ORIGINAL RESEARCH

# A Comparative Evaluation of Different Gingival Retraction Methods: A Double-blinded *In Vivo* Randomized Controlled Trial

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## Abstract

**Aims and background:** Successful treatment of a fixed prosthesis relies on the procedure's accuracy. An important step is to make an accurate impression. The impression at the margins should have substantial thickness to prevent tears and distortion. This study evaluates three different gingival retraction materials, namely retraction cord with epinephrine, retraction paste and retraction gel, using sulcular width and sulcular depth.

**Materials and methods:** The efficacy of the gingival retraction of retraction cord with epinephrine, retraction paste and retraction gel was evaluated by measuring the sulcus depth and sulcus width recorded in a single stage putty light body impression made with additional to silicone impression material.

**Results:** The mean change in sulcus width for the retraction cord with epinephrine was 0.310, that for the retraction paste was 0.264, and that for the retraction paste was 0.287. The mean change in sulcus depth produced by retraction cord with epinephrine was 0.337, followed by retraction gel 0.309 and then retraction paste 0.305.

**Conclusion:** Retraction cord with epinephrine was the most effective method of gingival retraction in terms of both sulcus width and depth when compared to retraction paste and retraction gel.

**Clinical significance:** Comparison of sulcus width and depth resulted in a statistically significant difference between the gingival retraction achieved by retraction cord with epinephrine (Group A) and retraction gel (Group C). Since this study is an *in vivo*, double-blinded and randomized controlled trial, the inferences drawn can be applied to clinical practice.

**Keywords:** Blinded study, Gingival retraction, *In vivo* study, Randomized controlled trial, Retraction cord, Retraction paste, Retraction gel, Sulcular width, Sulcular depth.

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## Introduction

Over the past ten years, the field of fixed prosthodontic procedures has advanced significantly. A variety of materials and enhanced processes have been brought about by the advancement. Subgingival margins or finish lines are frequently used in restorations involving fixed partial prostheses, either for practical or cosmetic longevity.[1] Many approaches and procedures, including mechanical, chemico-mechanical, rotary gingival curettage, and electro-surgical treatments, can reveal these preparatory finish lines.[2] The most popular of these four categories is the chemico-mechanical approach of gingival retraction, in which retraction cords are employed with chemical solutions advised for tissue management.[3]

In order to inject a large amount of low viscosity impression material into the enlarged sulcus and capture the edges, gingival retraction reversibly displaces the gingival tissues. Gingival tissues are moved vertically as well as laterally.[4] In order to remove the impression from the mouth without tearing, lateral retraction moves the tissues and provides enough volume.[5] Vertical retraction exposes the tooth part apical to the finish line. In this context, the crucial sulcular width appears to be between 0.15 and 0.2 mm. A sulcular width of less than 0.2 mm increases the likelihood of voids in the marginal area, increases the risk of the impression material ripping, and reduces marginal accuracy.[6]

Prior research has been done on retraction cords and a few cordless techniques. However, recently, new and distinct materials have been made available. The cordless procedures have been launched with a number of stated benefits, including reduced invasiveness and time savings, as well as improved patient comfort.[7]

The evaluation of three distinct gingival retraction techniques—retraction paste, retraction gel, and retraction cord with epinephrine using the width and depth of the gingival sulcus as criteria is the main objective of this study.[8] Other techniques that have undergone histological testing include electrosurgery and

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the rotary gingival curettage procedure.[9] Nonetheless, the materials and methods that are most frequently utilized in daily practice are compared in this study. Mechano-chemical gingival retraction procedures are becoming more widely accepted by practitioners. Retraction paste systems and retraction cords are two examples of this type of device.[10] According, to a report, the cord technique outperformed the paste technique in terms of sulcus representation for gingiva in good health. Nevertheless, in the case of moderate gingivitis, this benefit was mostly lost.[11] Prior research has been done to track changes in a number of clinical measures, such as attachment loss, probing depth, gingival index, and plaque index, after using particular gingival retraction procedures.[12]

