

Gingival Retraction in Fixed Partial Denture Prosthodontics: Contemporary Techniques, Materials, Biological Considerations and Digital Applications

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Abstract

Gingival retraction is an essential clinical procedure during the fabrication of fixed partial dentures when the preparation finish line is located close to or within the gingival sulcus. Adequate displacement of the marginal tissues permits visualization and recording of the cervical preparation, while control of blood and crevicular fluid is necessary for obtaining an accurate impression or digital scan. At the same time, excessive mechanical pressure, chemical irritation, or unnecessary removal of gingival tissue may produce inflammation, recession, discomfort, or alteration of the periodontal architecture. Various approaches have therefore been developed, including mechanical displacement with retraction cords, chemomechanical techniques using haemostatic agents, cordless pastes and expanding materials, electrosurgery, rotary curettage, and laser-assisted tissue management. More recently, gingival displacement has gained importance in digital dentistry because intraoral scanners also require direct visual access to the preparation margin and a relatively dry field. The available literature demonstrates that no single technique provides optimal displacement, haemostasis, patient comfort, and periodontal preservation in every clinical situation. Cord-based techniques generally provide substantial lateral and vertical displacement, whereas cordless systems may offer easier application and reduced tissue manipulation in selected cases. Recent clinical evidence has also explored laser-assisted troughing and gingival displacement specifically for digital impressions. The choice of technique should consequently be based on periodontal health, gingival phenotype, sulcular anatomy, preparation depth, required degree of displacement, haemostasis, patient comfort, and the impression modality. This narrative review discusses the biological principles, conventional and contemporary gingival retraction methods, their advantages and limitations, and their relevance to conventional and digital fixed prosthodontic procedures.

Keywords: Gingival retraction; gingival displacement; fixed partial denture; retraction cord; cordless retraction; haemostasis; laser; intraoral scanner; digital impression; periodontal health.

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I. Introduction

The accuracy of a fixed partial denture depends on several clinical and laboratory procedures, among which precise reproduction of the preparation finish line is particularly important. When the cervical margin is positioned near the gingival sulcus, the marginal tissue may partially cover the preparation and interfere with impression material or optical scanning. Blood, gingival crevicular fluid, and moisture can further compromise the recording of the preparation margin. Appropriate gingival management is therefore necessary before making the definitive impression or digital scan.[1,2]

Gingival retraction is commonly used to describe the temporary displacement of marginal gingiva away from the prepared tooth. The term gingival displacement is also used because the intended clinical objective is temporary lateral and/or vertical separation of the tissue rather than permanent apical migration of the gingival margin.[1,2] The procedure should ideally provide sufficient access to the finish line while producing minimal trauma and allowing the tissues to return to their preoperative condition.

The importance of atraumatic tissue management becomes particularly evident when subgingival margins are involved. Restoration margins placed within the gingival sulcus do not inevitably produce periodontal disease when periodontal health, plaque control, restoration contours, and maintenance are satisfactory. However, margins that encroach upon the supracrestal tissue attachment may be associated with inflammation and possible recession.[6] Consequently, gingival retraction should not be regarded merely as an impression-making step; it is also a periodontal procedure that must be performed with biological considerations in mind.

Several methods have been introduced for gingival displacement. Traditional techniques involve retraction cords, either alone or combined with haemostatic agents. Cordless systems include injectable pastes, gels and expanding materials. Surgical techniques such as rotary curettage, electrosurgery and laser troughing remove a limited amount of tissue to expose the preparation margin. Although these approaches share the objective

of creating access, they differ in their mechanisms, degree of tissue manipulation, haemostatic ability, ease of use, patient comfort and potential for postoperative tissue changes.[1-5]

The transition from conventional elastomeric impressions to intraoral scanning has introduced another dimension to gingival management. Digital scanning does not require impression material to enter the sulcus, but it still depends on optical access to the finish line. Therefore, digital workflows have not eliminated the need for gingival displacement; rather, they have changed the way the adequacy of displacement is assessed.[19]

This narrative review discusses the biological requirements of gingival retraction, conventional and contemporary displacement methods, haemostatic agents, surgical techniques, periodontal effects and the application of gingival management during digital impression procedures.

II. Literature Review Method

This narrative review was developed using foundational publications on gingival displacement together with comparative clinical studies, systematic reviews, randomized clinical trials and recent literature concerning digital impressions and laser-assisted tissue management. The literature was considered according to four major themes: biological principles, mechanical and chemomechanical displacement, surgical and laser techniques, and gingival management during digital impression procedures.

Particular attention was given to comparative clinical evidence evaluating gingival displacement, haemostasis, patient comfort, gingival inflammation, gingival recession and compatibility with digital scanning. The literature includes both historical studies that established the principles of gingival displacement and recent clinical investigations evaluating contemporary materials and digital workflows.

Because this is a narrative review rather than a systematic review, the available evidence was interpreted thematically rather than subjected to formal quantitative synthesis or meta-analysis.

