Review Article

SUCCESSFUL GINGIVAL RETRACTION USING DIODE LASER VS RETRACTION CORD: A SYSTEMATIC REVIEW

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ABSTRACT

Retraction of the gingival tissue is a well-known procedure. It is the displacement of the gingiva's margins away from a tooth. A restoration's marginal fit is affected by periodontal variables in terms of quality. The purpose of this systematic review was to determine the efficacy of diode lasers as compared to conventional retraction cords. A systematic literature review from 2010 to 2023 was performed using databases such as PubMed, Medline, and ScienceDirect. PRISMA flowchart was used to describe the selection process of searched articles with a total of nine articles included. It was concluded that as long as the operator can afford the expense, diode laser troughing may be advised since it offers enough vertical and lateral tissue displacement with greater patient satisfaction, less discomfort, and less tissue loss as compared to a retraction cord. When used on individuals with healthy, thick gingiva, laser devices for gingival retraction are efficient and secure.

Key words: Gingival retraction, Retraction cord, Diode laser, Systematic review.

Introduction

Retraction of the gingival tissue is a well-known procedure. It is the displacement of the gingiva's margins away from a tooth [1, 2]. A restoration's marginal fit is affected by periodontal variables in terms of quality [3]. The position of the finish lines, periodontal health, and sulcus hemorrhage during impression creation all affect the quality of the impressions. Although it is evident that having to insert the end line into the gingival sulcus has a detrimental impact on the quality of the impression, there hasn't been much research done on the many components of gingival retraction [4]. The purpose of gingival retraction is to provide room for the impression material to be adequately thick and to provide access for the impression material beyond the abutment borders. The thickness of the material may have an impact on the tear resistance of the impression material. Before taking an impression, gingival retraction should be required to expose the prepared tooth surfaces. Less sulcular width in an impression increases the likelihood of voids, and tears in the impression material, and decreased marginal accuracy [5].

A study found that 95% of dentists in North America regularly employed gingival retraction cords. In the market, over 125 gingival retraction cords are available in different colors, sizes, and formulations. A gingival retraction agent should be (1) effective for the purpose for which it is designed, (2) harmless both locally and systemically, and (3) its effects should be spontaneously reversible, wearing off quickly and leaving no lasting tissue displacement [6]. periodontal probe transparency is a non-invasive method of measuring the gingival phenotype and is a highly reproducible method with 85% agreement between records.

Lasers are the recent advancement in various dental procedures, and prosthodontics is not alien to this modality. The features of the wavelength and waveform have a significant role in the behavior of lasers. The wavelength of the most often used diode lasers is 980 nanometers (nm). The wavelength of neodymium: yttrium-aluminum-garnet (Nd: YAG) lasers is 1064 nm. Because they don't bleed as much, there is less gingival retraction. Because scarring reduces tissue loss, gingival margin heights are preserved [7]. Due to the dentists receiving no tactile sensation while using lasers for retraction, connected gingiva may thus be destroyed. Soft tissue lasers may be utilized as an alternative to traditional retraction procedures because they enable appropriate retraction and hemostasis while requiring less time to perform and causing no discomfort to the patient [8].

The traditional gingival retraction cord approach might harm the healthy epithelial lining, leading to postoperative gingival recession. Five to fifteen minutes after tooth preparation is the suggested period for inserting the cord into the sulcus [9]. Gingival recession may happen if the cord is inserted excessively firmly or if it has been kept in place for too long. In addition to pain and bleeding, it has been shown that medications in the cords might cause gingival inflammation. Therefore, methods without retraction cords, including electrosurgical methods, have been proposed [10].

Nearly 20% of dentists in the US already perform gingival retraction using lasers to get a perfect impression. The gingival retraction has been performed using Diode, Nd: YAG, Er: YAG, and Er, Cr: YSGG lasers [11, 12]. Lasers remove the sulcus' epithelial lining without harming the basal cell and connective tissue layers, unlike the retraction cord method, which shifts gingival tissue. This could reduce gingival recession in the future. Lasers have thus been proposed as an alternative to traditional gingival displacement procedures [13].