Accurate impressions are necessary to improve the quality of indirectly produced restorations. These conditions include exposing the preparation margin and controlling gingival sulcus hemorrhage.[13] Retraction materials and gingival sulcular epithelium are significantly correlated. It can be said that although impregnated retraction cord are technique-sensitive and require appropriate tissue manipulation, they may be used frequently. The effectiveness of recently developed materials such as retraction paste and retraction gel needs to be assessed histologically as they respect the periodontium.[14]

Retraction cord have aluminum sulphate, potassium sulphate, ferric sulphate and aluminum chloride were incorporated into them retraction cords to help achieve hemostasis since they do not produce the systemic side effects of epinephrine, however, the high concentration of such chemical products on the gingival tissue may still produce unwanted side effects such as irritation, tissue discoloration, acidic taste and even interfere in the setting of some impressions materials.[15] Retraction cords are time-consuming and might cause gingival laceration if not utilized properly.[16] Knitted retraction cord is a rapid, simple, and cheaper technique, but its utility is limited to supra-gingival preparation margins only.[17] This has led to a rise in the use of cordless retraction materials.[16]

Retraction gel (Smart Retract) is a gel-like gingival retraction material that relies on the hemostatic qualities of aluminum chloride, antiseptics, and gel-forming chemicals. In approximately 2 minutes, these features cause the gingiva to mildly move when in touch with the crevicular fluid. About 25% of the hemostatic gel is aluminum chloride, which promotes quick and efficient hemostasis without discoloring the delicate and hard tissues of the teeth. The water-based smart retract gel is simple to remove with water. Gingival retraction occurs instantly and lasts for 20–30 minutes. Dental products are made to be used in harsh biological media at temperatures between 32 and 42 degrees Celsius, with humidity levels between 60 and 90% and a temperature of 37 degrees Celsius in the oral cavity. Retraction gel is indicated in the following cases: (1) Cavity class II, gingival retraction gel following crown bridge, veneer cutting, (2) Bleeding from capillaries during gingival tissue during restoration, (3) Stop bleeding from gingival capillaries, (4) Stop gingival leakage, (5) Retraction of the gingiva for impression-making and treatment of cervical caries. It is an extremely effective astringent and hemostatic substance offers instant retraction with a 20–30 minutes' duration of effect. Using a water jet, it is readily removed. When it comes into contact with tissues and materials, it doesn't discolor them. With the aid of a flexible dispensing tip syringe, it is simple to use. Retraction gel is composed of 25% aluminum chloride, 25% benzalkonium chloride, and a gel-forming agent.


**Fig. 1:** Group A – Retraction cord impregnated with epinephrine

## Direction to Use

- Place the gel into the sub gingival area to promote gingival retraction.
- Rinse off the gel, pat the gum dry, and administer additional care.
- Soak a cotton ball in smart retract gel, place it over the bleeding area, press down a little, and let it sit for a minute.
- Rinse the gum to remove the gel, then let it air dry.[18]

Retraction paste (3M) is a substance intended to facilitate quick and simple sulcus retraction without the need for laborious and sometimes painful retraction cable packing. In order to effectively take a comprehensive impression of the preparation margin, the extra-fine tip injects a 15% aluminum chloride astringent paste directly into the sulcus, gently pressing the gingival tissue away from the tooth.

## Easy Method to Ensure a Dry and Clean Working Field

- Remove a small amount of paste by extruding it. Place the tip of the retractable capsule into the sulcus. The tissue retracts mechanically. Insert the tip into the sulcus with the assistance of the alignment ring. Inject astringent retraction paste gradually. Fill the sulcus all the way. Adhesive retraction paste should be left in place for at least 2 minutes.
- Use air-water spray and suction to remove the astringent retraction paste completely.

Retraction paste facilitates interproximal access is hygienic, and expeditiously allows for the impression-taking process for crown replacements. Retraction cords are not required since they efficiently control moisture and allow access to the preparation margin. Retraction paste creates a dry sulcus on a healthy periodontium and permits the temporary retraction of the marginal gingiva. It can be utilized for class II and V fillings, as well as material-based or digital impressions.[19]

The majority of research on cordless procedures shows how they are used in clinical settings; little is known about how they affect the gingival and periodontal tissues.

