

## Clinical Evaluation of Gingival Retraction Systems in Gingival Tissue Displacement Procedure for Fixed Prosthesis

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### Abstract

**Background:** To prepare a good fixed prosthesis an accurate impression is required that records the accurate finish line of the prepared tooth and a portion of the unprepared tooth structure and surrounding gingival tissue. An accurate adaptation of crown is possible only when preparation details are captured adequately in the impression and transferred to the cast. For these reasons, gingival displacement is necessary to capture sub gingival preparation details. The impression must include sufficient unprepared tooth structure immediately adjacent to the finish line for the dentist and laboratory technician to identify the contour of the tooth and all prepared surfaces.

**Objectives:** The objective of this study was to evaluate the effect of gingival retraction systems in gingival tissue displacement procedure.

**Material and methods:** This study was performed in the Department of Prosthodontics, Faculty of Dentistry, BSMMU, Dhaka. A total number of 64 patients, ages between 25 to 50 years requiring full veneer crown in single tooth were selected and purposively divided into four groups. Each group of patients were selected by the type of gingival retraction systems that would be used. Group 1: Plain retraction cord, Group 2: Expanding type of polyvinyl siloxane paste, Group 3: Aluminum chloride retraction paste, Group 4: Before tooth preparation the smooth rounded flexible measuring strip with 0.5 mm grading was used to measure the vertical displacement of gingiva before and after retraction of gingival tissue. For measurement of horizontal displacement of gingiva a depth oriented groove is prepared on the tooth without having tooth preparation. Then the horizontal gingival tissue displacement was measured indirectly using elastomer impression material (polyvinyl siloxane) before and after retraction of gingival tissue and compared using stereo microscope and image analyzing software. The time taken for placement of different retraction systems was recorded. The bleeding scores (0,1,2,3) was recorded immediately after removal of the retraction systems. Data were collected and statistically analyzed by ANOVA test, LSD and Kruskal Wallis test.

**Result:** The findings of present study showed the highest mean of horizontal displacement is recorded by Group IV (Astringent retraction paste) (212.50µm) and lowest mean of horizontal displacement is recorded by Group III (Racegel retraction paste) (81.18µm). The lowest mean of vertical displacement is recorded by Group III (Racegel retraction paste) at midbuccal region (0.562mm), Mesiobuccal (0.50mm), distobuccal (0.50mm). The highest mean of vertical displacement is recorded by Group II (Magic Foam retraction cord) at mid buccal region (1.187mm), mesobuccal region (1.03mm), distobuccal region (1.06mm). Oneway ANNOVA test showed statistically highly significant differences among the groups ( $p < 0.01$ ). LSD test was used to make multiple comparisons among groups and revealed a statistically highly significant difference between two groups ( $p < 0.01$ ).

**Conclusion:** Astringent retraction paste and Magic Foam (expanding type of polyvinyl siloxane) retraction paste could be used as alternative of retraction cord. The advantages of use of these two materials are simple technique of placement and short application time.

**Key words:** Fixed prosthesis, Gingival retraction, Gingival tissue displacement.

### Introduction

Gingival displacement is defined as the deflection of marginal gingiva away from the tooth. Gingival displacement or retraction is an important procedure in fabrication of fixed prosthesis. A healthy co-existence of restoration and the surrounding periodontium should be the aim of any fixed prosthodontic treatment. To achieve such a relationship or harmony an accurate impression is required. Displacement of gingival tissue is essential for obtaining an accurate impression for fabrication of

fixed prosthesis, particularly when the finish line is at or just inside the gingival sulcus.<sup>1</sup> It is essential that gingival tissue be healthy and free of inflammation before crown restorations are begun. Because the marginal fit of restoration is essential in preventing recurrent caries and gingival irritation, so the finish line of the tooth preparation must be reproduced in the impression.<sup>2</sup>

An accurate adaptation of fixed prosthesis is possible only when preparation details are captured adequately in the impression and transferred to the cast. For these reasons, gingival displacement is necessary to capture subgingival preparation details.<sup>3</sup> Elastomeric impression materials are popular due to its high degree of accuracy in registering details. Therefore, the control of fluids in the gingival sulcus is mandatory, particularly when hydrophobic impression materials are used, as the sulcular fluid can lead to a deficient impression of the crucial finish line.<sup>4</sup> The patients mouth is a challenging environment in which to make an accurate impression. Moisture control is probably one of the most important aspects of successful impression making. Any

