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COMPARATIVE EVALUATION OF TWO NONINVASIVE LATERAL GINGIVAL DISPLACEMENT; AN IN VIVO STUDY

Title: COMPARATIVE EVALUATION OF TWO NONINVASIVE LATERAL GINGIVAL DISPLACEMENT; AN IN VIVO STUDY

Subtitle: Analysis of efficacy of retraction cord with a haemostatic agent in comparison with retraction paste on lateral gingival displacement.

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ABSTRACT

Aim &Objective: To analyse the efficacy of retraction cord with a haemostatic agent in comparison with retraction paste on lateral gingival displacement, to achieve the success of fixed dental prostheses (FDP).

Material and Methods: Test samples included 15 teeth 30 samples that required treatment with metal-porcelain FDP. Impressions were taken with the help of special tray after the gingival retraction procedure and after 7 days with retraction paste application.. The impression was made using vinyl polysiloxane impression material. Lateral gingival displacement width was measured on vision inspection system (Sipcon Measuring Systems, India, Model No. AVI-IMG-3D). Images of the impressions were captured under high resolution and analyzed with specialized software to determine linear gingival changes with micrometer accuracy along the horizontal/lateral axes.

Results: The mean value of group A after gingival retraction was 0.435 mm, and with retraction paste .306 in mesiobuccal region. The mean value of group B after gingival retraction with cord was 0.555 mm, and after gingival retraction with paste was 0.404 mm in mesiolingualresion. . The mean value of group c after gingival retraction with cord was 0.511mm, and after gingival retraction with paste was 0.329 mm in distobuccalresion. The mean value of group D after gingival retraction with cord was 0.587 mm, and after gingival retraction with paste was 0.418 mm in distolingual resion. Lateral gingival displacement width between a combination of cord retraction and hemostatic agent group in comparison with the retraction paste group showed a significant difference ($p<0.001$).

*Conclusion**:** Gingival displacement width as a result of cord retraction with the hemostatic agent was larger compared to the retraction paste. Even though both of them are still considered to be effective in providing access for impression material.*

***Keywords**: Gingival Retraction Techniques; Dental Impression Technique. Polyvinyl siloxane impression material.*

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INTRODUCTION

Marginal fit of fixed dental prostheses is influenced by several factors, one of which is the accuracy of the impression[1]. Achieving an accurate impression can be facilitated through the gingival retraction procedure. Gingival retraction involves laterally displacing the gingival margin away from the tooth surface, allowing for better exposure of the cervical tooth surface covered by gingival tissue, so that it can be accurately recorded by the impression material. For an optimal impression, the lateral gingival displacement should range from 0.15 to 0.2 mm, ensuring that the impression material can reach the necessary areas effectively[2]. Various techniques and materials are available to assist clinicians in managing gingival tissues during restoration and impression-making. However, no scientific evidence conclusively proves the superiority of one method over another. The choice of a specific soft tissue management approach depends on the clinical scenario and the operator's preference.

The most commonly used gingival retraction method combines retraction cord with a haemostatic agent. While this method is popular due to its low cost, it has several drawbacks, including (1)difficulty in application and a lengthy processing time; (2) a higher risk of damaging the gingival epithelial attachment; (3) potential for gingival recession of about 0.2 ± 0.1 mm; (4) lingering haemostatic agent residue in the gingival sulcus, which could lead to inflammation if not properly removed; and (5) discomfort for the patient[3]. Alternatively, gingival retraction using paste is simpler and requires less time. The paste is injected into the gingival sulcus using an injector. Compared to retraction cords, the use of retraction paste offers advantages such as (1) an easier application process, (2) being noninvasive, and (3) greater comfort for the patient. However, some studies suggest that using paste for gingival retraction results in a smaller lateral gingival displacement compared to using a retraction cord, which can lead to insufficient exposure of the tooth surface. This may decrease the accuracy of the impression, affecting the dental technician's ability to accurately assess and fit the marginal restoration. The goal of this INVIVO STUDY was to analyse whether retraction cords have a different effect on lateral gingival displacement width compared to retraction paste.

MATERIALS AND METHODOLOGY

The study was conducted among 15 patients, who comes in the department of prosthodontic MCDRC Anjora DURG, (C.G.) between 2024-25 for restoration of root canal treated mandibular right and left first molar. This study used sample size of 30 that were indicated to be restored with metalporcelain fixed dental prostheses.

Patients were selected based on the following inclusion criteria:

1. Requirement for fixed dental prostheses (full veneer crown, dowel crown, or fixed partial denture).
2. Presence of healthy gingiva and periodontium, with no bleeding on probing (BOP).
3. Probing depth between 1-2 mm.
4. Thin gingival biotype.
5. Equigingival preparation margin.
6. Chamfer cervical preparation margin.
7. Overall systemic health without any systemic diseases.

These criteria are consistent with standard protocols for selecting patients for metal-porcelain fixed dental prostheses, as highlighted in various studies

The study was designed to evaluate two different gingival retraction techniques prior to preparing teeth for full-coverage porcelain-fused-to-metal (PFM) crowns. The subjects were divided into two groups:

- **Group I:** Retraction using mechanical means with Gingi-Pak cord.