The present study was therefore undertaken to identify the most efficient gingival retraction method out of retraction cord with epinephrine (Fig. 1), retraction paste (3M) (Fig. 2) and retraction gel

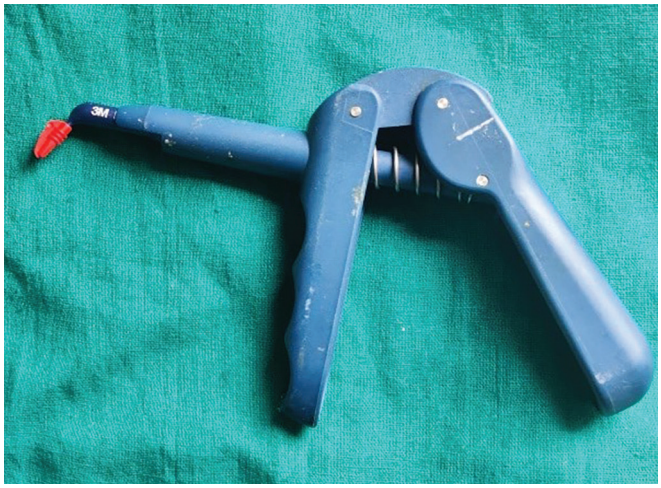

**Fig. 2:** Group B – Retraction paste

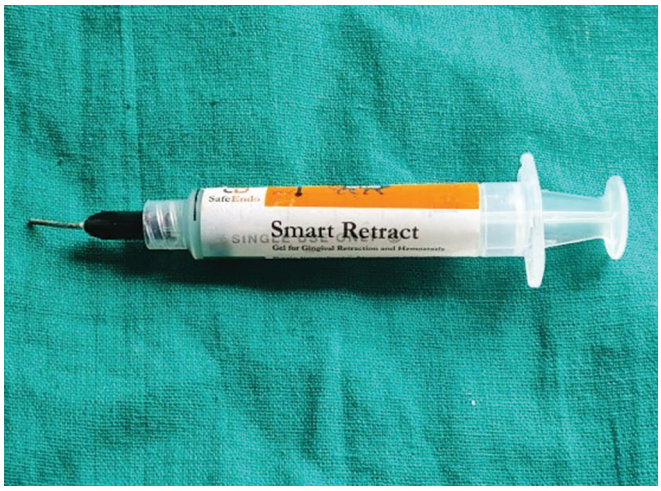


**Fig. 3:** Group C – Retraction gel

(Smart Retract) (Fig. 3) by measuring sulcus width and depth and to determine how efficient the retraction methods are and which is the better retraction material among the three of them. A control group of plain retraction cords was used in one single unit fixed partial denture (FPD) and the retraction method to be compared was used in another single unit FPD in the same patient, and the two groups were compared.

The aim of the study was to assess and compare the amount of gingival retraction using retraction cord with epinephrine, retraction paste and retraction gel in single unit FPDs in which full coverage porcelain fused metal crowns were to be given.

The working null hypothesis H0 is "There is no difference in the amount of gingival retraction achieved using retraction cord with epinephrine, retraction paste and retraction gel".

## Materials and Methods

The study included 36 patients, with 12 patients each in 3 groups. Each patient had at least 2 root canal treated teeth that required full coverage porcelain fused metal crowns. In each patient, gingival retraction was done using the retraction agent in the first tooth and a plain retraction cord in the second tooth, which was the control group.[8]

Group A – Gingival retraction done using a retraction cord with epinephrine.

Group B – Gingival retraction done using retraction paste.

Group C – Gingival retraction done using retraction gel.