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moisture results in voids. Consequently, saliva flow into the area must be reduced and diverted to obtain the necessary dry field of operation. Any bleeding must be controlled in order to obtain a successful impression.<sup>5</sup>

When the preparation margins are extended subgingivally, the adjacent gingival tissues must be displaced laterally to allow access and to provide space for adequate impression materials thickness. This may require gingival displacement. There are different techniques for gingival displacement, including mechanical retraction, chemico-mechanical, displacement pastes and surgical retraction techniques.<sup>6</sup>

The mechanical and chemico-mechanical methods act by physically pushing the gingival margin away from the finish line and its ability to control the sulcular fluid infiltration from the walls of the gingival sulcus. However, the placement of the cords into the gingival sulcus may cause slight trauma to the sulcular epithelium and is also time consuming.<sup>7</sup> Several retraction pastes systems are introduced, retraction cord, Aluminum chloride retraction paste, expanding type of polyvinyl Siloxane for accurate retraction of gingiva.<sup>8</sup>

Gingival retraction cord has been used and considered as a standard technique to obtain gingival retraction for long time. However, improper handling of cords might lead to gingival recession and marginal exposure of the prosthesis and affects the esthetics. Moreover it has been reported by different researchers that the retraction cord using procedure is inconvenient, time consuming and uncomfortable for the patient.<sup>9</sup>

Expanding type of polyvinyl siloxane cordless retraction paste gingival retraction system displaces the gingival tissue without being potentially traumatic and less time consuming comparing with retraction cord.<sup>10</sup> Aluminium chloride containing cordless paste gingival retraction systems is a flavoured gel like product which exhibits thermo-viscosifying properties.<sup>8</sup> Astringent retraction paste is dispensed in hygienic unit dose capsules. Its placement tip is finer than those of other systems and easy access to gingival sulcus.<sup>8</sup>

The study is designed to evaluate the clinical efficacy of these four gingival retraction systems by measuring horizontal and vertical displacement of gingival tissue, assessing the bleeding score of gingiva after removal of retraction materials and recording the time taken for application of different retraction systems.

### Objectives

This study was performed to find out vertical and horizontal displacement of gingival tissue, bleeding score, time taken for placement of retraction systems.

### Materials and methods

The experimental study was performed in the Department of Prosthodontics, Faculty of Dentistry, BSMMU, Dhaka and BCSIR Dhaka from September 2017 to September 2018. A total number of 64 patients, ages between 20 to 50 years requiring full veneer crown in single tooth either upper or lower arch was taken according to inclusion criteria from those patients reported to prosthodontic department of BSMMU. 64 patients were purposively selected after a thorough medical and dental history as well as clinical and radiographic examination and assurance of patients full cooperation. Each patient was received a brief description of the study and a written informed consent was taken from each patient. 64 patients were divided into four groups. Each group of patients were selected by the type of gingival retraction systems that was used.

Group I: Plain retraction cord

Group II: Expanding type polyvinyl siloxane retraction paste (Magic Foam)

Group III: Aluminum chloride retraction paste (Racegel retraction paste)

Group IV: Astringent retraction paste

A flexible scale was fabricated by printing scale markings on the transparent plastic sheets to the accuracy of 0.5 mm. Before tooth preparation a reference point was determined in the coronal portion of abutment tooth at mesiobuccal, midbuccal and distobuccal regions for measuring the vertical displacement of gingival tissue. A depth orientation groove was prepared in pre drawn lines parallel to the long axis of tooth extending from the middle to the gingival third at the level of free gingiva at mid buccal region without having tooth preparation on abutment tooth for measuring the horizontal displacement of gingival tissue, using a flat-ended diamond fissure bur No. (101L) (Shofu, Germany) followed by a bur No. (101R) (Shofu, Germany) for finishing in a high speed air turbine hand-piece with water coolant.

