turesky index is recognized as a reliable index for measuring plaque, recession may not be solely attributable to the amount of plaque but is rather an end result of multiple synchronously occurring factors. The only complaint about laser retraction was the odor produced because of tissue burn, which was reduced by the use of high vacuum suction. Future studies can assess the exact tissue response based on histological evaluation over a longer duration and also the wound healing rates after retraction by various methods.

CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

1. The retraction cord technique produced more gingival margin recession than the diode laser method which is statistically highly significant on both buccal and palatal aspects of the teeth. However, this amount of recession was clinically acceptable for both the methods
2. There was almost no difference in the gingival margin recession produced in the different regions of the same tooth produced by the retraction cord technique. Same was true about the diode laser technique
3. Patients experience with diode laser technique was more comfortable and less painful in comparison with chemicommechanical retraction.

Clinical implications

1. The amount of gingival recession caused due to laser is statistically significantly lesser than mechanical cord retraction. However, the recession is clinically acceptable for both the methods
2. Use of laser for gingival retraction causes less pain and discomfort to patients compared to mechanical cord retraction
3. Use of laser is recommended for retraction in tooth preparation with subgingival margins.

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Conflicts of interest

There are no conflicts of interest.

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