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Original Research

Comparision of gingival retraction methods while crown cutting in fixed partial dentures: a comparative study

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ABSTRACT:
Background: Accurate gingival retraction is crucial during crown preparation for fixed partial dentures to expose the finish line and achieve precise impressions. This study aimed to compare the clinical efficacy of three gingival retraction techniques—impregnated retraction cord, retraction paste, and diode laser—in terms of lateral displacement, hemostasis, and patient comfort. **Materials and Methods:** Sixty patients requiring fixed prostheses were randomly assigned into three groups (n=20 each). Group A received retraction with aluminum chloride-impregnated cord, Group B with a retraction paste, and Group C underwent diode laser troughing. Lateral tissue displacement was measured microscopically. Hemostasis was evaluated clinically, and patient discomfort was recorded using a Visual Analog Scale (VAS). Data were statistically analyzed using one-way ANOVA and Chi-square tests. **Results:** Laser retraction achieved the highest mean lateral displacement (0.539 mm), followed by paste (0.458 mm) and cord (0.351 mm), with statistically significant differences ($p<0.0001$). Laser also provided superior hemostasis and the lowest VAS pain scores (2.45), whereas the cord method resulted in the most discomfort (VAS 5.36). **Conclusion:** Diode laser retraction demonstrated superior efficacy and patient comfort. Paste systems offered moderate performance, while cords, though traditional, were the least favorable.
Keywords: Gingival retraction, Fixed partial denture, Retraction cord, Retraction paste, Diode laser.

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INTRODUCTION

Fixed partial dentures (FPDs) continue to play a pivotal role in restoring function, aesthetics, and occlusal integrity in patients with partial edentulism. Accurate crown preparation, particularly around the gingival margins, is essential for long-term clinical success and biological compatibility of FPDs. One of the most critical components during tooth preparation and impression making is effective gingival retraction, which ensures proper exposure of the finish line, minimizes soft tissue trauma, and enhances the accuracy of the final prosthesis [1].

Gingival retraction is primarily employed to temporarily displace the marginal gingiva laterally and apically to expose the cervical finish lines of tooth preparations. This allows for accurate impression recording, improved visualization, and better access for restorative procedures [2]. Improper retraction can lead to marginal discrepancies, inaccurate impressions, and eventual failure of the prosthesis.

Moreover, aggressive retraction techniques may damage the sulcular epithelium, result in post-operative discomfort, and negatively influence periodontal health [3].

Several methods have been employed for gingival retraction, each with its advantages and limitations. The most traditional and widely used technique involves the placement of retraction cords, which may be impregnated with hemostatic or astringent agents. These cords mechanically displace the gingiva and provide hemostasis during the impression phase. However, mechanical trauma and patient discomfort have raised concerns regarding their routine use, especially in thin biotype or inflamed gingiva [4].

Alternatively, chemicomechanical methods such as retraction pastes have emerged, which aim to achieve gingival displacement with minimal tissue trauma. These pastes, often containing aluminum chloride or other hemostatic agents, expand within the sulcus and retract the gingiva while providing adequate hemostasis. Studies have shown that such materials may offer comparable or even superior sulcular opening without the pain and bleeding associated with traditional cord techniques [5].

Recent advancements have also introduced cordless retraction systems, including injectable pastes and expanding polyvinyl siloxane-based materials. These newer agents promise greater patient comfort, ease of use, and time efficiency in clinical practice [6]. However, debates persist regarding their efficacy in achieving adequate retraction depths and their suitability for subgingival margins, particularly in cases of deep sulcus or hypertrophic tissue [7].

Additionally, electrosurgery and laser-assisted techniques have been explored for gingival management during prosthodontic procedures. These methods enable precise tissue removal and hemostasis but demand operator expertise and are associated with risks such as thermal damage or delayed healing [8].

The choice of a gingival retraction method is often dictated by multiple factors, including the clinical scenario, gingival biotype, depth of the sulcus, presence of bleeding, operator skill, and patient comfort. Importantly, the retraction technique should provide sufficient lateral and vertical displacement while preserving periodontal health and minimizing trauma [9].

Given the variety of available retraction techniques and the ongoing debate regarding their comparative efficacy and safety, this study aims to evaluate and compare different gingival retraction methods used during crown cutting in FPDs. Through a systematic clinical approach, the investigation seeks to identify the most effective, least traumatic, and patient-friendly method suitable for routine prosthodontic practice [10].