Each subject was divided into 2 sites (2 teeth) for study:

| | |
|---|---|
| Site 1 | Retraction agent |
| Site 2 | Control group |

### Sample Size Calculation

Expecting at least 0.55 mm mean change in the amount of retraction, (i.e., effect size: f) among three groups with a 5.0% margin of error ($\alpha = 0.05$, i.e., type I error), 80.0% power ($1-\beta = 0.80$, i.e., type II error) and 1:1 ratio, then a minimum of 36 patients need to be recruited (*n*) for the study or 12 patients per group.

For randomization, lottery system was used when the patients were enrolled.

Tooth preparation was done for a Porcelain fused metal crown following the standard protocol. A subgingival margin with a Chamfer finish line was given using a straight ogival (SO)-21 bur for all the teeth. There were 3 groups with 12 patients each. In each group, in one tooth, gingival retraction was done using the retraction agent, and in the second tooth (the control) gingival retraction was done using a plain retraction cord. Finally, a single stage putty light body impression was made using silicone.

## Collection of Data

After impression-making, the impressions were scanned at Pranjal Dental Lab to measure sulcus depth and height from the gingival margin using the 3Shape scanner, and the values were noted.

The present randomized controlled trial was a double-blinded study that evaluated the efficacy of gingival retraction of the retraction cord with epinephrine, retraction paste and retraction gel. The patients and the lab data analyzer were blinded and were not informed about the groups being used.

## Results

MS Excel 2016 was used to fabricate the data sheet. IBM SPSS Corp. in Armonk, New York for Windows, version 25.0, was used for the statistical analysis. Descriptive statistics were presented in the form of Mean and SD. Chi-square statistics were applied to calculate the inferential statistics of the different variables between the different groups. Mann–Whitney *U* test was applied to calculate the comparison between the two groups. The statistical constant was fixed at $p < 0.05$. The distribution of the study sample was not normally distributed; hence, a nonparametric test of significance was applied. Graphically, the results were represented as bar graphs.

- Descriptive statistics for the groups
  - Sulcular width: The sulcular width was reported for the different groups. It was seen that group A had a score of $0.310 \pm 0.030$; for group B, it was $0.264 \pm 0.028$ and for group C, it was $0.287 \pm 0.020$. There was a statistically significant difference noted between the groups.

