Original Article

Comparative Evaluation of the Amount of Gingival Displacement Using Three Recent Gingival Retraction Systems – *In vivo* Study

Siddique Mohammed Qureshi, Nayana Shriram Anasane, Dilip Kakade

Department of Prosthodontics and Crown and Bridge, Dr. D. Y. Patil Dental College and Hospital, Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India

Abstract

Background: Gingival retraction cord is the most commonly used gingival displacement material; however, it causes discomfort and produces damage to the periodontium. Various new gingival retraction materials have been introduced to overcome these problems. This *in vivo* study was conducted to compare the efficacy of three recent gingival displacement materials in achieving gingival tissue displacement. **Materials and Methods:** A total of 10 subjects was selected and 40 samples were made for the study. Samples were divided into four groups depending on the materials used for gingival displacement. The schedule for gingival displacement and impression making followed Latin block design. On day 1, baseline impression was made without gingival displacement. On day 2, day 22, and day 42 impressions were made after gingival displacement on intact maxillary right central incisor with any one of the three agents. The amount of gingival displacement was then measured as a distance from the tooth to the crest of the gingiva in a horizontal plane using stereomicroscope. **Results:** Statistical analysis was performed using one-way ANOVA test. The amount of gingival displacement obtained by all the experimental groups was more than the control group ($P < 0.01$). Among the experimental groups, astringent gingival retraction paste showed the highest value for gingival displacement (0.50 mm) followed by the stay-put retraction cord (0.48 mm), whereas expasyl (0.34 mm) showed the least value. **Conclusion:** Within the limitations of this *in vivo* study, astringent gingival retraction paste showed the highest value for gingival displacement followed by stay-put retraction cord whereas, expasyl showed the least value.

Keywords: *Gingival displacement, gingival retraction, retraction cord*

Introduction

The success of fixed restoration mostly depends on the long-term health and stability of the surrounding periodontal structures.[1] Fixed restorations, many of the times, have cervical finish lines that are intentionally placed in the gingival sulcus for esthetic and functional reasons.[2] The marginal integrity of fixed restoration plays an important role for the long-term clinical success. Lack of marginal integrity is responsible for the inflammation of surrounding periodontal tissues, and it also increases the risk of secondary caries.[3] Displacement of the gingival sulcus before recording an impression for fixed prosthodontic restoration is an important preliminary step so that the impression material flows into the sulcus and record the finish lines properly.

Gingival displacement is defined as the deflection of the marginal gingiva away from the tooth.[4] Gingival retraction reversibly displaces the gingival tissues to allow the impression material to be placed in the displaced gingival sulcus so that the margins can be captured.[5]

Many types of gingival retraction materials have been developed and tested. Among the most commonly employed material to obtain gingival displacement is gingival retraction cord. Aside from being time-consuming, the use of the traditional retraction cord causes discomfort and produces potential damage to the periodontium if used carelessly.[4]

Non medicated cords are safe to use, but they are not very effective in controlling hemorrhage. Medicated cords show adequate effect in controlling hemorrhage; however, many studies in the past have shown some local and systemic side effects caused by medicaments used for gingival displacement.[5]

To overcome these problems, various new materials have been introduced. These

How to cite this article: Qureshi SM, Anasane NS, Kakade D. Comparative evaluation of the amount of gingival displacement using three recent gingival retraction systems – *In vivo* study. Contemp Clin Dent 2020;11:28-33.

Submitted : 27-Apr-2019
Revised : 23-Dec-2019
Accepted : 13-Mar-2020
Published : 13-Jul-2020

Address for correspondence:
Dr. Nayana Shriram Anasane, Department of Prosthodontics and Crown and Bridge, Dr. D. Y. Patil Dental College and Hospital, Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.
E-mail: drnayana1979@gmail.com

Access this article online

Website: www.contempclindent.org

DOI: 10.4103/ccd.ccd_311_19

Quick Response Code:

newly introduced gingival retraction pastes are effective and tissue friendly products which function well as an alternative to the retraction cord for gingival displacement and homeostasis.

