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An invivo study to compare the efficacy of gingival retraction using conventional retraction cord, a cordless technique and laser

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Abstract

Objectives

1. To measure the amount of gingival retraction obtained using conventional retraction cord, cordless technique and soft tissue laser.
2. To determine which one among the three techniques was least detrimental to the periodontium while giving optimal gingival retraction.

Methodology: 90 abutment teeth/ crown in the mandibular posterior region were selected. Three different displacement methods were evaluated in this study; viz conventional retaction cord, a cordless technique (Expasyl) and soft tissue laser. Once the abutment tooth/ crown preparation was completed on one of the individuals the retraction was done using the cordless technique first,ten days following this, the same abutment teeth /crown was subjected to retraction using the conventional retraction cord. After a period of ten days, retraction was carried out on the same abutment teeth/crown using a soft tissue laser. During each of the procedure impressions were being made using putty wash technique immediately after the retraction procedure, and models were obtained from type IV stone. On the stone models the midbuccal region was selected for measurement of retraction. Gingival retraction was assessed using a Tool Makers Microscope.

Results: The statistical analysis of the collected data revealed that both the laser and the conventional retraction cord produced significant amount of gingival retraction than Expasyl. The mean gingival retraction value obtained for retraction cord, laser and Expasyl were 409.33µm, 496.83µm and 226.00µm respectively.

Conclusion: Laser produced statistically significant amount of gingival retraction with a mean of 496.83µmfollowed by conventional retraction cord and Expasyl with a mean of 409.33µm and 226.00µm respectively, because of its "remarkable cutting ability".

Keywords: Retraction cord; Expasyl; Diode laser; Tool Makers Microscope; Abutments; Midbuccal region; finish line.

Introduction

While recording impressions of subgingival crown margins or restoring cervical lesions, the clinician must often displace the gingival crown to gain access to the prepared margins. The technique used for this should be atraumatic to the periodontal tissues. The methods used for displacing the gingiva include mechanical, chemo-mechanical, and surgical. Whatever the method used, effective ideal gingival displacement should ensure the health of the epithelial attachment.[1] The use of conventional retraction cords as a mechanical or chemo-mechanical technique is well established in practice due to their relative predictability, effectiveness, and safety compared with rotary gingival curettage and electro-surgery, recently, cordless technique such as expanding polymers and expanding paste-like gingival displacement materials have been introduced which are said to save time and enhance patient comfort while being minimally invasive. Soft tissue lasers are gaining popularity in its effectiveness and predictability as a retraction method. Although crucial advances have been made in the hydrophilicity of impression materials and in their ability to reproduce detail, making an impression is still a concern, especially when preparation finish lines are located subgingivally.[4] Gingival retraction thus is mandatory for adequate lateral displacement of gingiva, for adequate flow of low viscosity impression materials into the sulcus and for accurate capturing of prepared finish line and a portion of apical uncut tooth structure.[5] With the availability of a wider variety of gingival retraction methods and with laser being touted as a viable alternative, which could be used as a substitute to conventional retraction techniques as they supposedly provide adequate retraction along with hemostasis in addition to the advantages of less working time and better patient comfort, this invivo study intends to compare the efficacy of two commonly used retraction method viz conventional retraction cord, cordless technique to soft tissue laser, to determine if laser have the aforesaid advantages and effectiveness as compared to the conventional technique.

Materials and methods

Armamentarium

1. Mouth mirror, William's periodontal probe, and tweezers.
2. Surgical gloves, mouth mask.
3. Cotton rolls
4. Scissors- straight and angled
5. Cord packer
6. Cheek retractor
7. Tool Makers Microscope (Mitutoyo, Dewinter capture pro-4.6)
8. Diode laser unit (setting-0.8- 1 W)
9. Polyvinyl siloxane impression material (Imprint 3M ESPE, Bangalore, India)
10. Die stone (Kal rock, Kalabhai Karson Pvt.Ltd, Mumbai, India)

Materials

1. Conventional retraction cord (Omin-pak knitted retraction cord, OSSUM Health Care PVT. LTD., Korea)
2. Expasyl paste (KERR manufacturing company, UK)
3. Soft tissue laser (PICASSO, AMD Laser, Australia)

Method of data collection

Inclusion criteria

1. Individuals between the age group of 18-30 years having sound gingival and periodontal health.
2. Individuals selected having a sulcus depth of 1 mm on the posterior abutment teeth/ crown.