PICO question
P: Patients undergoing fixed partial denture procedure.
I: Diode lasers
C: Conventional retraction cord
O: Higher impression accuracy and less damage to gingiva

Aims of the study
The purpose of this systematic review was to determine the efficacy of diode lasers as compared to conventional retraction cords.

Materials and Methods

A systematic literature review from 2010 to 2023 was performed using databases such as PubMed, Medline, and ScienceDirect. The keywords used were "gingival retraction", "retraction cord", and "diode laser". PRISMA flowchart was used to describe the selection process of searched articles **(Figure 1)**.

Inclusion criteria
- Case-control and randomized control studies
- Published between 2010 and 2023
- English language of publication
- In vivo (humans)

Exclusion criteria
- Systematic reviews or meta-analyses or expert opinions or narrative reviews
- Survey-based studies
- Out of the specified time range
- Language other than English
- In vitro

Primary outcomes
To determine if a diode laser is a better option for gingival retraction as compared to conventional methods.

Secondary outcomes
To list down the advantages and disadvantages of both diodes as well as a conventional gingival retraction.

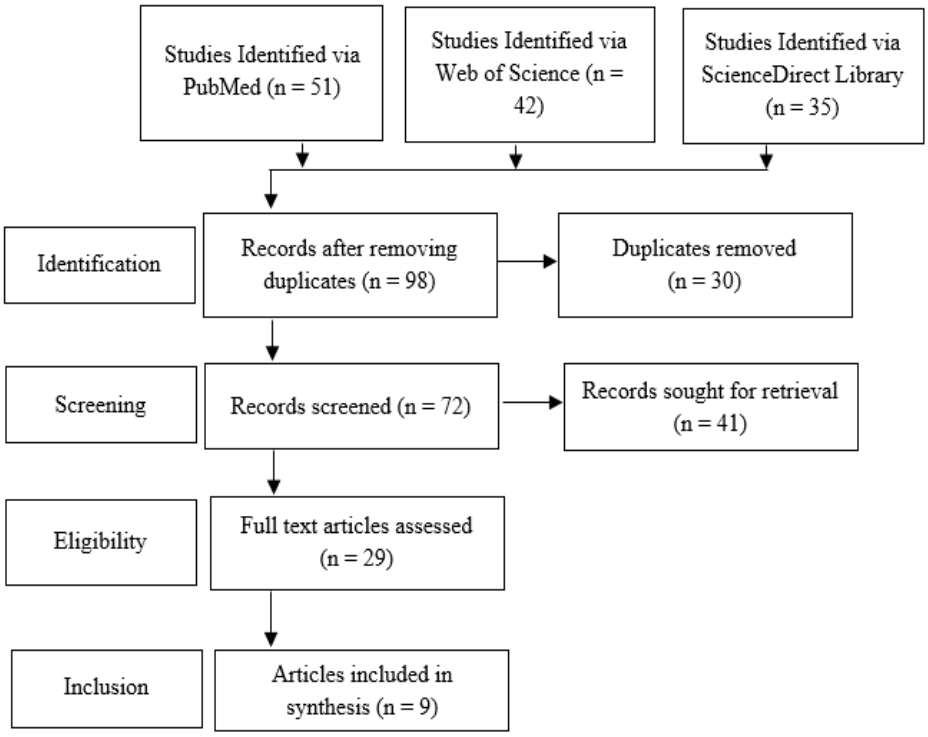

Figure 1. PRISMA Flow Diagram

Risk of bias assessment
The Cochrane risk of bias assessment method was used to assess the quality of the studies included **(Table 1)**.