The introduction of expasyl brings dentists a product providing a way to overcome some of the shortcomings of previous materials and techniques. Expasyl gingival retraction material contains aluminum chloride, which enhances the hemostatic action and causes gingival displacement up to 2 mm, while clay a "putty-like material" helps for mechanical action.[6] Many studies have shown that the expasyl paste has very good results in retraction along with painless application and minimal side effects to the patient.

Astringent gingival retraction paste is the newly introduced retraction paste for easy and fast retraction of the sulcus without causing trauma and time-consuming method.[7] Astringent gingival retraction material is available in paste form. Pastes are relatively easier in application and do not cause unnecessary harm and pain to the patient.

Stay-put is a mechanical cord system which combines the advantages of braided cord with the adaptability of a fine metal filament. It has no hemostatic agent. Stay-put serves quick homeostasis when impregnates with aluminum chloride or aluminum sulfate medicament.

Various studies have been conducted on the gingival retraction materials which are introduced recently. Stay-put, expasyl, and astringent gingival retraction paste are newer advances in the gingival retraction materials and till date, no studies have been carried out to compare the clinical efficacy of these materials. Hence, the purpose of this *in vivo* study was to evaluate and compare the efficacy of these three recent gingival retraction materials based on the amount of gingival retraction obtained. The null hypothesis was that no difference would be found in the resulting amount of gingival retraction among stay-put, expasyl, and astringent gingival retraction paste.

Materials and Methods

The project was approved by the Institutional Ethical Committee. A total of three recent gingival retraction materials were evaluated in this study. Participants ready to volunteer for the study were selected from Dr. D. Y. Patil Dental College and Hospital, Pimpri, Pune. A detailed clinical examination, case history, and written informed consent were obtained from all the participants.

The total of 10 subjects was selected and forty samples were made for the study. Forty samples were divided into four groups wherein each group comprised of 10 samples. The same subject served for all the four groups.

Groups were divided on the basis of materials being used for gingival displacement. Group 1 (n = 10) consisted of samples made without any gingival displacement that is control group. Group 2 (n = 10) consisted of samples made with gingival displacement by stay-put gingival retraction cord (Roeko, Coltene/Whaledent, US). Group 3 (n = 10) consisted of samples made with gingival displacement by expasyl gingival retraction paste (Kerr, US). Group 4 (n = 10) consisted of samples made with gingival displacement by astringent gingival retraction paste (3M ESPE, Germany).

Participants were selected according to the following inclusion and exclusion criteria.

Inclusion criteria

1. Age of 18–25 years
2. Systemically healthy controls
3. Volunteers should have maxillary right central incisor of healthy periodontium
4. The Loe H and Silness P gingival index score 0
5. The Silness P and Loe H plaque index score 0
6. Probing depth <3 mm
7. No bleeding on probing.

Exclusion criteria

1. Gingival and periodontal disease
2. Pregnancy and lactation
3. History of systemic diseases such as hypertension, diabetes mellitus, HIV, bone metabolic disorders, radiation therapy, and cancer
4. History of prolonged use of steroids/immunosuppressive agents/aspirin/anticoagulant/other medications
5. Deleterious habits.

Allocation of participants

The schedule for gingival displacement and impression making followed Latin block design which is presented in tabular form.[8] On day 1, the baseline impression was made without gingival displacement. On day 2, day 22, and on day 42 impressions were made after gingival displacement on intact maxillary right central incisor with anyone of the three gingival displacement agents according to Latin block design [Table 1].

Impressions were made for all 10 participants with irreversible hydrocolloid impression material to fabricate custom trays and disinfected using 2%

Table 1: Latin block design used in the study

Subject	Day 2	Day 22	Day 42
1	1	2	3
2	2	3	1
3	3	1	2
	-	-	-
	-	-	-
	-	-	-
8	2	3	1
9	3	1	2
10	1	2	3

glutaraldehyde (Korsolex rapid, Daman, India) and poured using type III dental stone (Kalabhai, India). The custom trays (Tray material Asian acrylates, Mumbai, India) were fabricated by adapting two layers of softened baseplate wax (Deepti dental products, Ratnagiri, India) onto the diagnostic cast to act as a spacer for impression material.