3. Non-impregnated, knitted conventional retraction cord with a thickness of 000 or 00 will be used.
4. Abutment teeth/ crown of normal size and contour (no developmental anomaly or regressive age changes)
5. Supragingival finish lines are selected.
6. Individuals having similar gingival Biotype.
7. Absence of periapical or any other intra oral infection.
8. No bleeding on probing.
9. Patients having no relevant medical history.

Exclusion criteria

1. Tipped, tilted or rotated abutment teeth.
2. Any kind of gingival pathology.
3. Individuals with uncontrolled diabetes and other systemic diseases which could influence clinical outcome of the study.
4. Patients who cannot read and write.

A total of ninety patients between the age group 18-30 years who reported to the department of prosthodontics, in Coorg institute of dental sciences and were in need of fixed partial dental prosthesis or a crown formed the study group. The study was approved by the ethical committee of Coorg institute of dental sciences and all the patients were provided with an informed consent. The criteria for case selection included patients with a sulcus depth of 1-1.5mm in mandibular posterior region, abutment teeth of normal size and contour. Individuals having similar gingival biotype, restorations requiring supragingival finish lines and patients with no relevant medical history. The preparation design protocols were followed based on “Fundamentals of tooth preparations” by Herbert T. Shillingburg. All selected abutments had healthy gingiva, without a periodontal pathology. A chamfer or shoulder finish line was given to the preparation according to the type of restoration indicated. Three different gingival displacement methods were evaluated in this study; viz conventional retraction cord, a cordless technique and soft tissue laser. All the three retraction methods were checked on the same abutment tooth with similar sulcus depth and each procedure done over a period of ten days interval. Once the abutment tooth preparation was completed, the retraction was done using the cordless technique first, ten days following this, the same abutment tooth was subjected to retraction using the conventional retraction technique and after a period of ten days, retraction was again carried out on the same abutment tooth using the soft tissue laser respectively.

Methods of gingival retraction

1. Gingival Retraction using cordless (Expasyl) technique.

Expasyl is a paste for temporary gingival retraction that ensures separation of the marginal gingiva and drying of the sulcus. The material is supplied in capsules (cartridges), and comes with a preformed gun-type of device into which the capsule has to be placed and then the material is expressed. Gingival sulcus of the abutment tooth was rinsed with water, the retraction paste was then slowly injected into the sulcus (2 mm/s) with the tip parallel to the long axis of the tooth. The point of the cannula must create a closed space between the tooth and the marginal gingiva. Clinically, the complete filling of the sulcus was discerned by a slight blanching of the gingival marginal area. Depending on the tonicity of the gingiva it was kept in place for one minute in the thin and two minutes in the thick marginal gingiva. It was easily visible because of its color. After which, it was removed by air and water spray.

2. Gingival retraction using conventional retraction cord (Omin-pak).

The use of gingival retraction cords which was non-impregnated is supposed to be safe and effective. The gingival sulcus, was rinsed, dried, and isolated with cotton rolls. The retraction cord was cut to the required length and packed into the sulcus with a cord packer and was left in place for seven to ten minutes. The placement started at the interproximal gingival crevice, where there was usually more tissue, and was continued circumferentially. After the required period, the retraction cord was wetted and removed, and the gingival sulcus was washed and dried.

During each of the procedure impressions were made using putty wash technique, immediately following the retraction procedure in each of the 3 methods. The impression thus obtained were poured in type IV stone. On the stone models the midbuccal region was selected for measurement of retraction. Two points were marked using a sharp pencil, one on finish line and the other on the crest of marginal gingiva, in midbuccal region for each abutment. The amount of gingival retraction obtained was assessed by measuring the distance between the two points by using a "Tool Makers Microscope".

3. Method of gingival retraction using soft tissue laser (Picasso).

For the purpose of gingival displacement using laser, a diode laser of 810 nm was used with a fibre optic tip of 200µm. Retraction procedure was carried out by passing the laser optic fibre in contact mode along the gingival sulcus, so as to remove sulcular epithelium. Laser was used at a power setting 1W in continuous mode. Continuous mode was used here because; the laser energy was delivered in a single stroke by passing the laser tip along the gingival sulcus. The laser was moved circumferentially with small and light brush like strokes around the preparation. These back-and-forth strokes created a slight distension of the tissue laterally away from the margin of the preparation. This lateral distension was not intended to lower the height of the tissue in an apical direction like a gingivectomy would, but simply to create a "moat" that separates tooth from soft tissue. This separation allowed for room for the light- body impression material to capture details of the margin location. The total time for the troughing circumferentially was around 45-90 seconds.