- **Group II:** Retraction using chemical means with 3M ESPE retraction capsules.

Tooth preparation followed standard prosthodontic principles for full-coverage PFM crowns. Reference points for measuring sulcus depth and width were established by making indentations at the mesio-buccal, mesio-lingual, disto-buccal, and disto-lingual aspects just above the finish line. After preparation, a vinyl polysiloxane impression was taken using a special tray derived from a diagnostic impression. In Group I, gingival retraction was performed using the Gingi-Pak cord system, where an adequate length of cord was cut and placed into the sulcus.

Gingi Pak
Gingi-Pak's original retraction cords are made from 100% cotton and are loosely wound, allowing the strands to be separated, twisted, or combined to suit various clinical situations. They are suitable for all retraction techniques, including the two-cord technique. The cords are available non-impregnated or impregnated with dl-epinephrine to aid in hemostasis.

3M RETRACTION PASTE
The 3M ESPE retraction capsule delivers a 15% aluminum chloride astringent paste directly into the sulcus via an extra-fine tip, effectively deflecting marginal gingiva and controlling bleeding. This method is designed to be faster and more comfortable for patients compared to traditional retraction cords.

By comparing these two methods, the study aimed to determine their effectiveness in gingival retraction during the preparation for PFM crowns.

Retraction was done using the retraction cord system(Group I). The cord of adequate length was cut. Knitted cord of sizes #000 was packed in the sulcus using a serrated cord packer with minimal pressure for about 8 minutes. A final impression with polyvinyl polysiloxane with help of special tray was made after removal of the retraction cord and stored.

After a 7-day interval, gingival retraction was performed using the 3M™ Astringent Retraction Paste (Group II). The retraction paste capsule was equipped with a dispensing tip, attached to a compatible dispenser, and the material was gently introduced into the sulcus without applying pressure to the gingiva. A final impression using vinyl polysiloxane was then taken and stored.

Gingival retraction efficiency was assessed at predetermined reference points—mesio-buccal, mesio-lingual, disto-buccal, and disto-lingual angles. Measurements of lateral displacement were conducted using a vision inspection system (Sipcon Measuring Systems, India, Model No. AVI-IMG-3D). Images of the impressions were captured under high resolution and analyzed with specialized software to determine linear gingival changes with micrometer accuracy along the horizontal/lateral axes. The differences in these measurements indicated the retraction efficiency of each system.

To minimize operator variability, all procedures—including tooth preparation, retraction, and software measurements—were performed by a single operator under the supervision of a senior prosthodontist.

RESULTS
Table 1: Comparison of lateral retraction among different systems on Mesiobuccal side
Table 2: Comparison of lateral retraction among different systems on Mesiolingual side
Table 3: Comparison of lateral retraction among different systems on Distolingual side
Table 4: Comparison of lateral retraction among different systems on Distobuccal side

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Result

Table 1: Comparison of vertical retraction among different systems on Mesiobuccal side

Methods	N	Mean	Std. Deviation	T value	P value
RETRACTION CORD	15	435.53	197.13	2.16	0.039*
CHEMICAL METHOD	15	306.07	122.49		

Table 2: Comparison of vertical retraction among different systems on Mesiolingual side

Methods	N	Mean	Std. Deviation	T value	P value
RETRACTION CORD	15	555.00	141.61	2.94	0.006*
CHEMICAL METHOD	15	408.80	130.38		

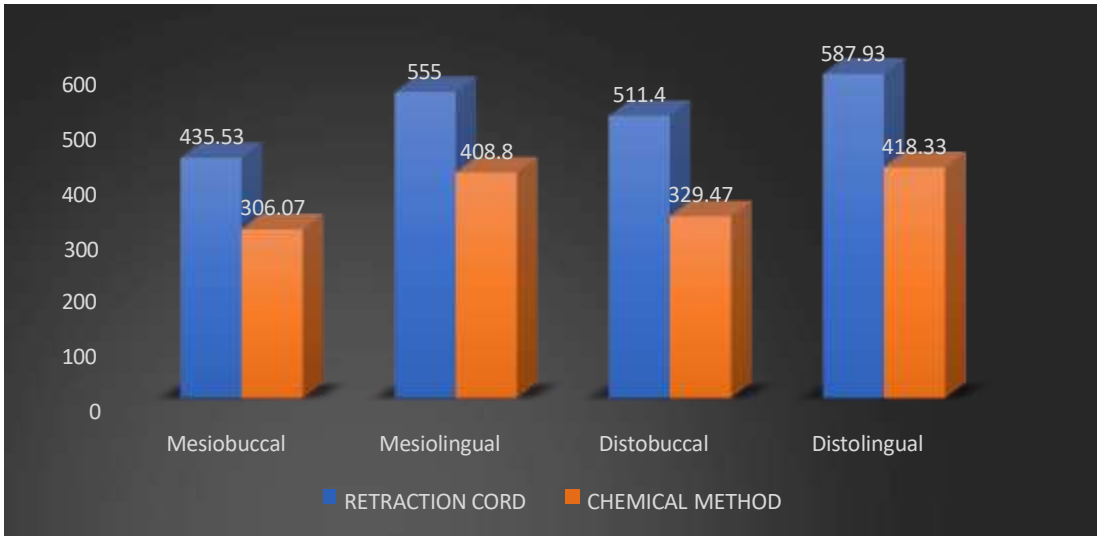
Table 3: Comparison of vertical retraction among different systems on Distolingual side