Baseline impression was made using custom tray for each subject on day 1 for the control group (Group 1) in which no gingival displacement was done. Baseline impression was made using Polyether monophase impression material (3M ESPE, Impregum™, Germany) and disinfected using 2% glutaraldehyde and poured using type IV die stone (Ultrarock, kalabhai, India).

On day 2, day 22, and day 42, gingival retraction was done on intact maxillary right central incisor by any one of the three gingival retraction materials, i.e. stay-put (Group 2), expasyl (Group 3), and astringent gingival retraction paste (Group 4) as per the Latin block design. All three gingival retraction materials were used as per the manufacturer's instructions.

Gingival displacement using stay-put retraction cord and impression making

Isolation was done on the right central incisor with cotton rolls to maintain the working area dry. The required size of the retraction cord was selected according to the gingival biotype of the subject. The required length of the cord was cut and impregnated with 25% aluminum sulfate solution (Gel cord, USA) in a clean dappen dish.

Impregnated retraction cord was looped around the labial surface of the tooth. Cord packing was started from the mesial to distal by pushing the cord into the labiogingival sulcus [Figure 1]. The cord was left in the sulcus for 5 min after which it was slowly retrieved and the impression was made with polyether impression material using custom tray.

Gingival displacement using expasyl gingival retraction paste and impression making

The gingival health was evaluated before using the next group of gingival retraction material. The gingival and plaque index was reconfirmed to be 0 in the maxillary right central incisor. The right central incisor was rinsed, dried, and then isolated to maintain the working area dry. The point of the cannula was placed between the tooth and the marginal edge of the gingiva and paste was slowly injected into the sulcus (2 mm/s). The sufficient quantity of the paste was injected into the sulcus to obtain an adequate retraction [Figure 1]. The material was left in place for 1–2 min depending on the tonicity of the marginal gingiva. The material was removed by an air and water spray with simultaneous aspiration and then impression was made with polyether impression material.

Figure 1: Gingival retraction with stay-put, expasyl, and astringent retraction material

Gingival displacement using 3M astringent gingival retraction paste and impression making

The gingival health was evaluated before using the next group of gingival retraction material. The gingival and plaque index were reconfirmed to be 0 in the maxillary right central incisor. The right central incisor was rinsed, dried, and then isolated to maintain the working area dry.

The extremity of the retraction capsule tip was placed into the labial gingival sulcus and the material was slowly and steadily injected into the sulcus. The astringent retraction paste was left in place to work for 2 min maximum [Figure 1]. The whitening of the gums shows the compression by the material. The paste was eliminated with gentle air-water spray and simultaneously aspirated. The sulcus was dried, and impression was made with polyether impression material using custom tray.

Sample preparation

All the impressions were disinfected with 2% glutaraldehyde solution and then poured using type IV die stone and the casts were obtained. The mesiodistal width of each maxillary right central incisor was measured on the cast with the help of Vernier caliper (Digimatic caliper, Mitutoyo, Japan) and center point of the tooth was marked on the cast. The second marking was done 3 mm distal to the center point. The cut was made on primary point and secondary point in labiopalatal direction through the entire length of the cast to obtain a 3 mm thick section using die cutting machine (Vilman, India) [Figure 2]. Perpendicular line was then drawn from the most prominent point of the crest of marginal gingiva to the tooth surface at primary point. The amount of gingival displacement was then measured as a distance from the tooth to the crest of the gingiva in a horizontal plane.

Samples were studied under the stereomicroscope having magnification of ×20 (Wuzhou New Found Instrument Co. Ltd., China). Image was captured and transferred to the MVIG 2005 image analyzer and the values obtained from the software as the amount of displacement [Figure 3]. The values of gingival displacement for all the specimens in μm were tabulated and subjected to statistical analysis.