Tool Makers Microscope

A plain "Tool Makers Microscope" is primarily intended for a particular application. On the other hand, universal toolmaker's microscope is adaptable to an uncommonly wide range of measuring tasks. A toolmaker's microscope is designed for measurements of parts of complex forms, e.g. profile of external threads, tools, templates and gauges. It can also be used for measuring centre-to-centre distance of holes in any planes, as well as the co-ordinate of the outline of a complex template gauge.

Results

The collected data were analysed using one way ANOVA and post hoc Tukey test with $p<0.05$ indicating significant difference between the variables.

The statistical analysis of the collected data revealed that both the laser and the conventional retraction cord produced significant amount of gingival retraction [Table 2]. The mean gingival retraction value obtained for retraction cord, laser and Expasyl were 409.33µ***m***, 496.83µ***m*** and 226.00µ***m*** respectively. The amount of retraction produced by the laser and conventional retraction cord was statistically more than that produced by the Expasyl, [Table 3] and the least amount of displacement was found with Expasyl that is, 226.00 as shown in the graph.

Table 1: Values obtained from Tool Makers Microscope

Sn.	LASER (µ***m***)	EXPASYL (µm)	RETRACTION CORD (µm)
1.	430	220	410
2	480	190	390
3	450	240	430
4	470	380	410
5	540	170	420
6	390	210	380
7	460	250	440
8	530	260	370
9	540	290	470
10	440	210	460
11	450	190	430
12	550	240	390
13	620	260	420
14	550	280	470
15	590	220	480
16	460	190	490
17	540	180	380
18	510	250	340
19	520	260	320
20	570	280	420
21	430	240	460
22	580	190	380
23	470	180	340
24	455	260	310
25	520	230	450
26	490	170	460
27	420	160	480
28	440	190	490
29	480	180	320
30	530	210	270

Table 2: Comparison of mean gingival retraction among different materials

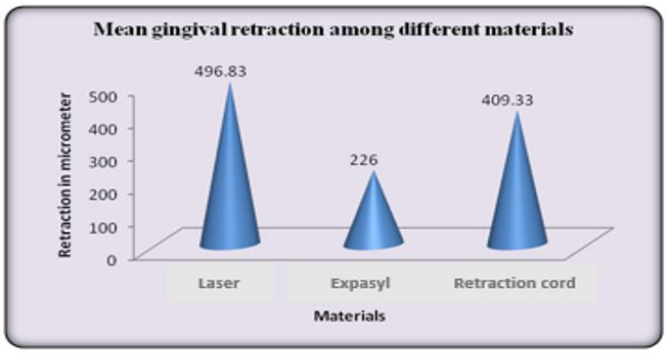
Materials	Mean (µ***m***)	Std. Deviation	F value	P value and significance
Laser	496.83	57.06	191.521	<0.001 HS
Expasyl	226.00	47.09		
Retraction Cord	409.33	59.18		

P<0.05, HS – Highly Significant

Table 3: Multiple Comparisons using Tukey HSD

Multiple Comparisons using Tukey HSD			
Material	Compared with	Mean Difference (I-J)	Sig.
Laser	Expasyl	270.83*	<0.001
	Retraction Cord	87.50*	<0.001
Retraction Cord	Expasyl	183.33*	<0.001

*. The mean difference is significant at the 0.05 level.



Graph 1: Showing maximum gingival displacement by Laser followed by Retraction cord and Expasyl respectively.

Discussion

The aim of this study was to clinically evaluate three gingival retraction techniques relative to impression making in fixed prosthodontics in order to compare their efficacy of retraction traumaticity to the periodontal tissues, and in terms of establishing the preparation margin of the treated dental elements.

This study investigated the effects of different retraction techniques on gingival displacement. Three different displacement methods evaluated in this study were, conventional retraction cord (Omin-pak), a cordless technique (Expasyl) and soft tissue laser (Picasso). All the three retraction methods were done on the same abutment teeth/crown in the mandibular posterior region with similar sulcus depth in an individual, with each procedure done over a period of ten days interval.