Before application of retraction systems, with the help of flexible scale the sulcular depth at mesiobuccal, mid buccal and distobuccal regions were measured on the abutment tooth. Then retraction system was applied on the abutment tooth according to the manufacturers instruction. Retraction materials were left in the sulcus for proper retraction and then removed gently with an air syringe by blowing of air. Similarly, the measurements were recorded after removal of gingival retraction system. The difference between the two readings were compared to obtain net amount of vertical gingival displacement. Before tooth preparation the depth orientation groove was prepared on abutment tooth. Then two final impressions with elastomeric impression materials (Polyvinyl Siloxane) were taken for each patient before and after application of gingival retraction systems with either of the previously mentioned retractions materials. These impressions were analyzed by using

stereomicroscope and image analysis software with an accuracy of 1/10th of a micron for measurement of horizontal displacement of gingival tissue before and after retraction of gingiva. Then the impressions were sectioned longitudinally buccopaltally by using BP blade. After sectioning, the sectioned specimen was painted with a black marker to give better contrast to distinguish the edge of the reference groove and crest of the gingiva during microscopic examination, followed by linear measurement of the horizontal width of the gingival sulcus from the end of each prepared groove to the crest of the gingiva, under a stereomicroscope at a magnification of 6.5X, which was connected to the computer to capture the image. The flexible arm of the stereomicroscope was adjusted in such a way that the stereomicroscope was perpendicular on the sectioned specimens with 85mm distance when capturing the images. Image analysis software (Image J) was used to measure the width of the gingival sulcus at the prepared groove line which was calculated in Pixels. The image analysis measurements in pixels were calibrated using the image of a (1mm) increment taken at the same focal length and input into (Image J) by the option of set scale that converted all calculated reading into ( $\mu\text{m}$ ), followed by quantitative measurement of the horizontal distance (in  $\mu\text{m}$ ) from the end of the prepared groove to the crest of the gingiva, before and after retraction of the gingival tissue. The difference of sulcus width (before and after retraction for buccal grooves) was measured for each patient, then the mean for each group was taken and used for comparison of significance among the groups.

Time taken for placement of each retraction system was recorded in seconds. The bleeding scores (scores #0,1,2) was recorded immediately after removal of retraction systems:

0= no bleeding on removal

1=bleeding control with air and water spray within 1 minute of removal

2=bleeding are not controlled within 1 minute

Collected data were analyzed by using Microsoft Excel 16 (Microsoft office professional 16) based program. Data were statistically analyzed by ANOVA, LSD and Kruskal-Wallis test. The results were presented in tables, figures or graphs and diagrams. Results of significance was expressed as p-value and p-value < 0.05 was considered as highest level of significance.



Fig-1: Stereo microscope used to measure horizontal displacement of gingiva



Fig 2: Measuring vertical displacement of gingiva with flexible measuring scale

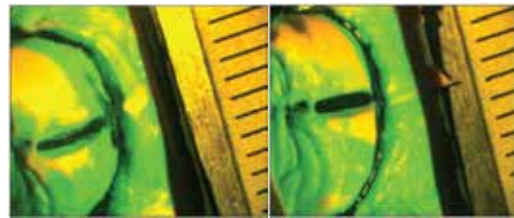


Fig-3: Impression under microscope, before (L) and after (R) displacement (Group- I)



Fig- 4: Application of Magic Foam Retraction cord (Group II)



Fig-5: Application of Racegel Retraction Paste (Group III)



Fig-6: Application of astringent retraction paste (Group IV)

**Result**

**Table 1:** Distribution of patient according to vertical displacement of gingiva(mm) at mid buccal region of abutment tooth

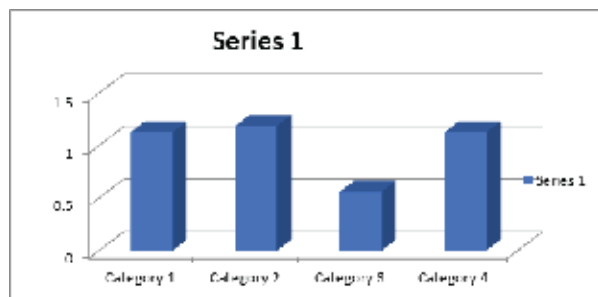
Groups	N	Mean	SD	Min	Max
Group I	16	1.125	± 0.42	0.5	2.0
Group II	16	1.187	±.35	1.0	2.0
Group III	16	0.562	±.17	0.5	1.0
Group IV	16	1.125	±.22	1.0	1.5

**Table 2:** ANOVA test for comparison of significance among the four groups for vertical displacement of gingiva at mid buccal region of abutment tooth.