Biological Principles of Gingival Retraction

Periodontal health before retraction

Healthy gingival tissues provide a more predictable environment for tissue displacement and impression making. Inflammation can increase bleeding and crevicular fluid and may make the gingival margin more susceptible to mechanical injury. Consequently, plaque control, gingival inflammation, bleeding on probing, existing recession, tissue thickness and the relationship between the restoration margin and the periodontal tissues should be assessed before definitive impression making.[1,2]

The condition of the provisional restoration is also relevant. Overextended or poorly contoured provisional restorations can contribute to gingival inflammation and bleeding, making subsequent tissue management more difficult. When persistent bleeding is encountered during retraction, repeated packing should not automatically be regarded as the solution; the underlying cause should first be determined.

Supracrestal tissue attachment

The periodontal tissues surrounding the cervical aspect of a tooth have biological dimensions that should be respected during restorative treatment. Placement of restoration margins within the junctional epithelium or supracrestal connective tissue attachment has been associated with inflammatory changes and potential periodontal complications.[6]

Therefore, gingival retraction cannot compensate for an incorrectly positioned preparation margin. When a margin is excessively deep or violates periodontal biological requirements, modifying the retraction technique alone does not resolve the underlying problem.

Required tissue displacement

For conventional impression procedures, approximately 0.2 mm of lateral sulcular space has historically been described as a useful reference for allowing impression material to enter the sulcus and reproduce the finish line.[1,2,5] However, this value should not be interpreted as an absolute requirement for every clinical situation.

The amount of displacement required depends on the impression material, viscosity, sulcular anatomy, margin depth and technique used. Excessive displacement is undesirable when it produces unnecessary pressure on the marginal tissues without providing additional diagnostic or restorative benefit.

Classification of Gingival Retraction Techniques

Gingival retraction techniques can broadly be classified as:

1. **Mechanical techniques**
 - Retraction cord
 - Double-cord technique
 - Mechanical matrices and other isolation aids

2. **Chemomechanical techniques**
 - Retraction cord with astringents
 - Retraction cord with haemostatic agents
3. **Cordless techniques**
 - Retraction pastes
 - Gels
 - Expanding silicone materials
 - Compression-assisted systems
4. **Surgical techniques**
 - Rotary curettage
 - Electrosurgery
 - Laser troughing
5. **Combined techniques**
 - Cord plus astringent
 - Cord plus paste
 - Surgical troughing followed by chemical haemostasis

The selection of a technique should be based on the required degree of tissue displacement and the biological characteristics of the site rather than on the assumption that one technique is universally superior.[1-5]

Mechanical Gingival Retraction

Retraction cord

Retraction cord remains one of the most established techniques in fixed prosthodontics. It produces mechanical separation between the gingival margin and the prepared tooth while also providing an absorbent pathway for crevicular fluid.[1,2]

Cords may differ in their structure and handling characteristics. Twisted, braided and knitted configurations are available, and they may be supplied untreated or impregnated with haemostatic agents.

The effectiveness of a cord depends not only on its material but also on its diameter, placement depth, packing force, sulcular anatomy, moisture control and duration of placement.

Mechanical pressure should be sufficient to create access but should not injure the epithelial attachment. Historical investigations have demonstrated that mechanical and chemical aspects of retraction can influence the gingival tissues, supporting the principle that tissue displacement should be performed conservatively.[16,17]

Single-cord technique

The single-cord technique involves placing one cord into the gingival sulcus around the prepared tooth. It is generally suitable when relatively limited displacement and fluid control are required.

The cord is commonly removed immediately before impression making or scanning. The operator should ensure that the cord is positioned sufficiently apically to expose the finish line without unnecessarily traumatizing the attachment.

Double-cord technique

The double-cord technique uses two cords of different dimensions. A smaller cord is placed deeper in the sulcus, followed by a larger superficial cord that produces greater lateral displacement. The superficial cord is removed immediately before impression making.

This technique can be useful when greater displacement and haemostasis are required, particularly around deeper margins. However, the technique requires adequate sulcular space and should not be forced into a shallow or delicate sulcus.[1,2]

Kuhn et al. compared double-cord retraction with an astringent paste under conditions of mild gingivitis. Horizontal displacement was broadly comparable between the techniques, whereas cord produced somewhat greater vertical displacement. The study also included longer-term observation of soft-tissue changes, emphasizing that displacement effectiveness should be considered together with tissue response.[9]

Chemomechanical Gingival Retraction

The combination of mechanical cord placement with chemical agents provides both tissue displacement and haemostasis. Commonly used agents include aluminium chloride and ferric sulphate, while epinephrine has historically been used because of its vasoconstrictor properties.[8]

Aluminium chloride

Aluminium chloride is frequently incorporated into retraction solutions, gels and pastes. Its principal clinical role is control of sulcular fluid and minor bleeding while the mechanical component provides tissue displacement.