In the present study, the laser retraction techniques using diode laser provided the maximum gingival displacement, both in terms of vertical and horizontal dilation (more easily obtained using the diode) (table-2). This technique has also been proven to be valid in patients with gingival bleeding tendencies, and efficient in terms of treatment speed and patient acceptance due to low invasiveness and lack of pain.

When crown troughing with the diode laser is compared with the traditional techniques, many clinicians find the laser to be easier and quicker than "packing cord". The safety of using lasers for tissue retraction is that these lasers yield less bleeding and less recession than either double cord or electrosurgery techniques.

The advantages of laser techniques are that it is in fact "less traumatic to the periodontal tissues." the diode laser has a "remarkable cutting ability and a tolerable damage zone", and due to its "excellent coagulation ability" it is a useful alternative in soft-tissue retraction of the oral cavity [8].

Hence laser has been emerged as reliable alternative surgical tool to treat soft tissue anomalies with the advantages like bloodless field and less postoperative pain with better healing.

Laser was used at a power setting 1W in continuous mode and a wavelength of 810nm. The laser unit was set at this power setting to prevent the charring of the soft tissues. Continuous mode was used here because; the laser energy was delivered in a single stroke by passing the laser tip along the gingival sulcus.

Diode laser was used in this study for gingival retraction because it has certain advantages like the diode laser seen in our clinical routine are that it requires no anaesthetics and that the wounds heal softly. Moreover, its simple use allows very good modelling of the gingiva[17].

The wavelength of the diode laser is considerably more absorbed due to haemoglobin than that of the Nd: YAG laser. This causes not only a better incision performance but also an excellent coagulation of tissue[17].

Therefore, in this present study laser technique showed the best gingival displacement because as mentioned above, it had a "remarkable cutting ability and a tolerable damage zone."

Krishna et Al reported that gingival troughing with the diode laser achieved greater than the minimum required sulcular width of 0.2 mm. This research confirmed that the impressions following the diode laser retraction was consistently accurate.

Gherlone et al had done a study on tissue retraction and gingival healing in pulsed laser (diode 980 nm) gingival retraction in comparison with the conventional mechanical or surgical techniques (double cord and electrosurgery). They concluded that lower traumaticity was found in the laser-assisted sulcus conditioning on the periodontal structures, as compared with conventional (mechanical and surgical) techniques.

Another study was done by Goharkhay at al where they investigated the characteristics and soft-tissue damage resulting from standardized incisions using a wide range of laser modes and parameters of a diode laser at 810 nm, and they finally reported that the remarkable cutting ability and the tolerable damage zone clearly show that

the diode laser is a very effective and, because of its excellent coagulation ability, useful alternative in soft-tissue surgery of the oral cavity[17].

In this study, for the technique using retraction cords, non-impregnated knitted cords were used that have substantially increased its popularity in recent years due to their ease of placement and their ability to expand when wet, making them easy to insert in the sulcus and also, they are safe. Their design requires the use of thin, smooth and nonserrated instruments. Serrated instruments can lift loosely woven cords out of the sulcus.

The advantages of a conventional retraction cord are that it is dark: it is dark in color, to maximize contrast with the tissues, tooth and cord; it acts as an absorbent, to allow the uptake of the liquid medicaments; and they are available in different diameters to accommodate varying morphologies of gingival sulcus. Various haemostatic agents with varying degrees of safety and effectiveness are available such as aluminium potassium sulphate (Alum), aluminium chloride, epinephrine, zinc chloride, ferric sulphate and sympathomimetic amines.

The disadvantages of conventional retraction cord are that it can be laborious, time-consuming, can cause gingival bleeding, uncomfortable for patients in the absence of anaesthesia, and when inappropriately manipulated, can lead to direct injury and gingival recession. Use of a retraction cord has the risk of epithelial attachment injury, pain during cord placement, sometimes requiring local anesthesia. They also require high technical sensitivity and clinical skill.

In this present study conventional retraction cord showed better gingival displacement than Expasyl because it acted as a good absorbent which allowed the uptake of oral fluid and expand resulting in subsequent gingival displacement.

The use of injectable matrix (Expasyl) for gingival retraction presents an atraumatic option for clinicians. There is no risk of laceration, as the material is injected in a kaolin matrix into the gingival sulcus. The limitation of this injectable matrix arises from the viscosity of the injectable matrix, which limits the force of retraction offered. It has a specially formulated consistency which exerts moderated calculated pressure on gingiva. It has both mechanical and chemical action. It creates and maintains space in the sulcus due to optimal characteristics of its viscosity which is mainly due to its kaolin component. It achieves haemostasis due to the presence of aluminium chloride. Time taken for retraction is 2 minutes and sulcus widening achieved is 0.5mm. The pressure exhibited is 0.1N/mm^2.