Source of variation	Sum of squares	Df	MS	F	P-value
Between groups	4.125	3	1.375	14.042	0.000
Within groups	5.875	60	0.0979		
Total	10	63			

**Table 3:** Distribution of patient according to horizontal displacement of gingiva (µm) at mid buccal region of abutment tooth.

Groups	n	Mean	SD	Min	Max
Group I	16	115.64	96.16	10.76	298.46
Group II	16	172.44	85.22	30.77	269.23
Group III	16	81.18	78.40	8.0	201.53
Group IV	16	212.5	52.34	78.46	298.50



**Figure 1:** Bar diagram showing the mean values of vertical gingival displacement (mm) at mid buccal region of four groups.

**Table 4:** ANOVA test for comparison of significance among the four groups for horizontal gingiva displacement at midbuccal region of abutment tooth

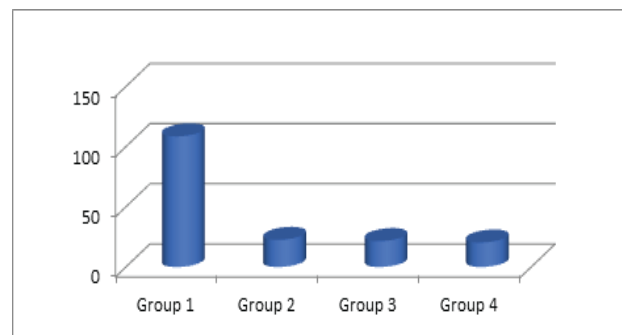
Source of variation	Sum of squares	df	MS	F	P-value
Between groups	163898.2	3	54632.74	8.604	0.000
Within groups	380965	60	6349.41		
Total	545863.2	63			

**Table 5 :** LSD test for comparison of significance between each two groups for horizontal displacement of gingiva at mid buccal region of abutment tooth.

Groups	LSD	Meandifference	Significance
I & II	47.048	56.79	S
II & III	47.048	34.47	NS
III & IV	47.048	96.86	S
I & III	47.048	91.26	S
II & IV	47.048	40.07	NS
I & IV	47.048	131.33	S

**Table 6 :** Descriptive statistics of time taken for placement of four different groups retraction materials (in sec).

Groups	n	Mean	SD	Min	Max
Group I	16	108.62	15.08	85	125
Group II	16	22.5	5.16	15	20
Group III	16	21.5	2.30	18	25
Group IV	16	20.31	3.85	15	25



**Figure 2:** Stacked cylinder showing mean values of time taken for placement of four groups of retraction material.

Table 7: LSD test for comparison of significance between each two groups for time taken of placement

Groups	LSD	Mean difference	Significance
I & II	4.857	86.125	S
II & III	4.857	1	NS
III & IV	4.857	1.187	NS
I & III	4.857	87.120	S
II & IV	4.857	2.190	NS
I & IV	4.857	88.310	S

Table 8: Kruskal-Wallis test for comparison of significance between four groups for bleeding score.

Retraction systems	Number of sample (N)	Mean rank	H value	P value
Group i	16	2.5	259.36	0.000
Group ii	16	1.87		
Group iii	16	1.25		
Group iv	16	1.25		

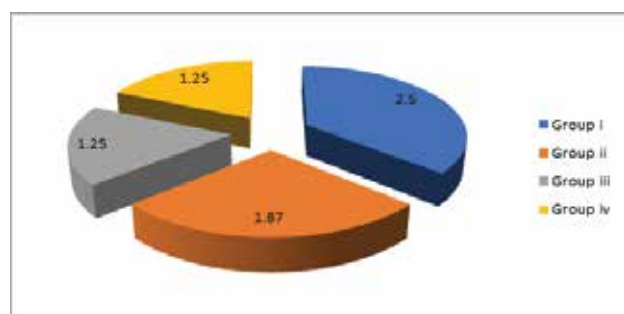


Figure 3: Exploded 3D pie chart showing the mean ranks of bleeding score among four groups of retraction systems.