Figure 2: 3 mm thick section

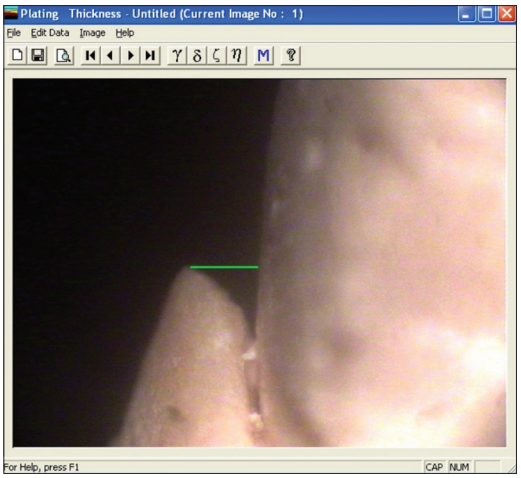

Figure 3: Distance measured in image analyzer software

Results

All three groups were compared against each other sequentially according to the objectives for gingival displacement. The one way ANOVA test was used to compare groups, i.e. Group 1 (Without retraction), Group 2 (stay-put), Group 3 (Expasyl), and Group 4 (Astringent gingival retraction paste). Table 2 shows the distribution of mean and standard deviation and comparison of the amount of gingival displacement by all the four groups used in the study. The amount of gingival displacement obtained by all the experimental groups was more than the control group [Table 3], and the difference is statistically significant ($P < 0.05$). Among the experimental groups, astringent gingival retraction paste showed the highest value for gingival displacement followed by stay-put retraction cord whereas, expasyl showed least value. The difference between astringent gingival retraction paste and stay-put retraction cord is clinically significant but statistically not significant. Astringent gingival retraction paste and stay-put retraction cord showed statistically significant difference with expasyl ($P < 0.05$) [Table 3].

Table 2: Distribution of mean and standard deviation and comparison of amount of gingival displacement by all the four groups used in the study

	n	Mean (µm)	SD	*F*	*P*
Without retraction (Group-1)	10	156.540	32.3406	37.242	<0.001
Stay-put (Group-2)	10	483.810	42.8334		
Expasyl (Group-3)	10	346.540	86.2514		
Astringent gingival retraction paste (Group-4)	10	500.530	130.0875		
Total	40	371.855	160.6166		

*ANOVA, $P<0.05$. SD: Standard deviation

Table 3: Comparison of amount of gingival displacement among all the four groups, i.e., Group 1 (without retraction), Group 2 (stay-put), Group 3 (expasyl), and Group 4 (astringent gingival retraction paste)

Groups	Mean difference	*P*
Stay-put		
Without retraction	−327.2700*	<0.001
Expasyl	137.2700*	0.004
Astringent paste	−16.7200	1.000
Expasyl		
Without retraction	−190.0000*	<0.001
Astringent paste	−153.9900*	0.001
Astringent paste		
Without retraction	−343.9900*	<0.001

*Boneferroni, $P<0.05$

Discussion

One of the most challenging aspects of fixed prosthodontic treatment is the gingival tissue management when making an impression. Gingival tissue management includes displacement of the gingiva away from the prepared margins so that impression can be made. While making an impression weather with the conventional impression material or by digital impression technique, the displacement of tissue is critical to record all the prepared margins in the impression to assure an excellent marginal fit of a laboratory fabricated restoration.[9]

Variety of techniques has been proposed in the literature throughout history. These techniques include mechanical retraction cord; mechanical retraction cord impregnated with chemical, chemical retraction pastes, surgical method, and in the current practice laser also has been used. There is no scientific evidence which establishes the dominance of one technique over the other, so the selection of technique depends upon the operator preference and clinical situation. Surgical method and use of lasers although look promising, these methods are technique sensitive and expensive. Hence, in day-to-day practice, mostly mechanical, chemicomechanical, and chemical methods are used.[9,10]

Hence, in the present study, we analyzed the three recent gingival retraction materials, i.e. stay-put gingival retraction

cord, expasyl gingival retraction paste, and astringent gingival retraction paste.