The advantages with Expasyl are that this material is non-traumatic, it is a conservative method of temporary gingival retraction, easy and fast application directly to the sulcus without pressure or packing making it comfortable to the patient, extensive rinsing is not required due to absence of haemostatic chemicals that could contaminate impression site, it provides outstanding retraction for perfect impressions.

Here the mechanism of retraction does not involve any chemical reaction and the material expands on setting displacing the gingiva. It does not damage the epithelium.

Hence in this study the retraction was carried out first using Expasyl followed by retraction cord and laser because Expasyl was non- traumatic and did not damage the epithelium.

The main disadvantage with Expasyl retraction material is that the amount of displacement achieved will be less compared to conventional techniques although it had advantages like less working time and patient comfort when compared to retraction cord and laser.It is

expensive, it is effective only under specific limited conditions, disposable metal dispenser tips are too large making it difficult to express Expasyl into interproximal area, the paste thickness makes it difficult for some evaluators to express it into the sulcus[22].This was the reason when all the three retraction techniques were compared in terms of the amount of gingival displacement achieved, Expasyl showed the least amount of gingival displacement.

Bennaniet al, compared the pressure generated from cordless methods to Knitted cords. Expasyl injection generated the least pressure and its pressure will be less in reuse.

Conclusion

This study compared the amount of gingival displacement produced by conventional retraction cord (Omin-pak), cordless technique (Expasyl)and soft tissue laser (Picasso). The study was conducted in 90 patients with good general and periodontal health requiring fixed restorations for their mandibular posterior teeth. The patients were divided into three groups. In group 1 retraction was done using Expasyl, Group 2 using conventional retraction cord and Group 3 using soft tissue laser in ten days interval time.

Measurements were recorded after retraction from the supragingival finish line to the crest of the free gingival margin using "Tool Makers Microscope" (Mitutoyo, Dewinter capture pro-4.6) in the midbuccal region. The collected data were analysed using one way ANOVA and post hoc Tukey test p value <0.05 indicates significant difference between the variables.

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

1. Laser produced statistically significant amount of gingival retraction with a mean of 496.83µm when compared to Expasyl and conventional retraction cord with a mean of 226.00µm and 409.33µm respectively, because of its "remarkable cutting ability".
2. When compared with the displacement produced by Expasyl(226.00), the displacement produced by conventional retraction cord was significantly more (409.33), because it acted as a good absorbent which allowed the uptake of oral fluid and expand resulting in subsequent gingival displacement, and Expasyl produced the least amount of gingival displacement because the disposable metal dispenser tips were too large making it difficult to express Expasyl into interproximal area, the paste thickness made it difficult to express it into the sulcus.
3. All the three materials and methods of displacement have not grossly affected the gingival health in 2 weeks follow-up.

Summary

Need for the gingival retraction is to widen the gingival sulcus in order to provide access for impression material to reach the subgingival margins and to record adequately the finish line. It helps in obtaining the perfect die with accurate margins, which helps in margin placement and contouring of the restoration. It helps in blending of the restoration with the unprepared tooth surface. It also helps in placement and finishing of the margins on the prepared tooth. During cementation it helps in easy removal of cement without tissue damage. It helps the dentist in visually assessing the marginal fit and any caries if present. To enhance access and to prevent damage to the soft tissue during tooth preparation procedure, it may be desirable to carry out some degree of gingival retraction prior to commencement of preparation.

The advantages with Expasyl is that this material is non-traumatic, it is a conservative method of temporary

gingival retraction, easy and fast application directly to the sulcus without pressure or packing making it comfortable to the patient, extensive rinsing is not required due to absence of haemostatic chemicals that could contaminate impression site, it provides outstanding retraction for perfect impressions.

Retraction techniques can be classified as mechanical, chemical or surgical, and are often used in combination. The use of conventional retraction cords as a mechanical or chemo-mechanical technique is well established in practice due to their relative predictability, effectiveness, and safety compared with rotary gingival curettage and electrosurgery.