Table 1. Summary of Cochrane Risk of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
[14]	+	-	+	+	+	+	+
[6]	+	+	+	+	+	+	-
[15]	+	+	+	+	+	_	+
[16]	+	+	+	+	+	+	-
[8]	+	+	+	+	+	+	+
[17]	+	-	+	+	+	+	+
[11]	+	+	+	+	+	+	+
[18]	+	+	+	+	+	+	-
[10]	+	+	+	-	+	+	+

Results and Discussion

Table 2. Summary of the studies included in the systematic review

Author's name	Laser type /technique	Objective	Sample	Follow-up period	Results
Ünalan *et al.* (2021) [14]	Cordless paste system, Er, Cr: YSGG laser troughing, and retraction cord	This clinical investigation compared the impact of three gingival displacement methods—cordless paste system, Er, Cr: YSGG laser troughing, and retraction cord—on the periodontal tissues.	52	1st day, 1st month, 3rd month, 6th month, and 1st year	There was a significant difference in the PD, GI, and BOP index scores across the three procedures (p =0.001).
Abdelhamid *et al.*, (2022) [6]	Retraction cord and diode laser	This research compared the amount of tissue displacement laterally and vertically between the two gingival retraction methods (retraction cord and diode laser).	22		The diode laser troughing provides better lateral and vertical retraction than retraction cable.
Gupta al., (2012) [15]	Diode laser	The outcomes of gingivectomy and gingival troughing are examined to assess the evidence for the efficacy of laser-assisted soft tissue treatments and soft tissue management in aesthetic dentistry	1	15 days	A successful cosmetic operation with appropriate tissue shape, function, and biocompatibility is guaranteed with dental laser therapy.
Einarsdottir *et al.*, (2018) [16]	Gingival retraction double-cord technique, aluminum chloride paste.	This clinical randomized controlled study (RCTgoal) assessed how three distinct gingival tissue displacement procedures affected the height of the marginal soft tissue.	67	30 ±10 days	The group differences were not statistically significant (P>.05).

Ch *et al.*, (2013) [8]	Diode lasers	The current research aimed to objectively measure the amount of lateral gingival retraction accomplished by employing diode lasers.	20		The amount of gingival retraction obtained was more than the minimum needed retraction of 200um and closer to the thickness of the sulcular epithelium.
Stuffken *et al.*, (2016) [17]	810 nm diode laser AND mechanical-chemical technique with double cords	This pilot clinical investigation aimed to compare and clinically monitor the regeneration of gingival tissue utilizing the mechanical-chemical procedure with double cords soaked with aluminum chloride and the 810 nm diode laser on the same participant.	6	1 week, 3 weeks, and 8 weeks	In this research, the double cord approach and the laser were shown to cause an average loss of gingival height of 0.26 mm and 0.27 mm, respectively. Recession intensity was deemed to be not clinically significant.
Tao *et al.*, (2018) [11]	Er:YAG laser, diode and Nd:YAG lasers. pre saturated cord	This research compared pre-saturated cord and lasers, the two most used techniques for gingival troughing.	50	1 week, and after 4 weeks	The gingival sulci were smaller, and the GR was substantially greater (P=.05) with the saturated cord than with lasers. As compared to diode and Nd: YAG lasers, Er: YAG laser produced the fastest and least disruptive wound healing.
Melilli *et al.*, (2018) [18]	gingival retraction cords (RC) and diode laser (DL)	The research compares retraction cords and a diode laser, two methods for preparing the gingival sulcus.	74	15 days, 10 minutes, 15 days,	There was no difference between the two techniques: DL took less time, was simpler for the operator, and was more pleasant for the patient than RC (all P=0.001)
Marsch *et al.*, (2013) [10]	SIROlaser Advance / Xtend	In this case study, the SIROlaser Advance / Xtend is used to visualize the preparation margins during gingival troughing	1	10 sessions per month	The laser or HF device is desirable due to its coagulation capabilities. Due to its many applications, a laser is unquestionably a superior expenditure from an economic standpoint.