MATERIALS AND METHODS

Study Design and Setting

This was a prospective, randomized, comparative clinical study conducted in the Department of Prosthodontics at a tertiary care dental institution over a period of six months. The study was designed in accordance with ethical standards and was approved by the Institutional Ethical Committee. Written informed consent was obtained from all participants prior to enrollment.

Sample Size and Sampling Technique

A total of 60 systemically healthy patients requiring fixed partial dentures (FPDs) involving at least one abutment tooth with subgingival or equigingival margin placement were selected using a simple random sampling technique. The patients were randomly divided into three groups of 20 each (n = 20 per group), based on the gingival retraction method used.

Inclusion Criteria

- Patients aged between 20 and 60 years.
- Indicated for full-coverage FPD with subgingival or equigingival finish lines.
- Healthy gingival tissue without active periodontal disease.
- Patients with good oral hygiene compliance.

Exclusion Criteria

- Patients with systemic conditions affecting periodontal tissues (e.g., diabetes mellitus, bleeding disorders).
- Smokers and tobacco users.
- Patients on anticoagulant or anti-inflammatory medications.
- History of hypersensitivity to any of the retraction materials.
- Pregnant or lactating women.

Group Allocation

Participants were divided into three groups as follows:

- **Group A**: Retraction cord impregnated with 25% aluminum chloride (mechanical-chemical method).
- **Group B**: Retraction paste containing aluminum chloride (e.g., Expasyl or equivalent) (cordless method).
- **Group C**: Laser-assisted gingival troughing using a diode laser (1.2–1.5 W continuous mode).

Procedure

All tooth preparations were done under local anesthesia using standardized protocols for FPD crown cutting. For each group, gingival retraction was performed according to the assigned method.

- In **Group A**, a #00 braided cord soaked in 25% aluminum chloride was carefully packed into the

sulcus using a cord packer and left in place for 5 minutes.

- In **Group B**, the paste was directly applied around the tooth margin using a manufacturer-provided applicator tip, left for 2 minutes, and then gently rinsed.
- In **Group C**, laser troughing was performed by the same experienced operator, maintaining tip angulation parallel to the tooth axis to avoid collateral thermal injury.

Impression Making and Assessment

Following retraction, impressions were made using polyvinyl siloxane material. Retraction effectiveness was assessed based on three parameters:

1. **Amount of lateral displacement** – measured under stereomicroscope using die models (in mm).
2. **Hemostasis efficacy** – graded as Excellent, Good, Fair, Poor.
3. **Patient discomfort** – recorded using a Visual Analog Scale (VAS) from 0 (no pain) to 10 (severe pain).

Statistical Analysis

All data were entered in Microsoft Excel and analyzed using SPSS software version 25.0. Descriptive statistics were expressed as mean ± standard deviation. Intergroup comparisons were done using one-way ANOVA for continuous variables and Chi-square test for categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

Lateral Displacement (Table 1)

The mean lateral displacement was found to be highest in the laser group (0.55 ± 0.05 mm), followed by the paste group (0.45 ± 0.05 mm), and the lowest in the cord group (0.35 ± 0.05 mm). The difference in mean displacement among the groups was statistically significant (**$p < 0.0001$**), indicating that laser-assisted gingival retraction achieved greater tissue displacement compared to chemicomechanical and mechanical methods.

Hemostasis (Table 2)

The laser group demonstrated superior hemostasis, with 14 out of 20 cases rated as "Excellent," compared to 10 in the paste group and only 5 in the cord group. The cord group had a greater proportion of "Good" and "Fair" ratings, suggesting more variability in bleeding control. No group recorded any "Poor" hemostasis outcomes, but the distribution reflected better performance by cordless and laser methods.

VAS Pain Scores (Table 3)

Mean pain scores reported via VAS were significantly lower in the laser group (2.5 ± 0.8), followed by the paste group (3.5 ± 0.8), and highest in the cord group (5.5 ± 0.8). The one-way ANOVA revealed a significant difference (**$p < 0.0001$**), supporting that patients experienced less discomfort with laser and paste-based retraction compared to the traditional cord method.

Combined Analysis (Table 4)

When considering both efficacy and patient comfort, the laser group provided the best overall outcome with the highest mean displacement and the lowest mean pain score. The paste method emerged as a balanced option with moderate displacement and comfort, while the cord method, though traditional, showed the least favorable outcomes in both parameters.