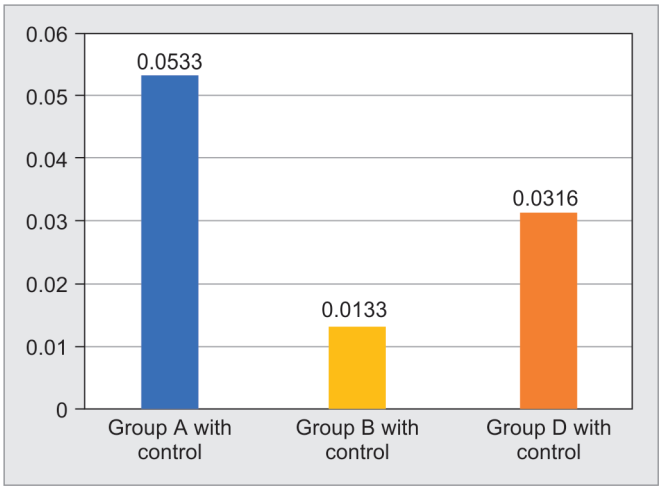


**Fig. 4:** Graphical representation of the sulcular width for comparison between groups and control

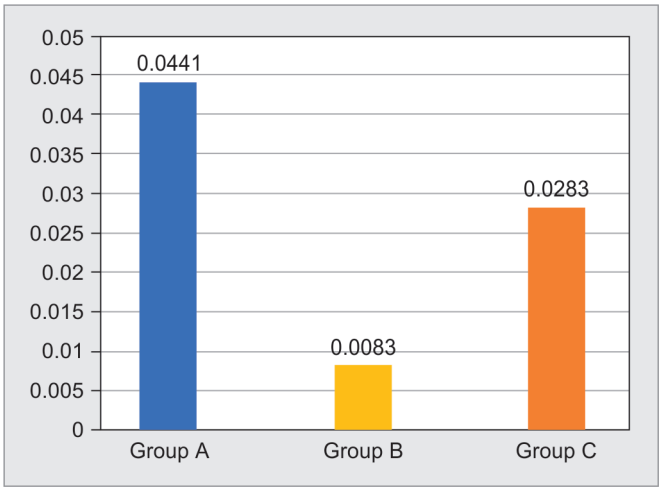


**Fig. 5:** Graphical representation of the sulcular depth for comparison between groups and control

- Sulcular depth: The sulcular depth was reported for the different groups. It was seen that group A had a score of 0.337 ± 0.015; for group B, it was 0.305 ± 0.020 and for group C, it was 0.309 ± 0.018. There was a statistically significant difference noted between the groups.

• Comparison of the individual groups with control group
- Sulcular width: The comparison of the individual groups, and control group was recorded. It was seen that group A and control group had a mean difference of score of 0.0533 ± 0.0115; for group B, it was 0.0133 ± 0.0065 and for group C and control group, it was 0.316 ± 0.0057. There was a statistically significant difference noted between group A and group C with the control group. The same has been graphically represented in Figure 4.
- Sulcular depth: The comparison of the individual groups and control group was recorded. It was seen that group A and control group had a mean difference of score of 0.0441 ± 0.0116; for group B it was 0.0083 ± 0.0093 and for group C and control group it was 0.0283 ± 0.0071. There was a statistically significant difference noted for group A and group C with the control group. The same have been graphically represented in Figure 5.

## Discussion

The introduction of cordless gingival retraction procedures has been accompanied by a number of claimed benefits, including reduced invasiveness, time savings, and improved patient comfort.[7]

Retraction gel (Smart Retract) is a gel-like gingival retraction substance that relies on antiseptics, gel-forming chemicals, and aluminum chloride's hemostatic qualities.

In approximately two minutes, these features cause the gingiva to mildly move when in touch with the crevicular fluid. Astringent qualities of aluminum chloride are widely recognized. On the tissue's surface, protein coagulation is caused by aluminum chloride. Applying the paste within the sulcus causes the gingival crest to become sufficiently separated to allow an impression to be taken without damaging the epithelial connection, and it also creates a pressure of 0.1 N/mm. Experimental research has shown that it is biocompatible with tissues and has strong antibacterial activity.[8]

Retraction paste (3M) is a substance intended to facilitate quick and simple sulcus retraction without the need for laborious and sometimes painful retraction cord packing.[19] The majority of research on cordless procedures shows how they are used in clinical settings; little is known about how they affect the gingival and periodontal tissues.

In the current investigation, we found that retraction caused by epinephrine-infused retraction cord was greater than that produced by retraction gel and retraction paste. However, the two cordless systems were easy to operate.

According to Parul Arora Sachdev et al. Comparative Evaluation of Different Gingival Retraction Methods – An *in vivo* Study, which supports my research, retraction cord was the most successful gingival retraction method in terms of both sulcus width and depth, but magic form cord was a better material for ease of clinical handling.[8]

Because the retraction cord was mechanically forced into the gingival sulcus, it caused a greater amount of retraction. Retraction cord with epinephrine, retraction paste, and retraction gel all produced sulcus widths of 0.310, 0.264, and 0.287 mm, respectively, according to the results of the current investigation. At the finish line level, these values are equivalent to the critical sulcular width of 0.2 mm. Less sulcular width impressions are more likely to exhibit distortion, voids, impression material ripping, and a decrease in marginal accuracy. All three of the retraction agents that were evaluated in our investigation were able to reach the required width of the displaced sulcus, which is 0.2 mm. Another conclusion from our research was that the sulcular depths attained by the retraction cord containing epinephrine, retraction paste, and retraction gel were 0.337, 0.305, and 0.309 mm, respectively. Regarding the amount of retraction generated in width and depth, the three approaches employed all achieved statistically significant results.