Table 2 shows the summary of all studies included in the systematic review. The clinical investigation done by Ünalan *et al*. (2018) compared the impact of three gingival displacement methods—cordless paste system, Er, Cr: YSGG laser troughing, and retraction cord—on the periodontal tissues surrounding a digitally scanned crown repair [14]. The probing depth (PD), plaque index (GI), gingival index (GI), mobility index (MI), sensitivity index (SI), and bleeding on probing (BOP) indexes were all recorded and examined. Sixty mandibular first molars from 52 individuals (20 men and 32 women) who needed crown restorations were considered in this research. The crown preparations' margin lines were positioned 1 mm subgingivally. The patients were split into three groups based on the gingival displacement method: retraction cord, cordless paste system, and Er, Cr: YSGG laser troughing. The prepared tooth was digitally scanned. Five separate periods were designated for follow-up visits: daily, monthly, after 3 months, after 6 months, and the first year. The periodontal health was evaluated using six periodontal indicators. Based on the groupings, the chi-square test was employed to compare categorical data. Throughout the 1-year clinical surveillance, there was a significant difference in the PD, GI, and BOP index scores across the three procedures (p 0.001). In the retraction cable and cordless paste system groups, the PD in the three buccal surface zones significantly increased with time (p =0.001).

The research done by Abdelhamid *et al*. (2022), compared the amount of tissue displacement laterally and vertically between the two gingival retraction methods (retraction cord and diode laser) [6]. Also, the degree of satisfaction of the applicant. The twenty-two cases from Cairo University's outpatient clinic that required full coverage porcelain fused to metal fixed prostheses in the anterior esthetic zone were collected. The teeth were dispersed using the gingival retraction method and prepared with a deep subgingival chamfer finish line. Patients in Group I was retracted using

a retraction cord. Patients in Group II get diode laser retraction. Regarding lateral and vertical displacement, the two groups differed significantly. In addition to higher vertical retraction, laser troughing also results in more lateral retraction. Under the constraints of this investigation, diode laser troughing provides better lateral and vertical retraction than retraction cable. The patient found laser troughing to be more comfortable and to cause less discomfort.

In the case studies regulated by Gupta *et al*., (2012), the outcomes of gingivectomy and gingival troughing are examined to assess the evidence for the efficacy of laser-assisted soft tissue treatments and soft tissue management in aesthetic dentistry [15]. The patients in these case studies received 980 nm diode laser-assisted gingivectomy and gingival troughing in addition to the cosmetic restoration of the carious lesion and prosthetic rehabilitation of the posterior tooth to achieve rapid hemostasis and moisture management. After 15 days in both cases, gingival tissues were successfully healed. For practitioners who are removing gingival tissue and employing reconstructive procedures for gingival troughing, the potential of soft tissue lasers to manage moisture and promote hemostasis looks very promising. A successful cosmetic operation with appropriate tissue shape, function, and biocompatibility is guaranteed with dental laser therapy.

This clinical randomized controlled study (RCTgoal) organized by Einarsdottir *et al*., (2018) assessed how three distinct gingival tissue displacement procedures affected the height of the marginal soft tissue while creating a final imprint of a patient's natural teeth. Sixty-seven people in all were randomly assigned to 3 groups [16]. Only aluminum chloride paste was utilized to remove the gingiva in test group 1 (P; n=22). A cord was inserted, and aluminum chloride paste was employed in test group 2 (CP; n=23). For the gingiva displacement in the control group (C; n=22), two cords were employed (double-cord technique). Before starting therapy and 30–10 days after receiving the prosthesis, clinical measures of the gingival position were taken. Throughout the procedure, study casts were created, standard images were taken, and graphics editing software was used to quantify changes in the buccal gingival position. Little gingival recession was more common in groups P (8%) than CP (23%) and C (32%; P=.015). After the surgery, 15 subjects (24%) complained of pain. The group differences were not statistically significant (P>.05).