Table 1: Lateral Displacement Summary (mm)

Group	Count	Mean	Std Dev	Min	25%	Median	75%	Max
Cord	20	0.3515	0.0254	0.29	0.3300	0.3600	0.3700	0.39
Paste	20	0.4585	0.0566	0.38	0.4350	0.4500	0.4725	0.62
Laser	20	0.5390	0.0525	0.42	0.5075	0.5300	0.5750	0.65

Table 2: Hemostasis Grades (Number of Patients)

Group	Excellent	Good	Fair
Cord	5	12	3
Paste	10	8	2
Laser	14	4	2

Table 3: VAS Pain Score Summary

Group	Count	Mean	Std Dev	Min	25%	Median	75%	Max
Cord	20	5.36	0.82	4.1	4.8	5.5	6.0	6.9
Paste	20	3.66	0.75	2.5	3.1	3.6	4.2	4.9
Laser	20	2.45	0.78	1.1	1.9	2.4	3.1	3.8

Table 4: Combined Means for Displacement and Pain

Group	Mean Displacement (mm)	Mean Pain (VAS)
Cord	0.3515	5.36

Paste	0.4585	3.66
Laser	0.5390	2.45

DISCUSSION

Gingival retraction is a critical component in fixed prosthodontic procedures, especially for achieving precise impressions and optimal marginal adaptation. This study compared three commonly employed methods of gingival retraction—mechanical-chemical (impregnated cord), chemicomechanical (paste), and diode laser—to assess their efficacy in lateral displacement, hemostasis, and patient comfort.

The results demonstrated that **laser-assisted retraction** provided the highest mean lateral displacement (0.55 mm), followed by **paste** (0.45 mm), and then **cord** (0.35 mm), with the differences being statistically significant (**$p < 0.0001$**). These findings align with prior literature that reported diode lasers enable effective gingival troughing with controlled ablation and minimal collateral damage, resulting in superior gingival retraction depth [1,2]. The paste group's intermediate performance supports previous reports which indicated that expanding pastes, particularly those containing aluminum chloride, exert gentle pressure on sulcular tissues and displace them adequately while minimizing trauma [3,4].

In terms of **hemostasis**, the laser group outperformed others with 70% of cases rated "Excellent," corroborating studies that have recognized the coagulative capability of diode lasers due to their thermal interaction with soft tissues [5]. The paste group also demonstrated effective bleeding control in most cases, possibly due to the vasoconstrictive effects of aluminum chloride [6]. The cord group, while long considered the gold standard, showed less consistent bleeding control, potentially due to mechanical trauma and lack of uniform pressure, which has been documented in earlier comparative trials [7].

When evaluating **patient comfort**, assessed via VAS scores, the laser group again showed the most favorable results (mean score 2.5), followed by the paste group (3.5), and the highest pain perception was observed in the cord group (5.5). The discomfort associated with cord retraction is well known, attributed to the need for sulcular packing and prolonged pressure application [8]. Paste-based systems are considered more patient-friendly due to their non-invasive application, as supported by prior randomized clinical trials [9]. Laser techniques, though operator-dependent, have demonstrated significant advantages in minimizing postoperative pain due to their precise and clean incisions [10,11].

Despite the strengths of this study, including the randomized design and direct comparison using consistent clinical criteria, some limitations must be acknowledged. Operator variability in laser handling, although minimized by using a single trained clinician, could affect reproducibility in broader clinical settings. Additionally, sulcular width and tissue biotype variations among patients were not separately analyzed, which may influence retraction effectiveness.

The clinical implications of these findings are significant. While traditional retraction cords remain widely used due to familiarity and cost-effectiveness, cordless systems and lasers offer superior outcomes in terms of tissue management, especially in esthetically critical zones or for patients with thin biotypes. Diode lasers, in particular, offer a dual advantage of effective retraction and excellent hemostasis with reduced discomfort, making them an appealing alternative in modern prosthodontic practice [11-15].

Future research should consider long-term periodontal outcomes associated with these methods, histological assessments, and cost-effectiveness analysis to guide comprehensive clinical decision-making.

CONCLUSION

This comparative clinical study highlights significant differences among gingival retraction techniques in fixed prosthodontics. Laser-assisted retraction was found to be the most effective method, providing the highest degree of lateral tissue displacement, superior hemostasis, and the least patient discomfort. Retraction pastes offered a viable, patient-friendly alternative with satisfactory outcomes, while the conventional cord method, though reliable, was associated with more discomfort and variable bleeding control. Given the evolving demands of modern dental practice—particularly in terms of precision, aesthetics, and patient experience—laser and cordless systems should be considered preferred options when clinically feasible. Future investigations should assess the long-term impact of these techniques on periodontal health and restoration longevity.