Stay-put, a braided retraction cord is a "Chemicomechanical method" of gingival retraction. The method brings physical as well as chemical displacement of the tissue.[11] In this study, stay-put cord was selected as one of the gingival retraction materials for its unique property of being wrapped around an ultrathin copper wire, which provides better stability in the gingival sulcus. The advantages of stay-put gingival retraction cord are that it is adaptable and pliable which gives freedom of preshaping.[12] It also provides good color contrast with gingiva. It does not have any cardiovascular risk. Thus, stay-put could provide greater retraction than any other conventional retraction cords, which encouraged us to compare the efficacy of stay-put retraction system with expasyl and astringent gingival retraction paste.

Expasyl gingival retraction paste provides excellent hemorrhage control as compared to the medicated displacement cord technique. This may be attributed to the increased concentration of aluminum chloride in expasyl displacement system (15%) as compared to medicated displacement cord (10%). Several advantages of expasyl retraction paste are that they achieve homeostasis effectively, atraumatic, less time consuming, and easy removal from sulcus.[8] Hence, expasyl was included in the experimental group to evaluate if the increase in concentration and the medium of dispensing aluminum chloride in the gingival sulcus as a paste have a role in the amount of displacement.

Astringent gingival retraction paste contains 15% aluminum chloride. It is easy and time-saving retraction process and decreases the risk of bleeding after removal. The extra-fine tip of the capsule fits directly into the sulcus and gets easy access into the gingival sulcus and in interproximal areas. Astringents are metal salts that cause gingival displacement by precipitation of proteins and inhibition of transcapillary movement of plasma proteins. They act by reducing cell permeability and drying surrounding tissue. Hence, this retraction material was included in the study.

All the measurements done in the present study were made by a single operator to avoid interoperator variability.

Latin block design was used in the sequence of gingival displacement to avoid tissue fatigue in this study. It may be logical to think that the amount of displacement produced during the first displacement be the least when compared to the last displacement or vice versa.[8] Latin block design that gives equal chance for each agent to be placed at different rank order of treatment was used in this study. The sequence of displacement by stay-put, expasyl, and astringent gingival retraction paste was not similar for each subject and was ordered according to the Latin block design, thus eliminating the bias.

The duration between the sessions of each gingival displacement was kept 20 days because the gingival inflammation due to the displacement of the previously used system, if any, subsides in 20 days.

In the present study, among the three gingival retraction materials compared, the expasyl and astringent gingival retraction pastes was relatively clinician friendly because these pastes were placed directly into the sulcus with the applicator tip.

For impression making, single-step technique was used to avoid discrepancy due to the use of two materials, tray positioning and the time that elapses in the two-stage procedure between removal of retraction material and impression making. Polyether impression material was preferred for excellent reproduction of the finish line in moist conditions because of the known hydrophilicity of the material.

In the present study, the amount of gingival displacement was measured on the 3 mm sectioned part of the cast under microscope with image analyzer software. This method in part was similar to the technique followed by Bowles *et al*., and Chaudhari *et al*.[8,13]

Comparison of the means of the experimental groups, i.e. Group 2, Group 3, and Group 4 showed higher values than control groups with statistically significant difference. This means that all three materials are capable of producing some amount of displacement. Among the experimental groups, Group 4 (Astringent gingival retraction paste) showed the highest amount of gingival displacement, i.e. 500.530 μm, next in line the Group 2 (stay-put retraction cord) showed 483.810 μm displacement. The least amount of displacement was found with Group 3 (expasyl retraction paste), i.e. 346.540 μm.

The results of this study are in accordance with the study conducted by Gupta *et al*. in 2013.[4] He compared the three gingival retraction materials, i.e. stay-put, expasyl and magic form cord. The stay-put gingival retraction cord showed more amount of gingival displacement than expasyl gingival retraction paste. Results obtained in this study are in accordance with the study conducted by Chaudhari *et al*.[8] He compared the cord impregnated with aluminum chloride, tetrahydrozoline, and expasyl gingival retraction paste. Expasyl showed the least amount of gingival displacement.