The research managed by Ch *et al*., (2013) aimed to objectively measure the amount of lateral gingival retraction accomplished by employing diode lasers [8]. Twenty dental patients who had root canal therapy and were advised to have crowns made were the subject of the study. On 20 teeth, the gingival retraction was done, and elastomeric imprints were taken. Models extracted from the impressions were cut into sections, and a toolmaker's microscope was used to determine the lateral distance between the finish line and the marginal gingival. Mid-buccal, mesio buccal, and disto-buccal areas showed mean retraction values of 399.5 m, 445.5 m, and 422.5 m, respectively. The amount of gingival retraction obtained was more than the minimum needed retraction of 200um and closer to the thickness of the sulcular epithelium.

This pilot clinical investigation conducted by Stuffken *et al*., (2016) aimed to compare and clinically monitor the regeneration of gingival tissue utilizing the mechanical-chemical procedure with double cords soaked with aluminum chloride and the 810 nm diode laser on the same participant [17]. The research involved a total of 6 individuals, each requiring two crowns on their natural teeth. The teeth were cleaned with a 0.5-mm subgingival finishing line at the first session, and temporary crowns were made. Two cords impregnated with 5% AlCl3 were used on one tooth in the double cord procedure, while an 810 nm diode laser was used on the other. Once the final crowns were cemented, the patients were observed after one week, three weeks, and eight weeks. In this research, the double cord approach and the laser were shown to cause an average loss of gingival height of 0.26 mm and 0.27 mm, respectively. Recession intensity was deemed to be not clinically significant.

This research performed by Tao *et al*., (2018) compared pre-saturated cord and lasers, the two most used techniques for gingival troughing (including diode, Nd: YAG, and Er: YAG) [11]. This research involved 50 individuals with 108 front teeth (58 maxillary and 50 mandibular). The four groups that received gingival therapy were: pre-saturated cord; diode laser; Nd: YAG laser; and Er: YAG laser. At various stages, the gingival breadth and gingival recession (GR) were measured (at the time of treatment, after 1 week, and after 4 weeks). The gingival sulci were smaller, and the GR was substantially greater (P .05) with the saturated cord than with lasers. As compared to diode and Nd: YAG lasers, Er: YAG laser produced the fastest and least disruptive wound healing.

The research examined by Melilli *et al*., (2018) compares retraction cords and a diode laser, two methods for preparing the gingival sulcus and exposing the finish line before taking the final impression for a fixed denture [18]. Before fixed prosthesis treatments, all research participants had good gingival and periodontal conditions. To move the gingival sulcus before the final impression, 74 abutments for total crown restoration were randomly split into two groups using gingival retraction cords (RC) and a diode laser (DL). After tooth preparation (T0), 15 days after tooth preparation, before exposing the finish line with RC or with DL (T1), 10 minutes after exposing the finish line (T2), and 15 days after the final impression was taken, the height of the clinical crowns was measured by a blinded examiner in three points of the buccal surface (mesial, midline, and distal) (T3). Regarding height disparities, there was no difference between the two techniques: DL took less time, was simpler

for the operator, and was more pleasant for the patient than RC (all P= 0.001).

In the case study presented by Melilli *et al*., (2018) the SIROlaser Advance / Xtend is used to visualize the preparation margins during gingival troughing [18]. Although using the diode laser for gingival troughing to see the preparation margin is a very tiny application, it significantly impacts practice efficiency. The diode laser is utilized to produce an ideal CAD/CAM model throughout ten CEREC (CAD/CAM) sessions per month. Due to damage to the front teeth, this young patient had lost significant dental hard tissue. It was unsuccessful to use a composite to rebuild the tooth. When scanning, overlapping gingival tissues might result in inaccurate imprints because these regions might not be scanned. The mesial papilla's tissue was partially destroyed using the laser to reveal a circular chamfer. A digital and analog imprint was then created. Making analog imprints often requires the traditional technique of utilizing retraction cords and the accompanying coagulants. Only dry surfaces provide a clear picture due to the high requirements of digital scanning. Thus, extra equipment like the laser or HF device is desirable due to its coagulation capabilities. Because of its mild action that promotes quicker tissue healing, the pulse mode laser is superior to most HF devices. Due to its many applications, a laser is unquestionably a superior expenditure from an economic standpoint.