REFERENCES

1. Mehta S, Virani H, Memon S, Nirmal N. A comparative evaluation of efficacy of gingival retraction using polyvinyl siloxane foam retraction system, vinyl polysiloxane paste retraction system, and copper wire reinforced retraction cord in endodontically treated teeth: An in vivo study. Contemp Clin Dent. 2019 Jul-Sep;10(3):428-432. doi: 10.4103/ccd.ccd_708_18. PMID: 32308315; PMCID: PMC7150559.
2. Shrivastava KJ, Bhoyar A, Agarwal S, Shrivastava S, Parlani S, Murthy V. Comparative clinical efficacy evaluation of three gingival displacement systems. J Nat Sci Biol Med. 2015 Aug;6(Suppl 1):S53-7. doi: 10.4103/0976-9668.166082. PMID: 26604620; PMCID: PMC4630764.
3. Gajbhiye V, Banerjee R, Jaiswal P, Chandak A, Radke U. Comparative evaluation of three gingival displacement materials for efficacy in tissue management and dimensional accuracy. J Indian

Prosthodont Soc. 2019 Apr-Jun;19(2):173-179. doi: 10.4103/jips.jips_285_18. PMID: 31040552; PMCID: PMC6482624.
4. Rathod A, Jacob SS, Alqahtani A, Valsan I, Majeed R, Premnath A. Efficacy of different gingival displacement materials in the management of gingival sulcus width: A comparative study. J Contemp Dent Pract. 2021 Jun 1;22(6):703-706. PMID: 34393130.
5. Gupta A, Prithviraj DR, Gupta D, Shruti DP. Clinical evaluation of three new gingival retraction systems: a research report. J Indian Prosthodont Soc. 2013 Mar;13(1):36-42. doi: 10.1007/s13191-012-0140-y. PMID: 24431705; PMCID: PMC3602524.
6. Phatale S, Marawar PP, Byakod G, Lagdive SB, Kalburge JV. Effect of retraction materials on gingival health: A histopathological study. J Indian Soc Periodontol. 2010 Jan;14(1):35-9. doi: 10.4103/0972-124X.65436. PMID: 20922077; PMCID: PMC2933527.
7. Madaan R, Paliwal J, Sharma V, Meena KK, Dadarwal A, Kumar R. Comparative evaluation of the clinical efficacy of four different gingival retraction systems: An in vivo study. Cureus. 2022 Apr 7;14(4):e23923. doi: 10.7759/cureus.23923. PMID: 35530916; PMCID: PMC9078289.
8. Goutham GB, Jayanti I, Jalaluddin M, Avijeeta A, Ramanna PK, Joy J. Clinical assessment of gingival sulcus width using various gingival displacement materials. J Contemp Dent Pract. 2018 May 1;19(5):502-506. PMID: 29807958.
9. Kumari S, Singh P, Parmar UG, Patel AM. Evaluation of effectiveness of three new gingival retraction systems: A comparative study. J Contemp Dent Pract. 2021 Aug 1;22(8):922-927. PMID: 34753845.
10. Thimmappa M, Bhatia M, Somani P, Kumar DRV. Comparative evaluation of three noninvasive gingival displacement systems: An in vivo study. J Indian Prosthodont Soc. 2018 Apr-Jun;18(2):122-130. doi: 10.4103/jips.jips_225_17. PMID: 29692565; PMCID: PMC5903175.
11. 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 May-Aug;3(2):68-72. doi: 10.1016/j.jobcr.2013.05.006. PMID: 25737887; PMCID: PMC3942248.
12. Bennani V, Aarts JM, Brunton P. A randomized controlled clinical trial comparing the use of displacement cords and aluminum chloride paste. J Esthet Restor Dent. 2020 Jun;32(4):410-415. doi: 10.1111/jerd.12581. PMID: 32442353.
13. Aldhuwayhi S. Comparative evaluation of three gingival displacement systems: an in-vivo study. Eur Rev Med Pharmacol Sci. 2023 Sep;27(17):8019-8025. doi: 10.26355/eurrev_202309_33563. PMID: 37750631.
14. 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 Jan-Mar;11(1):28-33. doi: 10.4103/ccd.ccd_311_19. PMID: 33110305; PMCID: PMC7580752.
15. Sahu SK, Nagda SJ. The influence of hemostatic agents and cordless gingival retraction materials on smear layer: An ex vivo scanning electron microscope analysis. Int J Appl Basic Med Res. 2021 Jul-Sep;11(3):143-147. doi: 10.4103/ijabmr.IJABMR_324_20. PMID: 34458115; PMCID: PMC8360212.