According to a previous study, using an Ultrapak retraction cord seemed to cause more gingival recession than using cordless methods. Recession in cordless technique was too tiny to be clinically meaningful. Furthermore, it was noted that the clinical handling of retraction cords was a laborious procedure that gave the volunteers some pain or discomfort during application. Retraction gel worked just as well and caused less discomfort or gingival stress.[6]

It was regarded as a superior retraction material as a result. This was also deduced from earlier research, since it is nearly clinically inevitable to apply focused mechanical pressure to the sensitive gingival tissue in order to insert the retraction cable into the gingival sulcus. The outcomes showed that using a medicated cord caused more discomfort than using an injectable kind. The clinical comfort and convenience of injection-type retraction materials were validated by this outcome.[14]

It is reasonable to conclude that all three of the test materials utilized in this investigation produced sufficient gingival displacement based on clinical and statistical analysis. Better is the substance that causes the least amount of tissue stress. Retraction gel is a superior retraction material than gingival retraction cord because it causes less discomfort to the patient while offering nearly similar horizontal and vertical displacement. In contrast to retraction cord with epinephrine and retraction gel, retraction paste caused less gingival displacement in terms of width and depth.

A related study on the comparative evaluation of the clinical effectiveness of four different gingival retraction systems by Rahul Madaan et al. provided evidence in favor of my findings, indicating that all experimental groups had larger gingival displacement than the control group ($p < 0.01$). The maximum gingival displacement value (541.65 μm) was recorded by the polyvinyl acetate strips among the experimental groups, with the impregnated retraction cord (505.37 μm), retraction capsule (333.57 μm), and retraction paste (230.63 μm) following closely behind.[16]

In line with my research, Cui Huang et al.'s study, "Efficiency of Cordless Versus Cord Techniques of Gingival Retraction: A Systematic Review," found that gingival retraction paste is less harmful to soft tissues and can assist in achieving a dry field more successfully than retraction cords. However, its capacity to displace gingival tissues is less effective than retraction cords.[10]

Comparison of sulcular width and depth for each group with the control group showed that group B, i.e., retraction paste showed statistically insignificant retraction.

The working null hypothesis H0 is "There is no difference in the amount of gingival retraction achieved using retraction cord with epinephrine, retraction paste and retraction gel" was rejected.

Procedures involving the packing of cords may result in bleeding and sulcular epithelium separation. Retraction gel, on the other hand, was simple to apply and caused less damage to the sulcular tissues. This study looked at the effects of retraction techniques on gingival displacement rather than periodontal and gingival health issues, including inflammation. The impact was investigated in the presence of blood, which may remain after teeth have been prepared or in cases where the gingiva is irritated. Since, the retraction materials were applied to endodontically treated teeth, in which crown preparation was done, one can argue that the results can be extrapolated to clinical reality. Significant retraction was achieved with group A and group C where group A proved to be better than the latter.

Comparing all the three groups in different subjects and not in the same oral environment limits the study to direct comparison.

## Conclusion

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

- All the three retraction methods-retraction cord with epinephrine, retraction paste and retraction gel employed in this study achieved adequate sulcus width and depth.
- Retraction cord with epinephrine was the most effective method of gingival retraction in terms of both sulcus width and depth, but in terms of ease of clinical handling, retraction gel proved to be a better material. Retraction paste was seen to be the least effective.

Future studies should compare the different retraction agents in the same patient for direct comparison amongst them under the same oral conditions.

### Clinical Significance

- Statistical analysis for sulcus width resulted in a statistically significant difference between the retraction produced by retraction cord with epinephrine (Group A) and the retraction gel (Group C). The retraction produced by retraction paste (Group B) was less, and the difference was clinically insignificant compared to the other two.
- Statistical analysis for sulcus depth resulted in a statistically significant difference between the retraction produced by retraction cord with epinephrine (Group A) and the retraction gel (Group C). The retraction produced by retraction paste (Group B) was less, and the difference was clinically insignificant compared to the other two.

Since this study is an *in vivo*, double-blinded and randomized controlled trial the inference drawn can be applied to clinical practice.

### Ethical Approval

Registration number of the Institutional Ethical Committee: EC/NEW/NEW/INT/2020/1173.

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