### Discussion

The objective of the present study is to evaluate the tissue displacing efficacy of three new different gingival retraction pastes in comparison to the retraction cord, which is used and considered as a standard technique to obtain gingival retraction. All the tested materials (Retraction cord, Magic Foam Cord, Racegel and Astringent Retraction Paste) have the property of retraction of gingiva but they differ in their chemical composition, mode of action and time of placement. The main advantage of using a cord in the current study is easily available and it could achieve varying degrees of retraction depending on its size. Thus, retraction cord is considered as a standard technique. Improper handling of cords may cause gingival recession and marginal exposure of the prosthesis, which may affect esthetics. Different researchers reported that the retraction procedure is inconvenient, time consuming and uncomfortable for the patient. Clinically all gingival retraction pastes are easier to place and require shorter application time in

comparison to retraction cord. Retraction pastes had been found better than cords when assessed periodontal health.<sup>11</sup> In my study the tissue displacing efficacy of the gingival retraction materials were assessed by taking two impressions (pre/post-retraction). Some researchers assessed it on the cast from the pre/post-retraction impressions after its sectioning.<sup>12</sup> While others assessed the tissue displacing efficacy directly on the impression after its sectioning.<sup>13</sup> In present study, the statistically highly significant differences in the horizontal displacement of the gingival tissues produced by the different materials due to the chemical composition, mode of action, consistency and application time of these materials. The least gingival displacement shown by Racegel (Group III) which was statistically highly significant in comparison with all other groups due to the low consistency of the material, form of materials and its short application time (2 minute). Moreover, the short application time recommended by the manufacturer might not give enough time for adequate retraction but only for hemostasis. The greater gingival displacement shown by the retraction cord (Group I) than Racegel may be due to the difference in the technique of gingival retraction (chemo-mechanical method) and longer application time (10 minutes).<sup>7</sup> However, the horizontal displacement produced by the retraction cord was less than that produced by Magic Foam Cord (Group II) and Astringent Retraction Paste (Group IV) with statistically highly significant differences due to that Magic Foam Cord contains expanding type polyvinyl siloxane material which generated hydrogen gas during setting and induced expansion. The greatest gingival displacement produced by Astringent Retraction Paste (Group IV) which was statistically highly significant when compared with all other groups because of its thicker consistency than Racegel and Magic Foam Cord due to its kaolin content and its fine application tip (1mm in diameter) which may allow the material to flow deeper in the sulcus. In addition to the thicker consistency, Astringent Retraction Paste contains polydimethylsiloxane and 15% aluminum chloride in paste form.<sup>3</sup> This means that the material might act mechanically pushing the sulcus away due to the high consistency of the kaolin material (an aluminum-silicate-hydrate), absorbs gingival crevicular fluid and expands and aluminum chloride (15%) enters into the intra-crevicular space beneath the gingival margin by the fine application tip (1mm) and constricted the gingival tissues. The bleeding scores on removal of each retraction system were compared using Kruskal-Wallis test. The plain retraction cord induced maximal bleeding on removal and Racegel induced minimum bleeding on removal. The results of my study agree with the results of Prasanna et al.<sup>7</sup> concluded that the mean width of the retraction paste was greater than the mean width of the retraction cord. This is due to similarity in size and type of the cord used (#00 plain cord) in my study. This study disagrees with the results of Kazemi et al.<sup>12</sup> and Gupta et al.<sup>13</sup> who concluded that the mean width of the retraction cord was significantly greater than retraction paste (Expasyl®). Such disagreement is due to the larger size of the cord used (#1), which might give

better mechanical retraction than the thinner cord (#00) used in my study. Another possible cause is the difference in the type of medicament used to impregnate the cord (15% aluminum chloride) used by Kazemie et al.<sup>12</sup> and the difference in the composition of the cord used (softly braided retraction cord and ultra-fine copper filaments) used by Gupta et al.<sup>13</sup> which might have better mechanical retraction efficacy than the plain cord used in my Astringent Retraction paste and Magic Foam Cord® provide better horizontal displacement of the gingival sulcus than medicated cords and the advantage is simple placement technique, clinically shorter application time and Astringent Retraction paste also provides better infection control because of its disposable hygienic unit.

### Conclusion

Displacement of the gingival tissue is essential for obtaining an accurate impression for fabrication of fixed prosthesis, particularly when the subgingival finish line is prepared. From this study it can be concluded that Magic foam retraction cord provide better vertical displacement and Astringent retraction paste provide better horizontal displacement of gingiva. Racegel and Astringent retraction paste provide better hemostasis. Racegel retraction paste provide less time taken for placement.

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