Lasers are used to safely remove the sulcus' epithelial lining without damaging the underlying basal cells or connective tissue. This could lessen the gingival recession. It has been proposed that lasers may replace the traditional cable gingival displacement technique [19].

Several studies have identified the clinical diagnostic indices of periodontal health (pocket depth, gingival index, probing depth, mobility, sensitivity, and bleeding on probing [BOP]) as reliable, inexpensive, and simple to implement. The author showed, however, that factors such as probe tip, probe positioning and angling, and clinician expertise may introduce some heterogeneity into the data made using these indices [20-22]. As the additional silicon putty provides greater gingival tissue displacement and the hardness of the putty allows light body substance to be forced into direct contact with the teeth and gingival tissues, a double-step impression method was used in this study to ensure a high degree of impression accuracy [23, 24]. Using a scalpel in conventional surgery causes blood loss, which might be problematic if restorative dental work is planned for the future. Gingival tissue may be removed safely and with sufficient hemostasis using electrosurgery. Nevertheless, this approach has drawbacks due to lateral heat production, which might result in necrosis of the alveolar crest, which then causes recession and exposes the restorative margins [7, 25].

Lasers can improve control by the operator with minimal side effects on surrounding tissue. In particular, diode lasers use a wavelength readily absorbed by the chromophores (melanin and hemoglobin) in the gingival tissues while presenting little danger to the tooth structure. Impression processes for indirect restoration fabrication are also crucial to the aesthetic outcome. Appropriate impressions need exposure to the subgingival finish lines and sufficient moisture control. It is recommended to use a double-cord retraction method to mechanically displace the sulcus to capture the sulcus completely in the impression material [26, 27].

Little marginal abnormalities in the final cast were noted rarely in the current study's P and CP test groups. Nevertheless, research has shown that polyether polymerization may be extended in contact with aluminum chloride, suggesting that the polymerization of impression materials may interact with displacement materials or medications. The current research's findings are consistent with those of an in vitro investigation, which found that medications like ferric sulfate and aluminum chloride did not substantially alter the dimensional accuracy of PVS impression material but had a significant negative effect on surface detail reproduction [22].

Diode lasers are increasingly employed for periodontal and peri-implant operations and other soft tissue dentistry treatments. Diode laser gingival retraction was used in the investigation. Good hemostasis and patient comfort are only two of the many ways laser surgery improves upon traditional treatment methods [28]. When the laser unit's power is turned down, a dragging cutting motion tears apart the tissue, and the power of the preparation's trough should improve with greater power. Nevertheless, excessive force should be avoided since it causes tissue necrosis. The sulcular width attained by diode laser gingival troughing was more than the bare minimum of 0.2 mm. This study demonstrated the reliability of the diode laser impression [29].

The digitalization of dental care is imminent. This justifies the use of laser therapy to help with gingival troughing. In many situations, the traditional technique of creating analog imprints using retraction cords and the associated coagulants may be adequate. As only dry surfaces provide a crisp picture, specialized equipment like the laser or HF device is helpful for the stringent criteria of digital scanning. The mild action of the laser in pulse mode promotes faster tissue recovery than other HF devices. Due to its many practical applications, a laser is a superior financial investment [30].

Conclusion

As long as the operator can afford the expense, diode laser troughing may be advised since it offers enough vertical and lateral tissue displacement with greater patient satisfaction, less discomfort, and less tissue loss as compared to a

retraction cord. When used on individuals with healthy, thick gingiva, laser devices for gingival retraction are efficient and secure.

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