When crown troughing with the diode laser is compared with the traditional techniques, many clinicians find the laser to be easier and quicker than “packing cord”. The safety of using lasers for tissue retraction is that these lasers yield less bleeding and less recession than either double cord or electrosurgery techniques. Laser techniques are in fact “less traumatic to the periodontal tissues”. The diode laser has a “remarkable cutting ability and a tolerable damage zone,” and due to its “excellent coagulation ability” it is a useful alternative in soft-tissue retraction of the oral cavity.

Gingival retraction using soft tissue laser has become a viable alternative for soft tissue management before an impression is made. Several problems that can arise from poor marginal fit of fixed dental prosthesis can be prevented if the margins of prepared tooth are recorded after adequate exposure by any of the above-mentioned gingival retraction methods. The choice of technique and material depends on operator’s judgement of the clinical situation apart from availability and cost of the materials. Swift increase in research work in the recent past leaves no option for a clinician, but to be updated and to possess optimum knowledge to rationalize the use of materials and techniques like the use of soft tissue lasers that are employed for gingival displacement in proximity to both teeth as well as implants.

The purpose of this invivo study was to compare the efficacy of amount of gingival displacement obtained using a cordless technique, conventional retraction cord and soft tissue laser. The amount of gingival displacement was assumed by measuring the distance between two points one on the finish line and the other on the crest of marginal gingiva using Tool Makers Microscope.

90 abutment teeth/ crown in the mandibular posterior region that was indicated for fixed partial dental prosthesis or crowns were selected. Three different displacement methods were evaluated in this study; viz conventional retaction cord, a cordless technique (Expasyl) and soft tissue laser. All the three retraction methods were done on the same abutment teeth/crown with similar sulcus depth in an individual, with each procedure done in a period of ten days interval. A chamfer or shoulder finish line were given to the preparation according to the type of restoration indicated. Once the abutment tooth/ crown preparation was completed on one of the individuals the retraction was done using the cordless technique first, ten days following this, the same abutment teeth /crown was subjected to retraction using the conventional retraction cord. After a period of ten days, retraction was carried out on the same abutment teeth/crown using a soft tissue laser, a diode laser with a fibre optic tip was used (PICASSO). Retraction procedure was carried out by passing laser optic fibre in contact mode along the gingival sulcus, to remove sulcular epithelium. Laser energy delivered had a wavelength of 810nm and power of 0.8-1W in continuous mode. Continuous mode was used here because; the laser energy was delivered in a

single stroke by passing the laser tip along the gingival sulcus. During each of the procedure impressions were being made using putty wash technique immediately after the retraction procedure in each of the 3 methods, and models were obtained from type IV stone with 30 abutment teeth/crown in each group. On the stone models the midbuccal region was selected for measurement of retraction. Two points were marked, one on finish line and the other on the crest of marginal gingiva, in midbuccal region for each abutment. Gingival retraction was assessed by measuring the distance between two points by using a Tool Makers Microscope.

Here in this study a Tool Makers Microscope was chosen as the measuring device because there will be no physical contact between the specimen and the measuring instruments in projectors. Thus, specimen to be inspected is free from mechanical distortion or defects. This increases the accuracy in measurement.

It has other advantages like:

1. A single setting of the specimen provides observation, comparison and inspection of several dimensions and form characteristics in a projector.
2. Unlike the mechanical gauges, which undergo wear and tear due to prolong uses, measurements by optical projectors are free from wear.
3. The open screen, commonly at eye level, permits the observation of the image in unrestricted position under more natural conditions than viewing through a microscope eyepiece.

Here each specimen (casts) was measured in X, Y and Z axes using the Dewinter capture pro 4.6 software and an average of these values were taken into account.

Within the limitations of this study, it was concluded that:

1. Laser produced statistically significant amount of gingival retraction with a mean of 496.83µm when compared to Expasyl and conventional retraction cord with a mean of 226.00µm and 409.33µm respectively, because of its “remarkable cutting ability”.
2. When compared with the displacement produced by Expasyl (226.00), the displacement produced by conventional retraction cord was significantly more (409.33), because it acted as a good absorbent which allowed the uptake of oral fluid and expand resulting in subsequent gingival displacement, and Expasyl produced the least amount of gingival displacement because the disposable metal dispenser tips were too large making it difficult to express Expasyl into interproximal area, the paste thickness made it difficult to express it into the sulcus.
3. All the three materials and methods of displacement have not grossly affected the gingival health in 2 weeks follow-up.

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