Methods	N	Mean	Std. Deviation	T value	P value
RETRACTION CORD	15	511.40	190.28	2.87	0.008
CHEMICAL METHOD	15	329.47	155.16		

Table 4: Comparison of vertical retraction among different systems on Distobuccal side

Methods	N	Mean	Std. Deviation	T value	P value
RETRACTION CORD	15	587.93	227.85	2.15	0.040*
CHEMICAL METHOD	15	418.33	203.50		

Graph1: Comparison of vertical retraction among different systems



DISCUSSION

The accuracy of impression is essential for better fitting crown in bridge in the age of digital era conventional impression accuracy is still foremost. Therefore, gingival retraction is mandatory.Mechanical methods, particularly the use of medicated retraction cords, are commonly employed for gingival retraction. In a clinical study, Zeena Raja and Chandrasekharan Nair found that knitted cords provided superior retraction compared to braided cords, achieving a maximum displacement of 0.61 mm. Additionally, they observed that the retraction efficiency among different sizes of knitted cords (#000, 00, 0) was similar, averaging around 0.6 mm[4].

Cordless displacement techniques offer several advantages over traditional cord methods, including time efficiency, enhanced patient comfort, effective gingival displacement, reduced gingival crevicular fluid flow, minimal application pressure, and improved maintenance of gingival health. Various cordless retraction systems are available in paste, foam, and gel forms, providing comparable displacement to cord techniques. Notable examples include:

- **Magic Foam Cord**: An addition-curing silicone foam produced by Coltène, Switzerland.
- **Expasyl**: A kaolin-based paste system from Pierre Rolland, Merignac, France.
- **3M™ Astringent Retraction Paste**: A kaolin and aluminum chloride-based paste.

The 3M™ Astringent Retraction Paste is a relatively recent addition to the market, designed for ease of application with thin tips that allow for painless and rapid delivery. Its suitable viscosity ensures effective gingival displacement. Limited studies have been conducted on its performance; however, available literature suggests its potential. For instance, a clinical study comparing various retraction systems found that the 3M ESPE retraction capsule achieved effective gingival displacement, comparable to traditional methods[5].

Furthermore, a systematic review and meta-analysis evaluating cordless techniques for gingival displacement concluded that these methods, including the 3M ESPE retraction capsule, are effective alternatives to conventional cord techniques, offering similar gingival displacement with added benefits such as reduced chair time and enhanced patient comfort.

In summary, while mechanical retraction using cords remains a standard practice, cordless systems like the 3M™ Astringent Retraction Paste present viable alternatives, combining efficacy with improved patient experience.

Several studies have compared the efficacy and patient comfort of traditional gingival retraction cords versus newer retraction pastes. Choudhary et al evaluated the displacement of free gingiva using a retraction paste (3M™ Astringent Retraction Paste) and a retraction cord (Ultrathin Gingival Retraction Cord - SureEndo #000). They concluded that while traditional retraction cords can cause discomfort and potential periodontal damage if used carelessly, the cordless method was more effective and patient-friendly[6].

Similarly, Renuka Prasanna and Kesava Reddy compared two gingival displacement systems: retraction cords and displacement pastes. Their study found that both methods achieved adequate sulcus width enlargement; however, the displacement paste (Expasyl) demonstrated superior horizontal displacement of the gingival sulcus compared to the knitted impregnated retraction cord[7].

The study concluded that retraction cords produced greater displacement due to mechanical insertion into the gingival sulcus. However, clinical handling of retraction cords was found to be tedious and caused some patient discomfort. In contrast, retraction pastes provided adequate margin retraction for improved impression details and were associated with enhanced patient comfort. A limitation of these studies is that they were conducted under healthy gingival conditions, which may not represent all clinical scenarios. Further studies are needed with an increased sample size to evaluate the same parameters in

different population group. Also, the performance of the material in the presence of gingivitis and periodontitis should also be examined, as well as different gingival thickness group.

CONCLUSION

Within the limitations of this study, both the retraction cord and retraction paste methods achieved adequate sulcus width. In terms of clinical handling ease, retraction paste proved to be the better material. Although the retraction cord resulted in a larger sulcus width, the retraction paste remains a viable option due to its ability to provide good access for impression materials. This study did not consider certain factors that could influence lateral gingival displacement, such as sulcus depth, gingival biotype, and preparation margin type. Further research is required to explore these factors and their impact on gingival displacement width.

Gingival retraction cord	3M Retraction paste

Retraction paste dispensing gun

Retraction cord	3M retraction paste

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