In the present study, astringent gingival retraction paste showed the highest amount of gingival retraction among the experimental groups. The probable reason being the consistency of the material, which was very thick, which caused more tissue displacement also the extra fine tip of the capsule provided easy access into the sulcus.

There are limitations to this study because type of gingival biotype and gingival sulcus depth influences the gingival

displacement. However, studies should be conducted in future to evaluate the patient's comfort, gingival injury while application of the material, or recession after application of the material. Further clinical investigations are needed to investigate the clinical performance of newly formulated gingival displacement materials.

Conclusion

Within the limitations of this *in vivo* study following conclusions were drawn:

1. The amount of gingival displacement of control group, i.e. without displacement was least as compared to stay-put cord, expasyl paste, and astringent paste. This indicates that the materials used in the study are capable of some amount of displacement
2. After assessment of all three recent gingival retraction materials, the astringent gingival retraction paste produced the highest amount of gingival displacement followed by stay-put cord
3. Expasyl gingival retraction paste showed the least amount of gingival displacement
4. The use of retraction paste was found to be easier, effective, and less time consuming than cord.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Kostić I, Najman S, Kostić M, Stojanović S. Comparative review of gingival retraction agents. Acta Med Medianae 2012;51:81-4.
2. Acar Ö, Erkut S, Özçelik TB, Ozdemır E, Akçil M. A clinical comparison of cordless and conventional displacement systems regarding clinical performance and impression quality. J Prosthet Dent 2014;111:388-94.
3. Shamsuzzaman M, Quader SM, Fatema S, Gofur MA, Akter K. Effect of gingival retraction cord and retraction paste on gingival tissue in fixed prosthodontics impression. Update Dent Coll J 2013;3:20-7.
4. Gupta A, Prithviraj DR, Gupta D, Shruti DP. Clinical evaluation of three new gingival retraction systems: A research report. J Indian Prosthodont Soc 2013;13:36-42.
5. Anupam P, Namratha N, Vibha S, Anandakrishna GN, Shally K, Singh A. Efficacy of two gingival retraction systems on lateral gingival displacement: A prospective clinical study. J Oral Biol Craniofac Res 2013;3:68-72.
6. Al Baker AM, El Araby A, Al Amri MD, Sukumaran A. The impact of Expasyl® gingival retraction paste on the bond strength of self-etch and total-etch systems. J Contemp Dent Pract 2015;16:335-9.
7. Sachdev PA, Arora A, Nanda S. A comparative evaluation of different gingival retraction methods – An *in vivo* study. Oral Health Case Rep 2018;4:3-7.
8. Chaudhari J, Prajapati P, Patel J, Sethuraman R, Naveen YG. Comparative evaluation of the amount of gingival displacement produced by three different gingival retraction systems: An *in vivo* study. Contemp Clin Dent 2015;6:189-95.
9. Raghav D, Singh S, Kola MZ, Shah AH, Khalil HS, Kumar P. A comparative clinical and quantitative evaluation of the efficacy of conventional and recent gingival retraction systems: An *in vitro* study. Eur J Prosthodont 2013;2:76-81.
10. Prasad KD, Hegde C, Agrawal G, Shetty M. Gingival displacement in prosthodontics: A critical review of existing methods. J Interdiscipl Dent 2011;1:80-6.
11. Darby H, Darby LH 3rd. Copper-band gingival retraction to produce void-free crown and bridge impressions. J Prosthet Dent 1973;29:513-6.
12. Khajuria RR, Sharma V, Vadavadgi SV, Singh R. Advancements in tissue displacement – A review. Ann Dent Spec 2014;2:100-10.
13. Bowles WH, Tardy SJ, Vahadi A. Evaluation of new gingival retraction agents. J Dent Res 1991;70:1447-9.