Its clinical effect depends on concentration, formulation and duration of contact. Consequently, the behaviour of one commercial product should not automatically be extrapolated to all aluminium chloride-containing materials.

Ferric sulphate

Ferric sulphate is an effective haemostatic agent and can be useful when bleeding interferes with impression making. However, its interaction with blood and tissue fluids may produce coagulated residues that should be thoroughly removed before impression making or digital scanning.

Epinephrine

Epinephrine-containing retraction cords have historically been used because of their vasoconstrictive action. However, systemic absorption is an important consideration, particularly when multiple teeth are treated or when tissue injury increases vascular exposure.[8]

The historical literature demonstrated that gingival retraction agents can have systemic as well as local effects. Bowles et al. evaluated several vasoconstrictive agents and reported differences in tissue displacement and cardiovascular responses in an animal model.[14] Therefore, contemporary practice generally emphasizes careful patient assessment and the use of alternative haemostatic agents when appropriate.

Biological Effects of Retraction Materials

Gingival retraction is inherently associated with some degree of tissue manipulation. The clinical objective is therefore not to eliminate all tissue changes but to minimize unnecessary trauma while obtaining sufficient access.

Historical studies demonstrated that retraction materials can influence the sulcular epithelium.[16] Loe and Silness also investigated tissue reactions associated with string packing during fixed restorative procedures.[17] These early investigations remain important because they established the biological basis for the current emphasis on atraumatic displacement.

De Gennaro et al. compared gingival inflammatory responses associated with different medicaments used with retraction cords. Their findings suggested that inflammatory response was influenced not only by the chemical agent but also by individual biological factors.[15]

Modern clinical evidence supports the concept that tissue manipulation should be temporary and controlled. Al Hamad et al. compared conventional cord, an expanding polyvinyl siloxane material and a paste-based system in 60 subjects. Temporary gingival inflammation occurred with all tested approaches, while bleeding was associated particularly with the conventional cord group.[13]

These findings demonstrate that the absence of a cord does not necessarily mean the absence of tissue response. Cordless systems may reduce mechanical trauma in selected situations, but the pressure generated by the material, chemical composition and duration of application must also be considered.

Cordless Gingival Retraction Systems

Cordless systems were developed to simplify gingival displacement and reduce the mechanical manipulation associated with cord packing. They include pastes, gels and expanding silicone materials.

Retraction pastes

Retraction pastes are introduced into the sulcus using a syringe or applicator tip. Some contain astringent agents, while others depend primarily on mechanical expansion and compression.

Their main clinical advantages include:

- relatively simple application;
- reduced need for cord packing;
- potentially improved patient comfort;
- useful haemostatic action in some formulations; and
- compatibility with selected digital scanning procedures.

However, the degree of displacement may vary according to the depth of the sulcus and the physical characteristics of the material.

Huang et al. reviewed clinical studies comparing cord and cordless systems and found considerable variation in displacement outcomes. Their review indicated that cords could provide greater displacement in some subgingival situations, whereas paste systems were frequently associated with greater comfort and easier handling.[3]

Tabassum et al. similarly found considerable heterogeneity among clinical studies and did not identify a single method that was consistently superior across all outcomes.[4]

Expanding Silicone Materials

Expanding silicone materials are another form of cordless displacement. After application, the material expands within the sulcus and produces tissue separation. Some systems are used together with a compression cap that assists lateral tissue displacement.

Compared with conventional cord packing, these materials may reduce direct instrumentation of the sulcus. However, their effectiveness depends on the sulcular anatomy and the ability of the material to remain positioned around the preparation.

The clinical study by Al Hamad et al. demonstrated that cordless materials can produce gingival changes comparable to conventional cord techniques while reducing bleeding during the procedure.[13]

Comparative Evidence: Cord Versus Cordless Techniques

The comparative literature does not demonstrate a universal superiority of either cord or cordless techniques.

Huang et al. analyzed seven clinical studies and reported heterogeneous findings concerning haemostasis and sulcular displacement. Cordless systems were generally associated with improved patient comfort, while cord techniques demonstrated advantages in some situations involving deeper or subgingival margins.[3]

Tabassum et al. included ten studies involving 400 teeth and similarly reported heterogeneous results. No method showed consistent superiority with respect to gingival displacement or clinical periodontal parameters.[4]

Martins et al. subsequently conducted a systematic review and meta-analysis involving nine studies. The analysis generally showed greater gingival displacement with conventional cord techniques compared with cordless methods, although considerable methodological heterogeneity was present.[5]

A later randomized clinical study by Kuhn et al. found broadly comparable horizontal displacement between an astringent paste and double-cord technique under mild gingivitis conditions, although vertical displacement tended to favour the cord technique.[9]

These differences demonstrate that the result of gingival displacement is influenced by several factors beyond the material itself, including margin depth, gingival anatomy, periodontal condition, operator technique and measurement method.

Recent Evidence on Contemporary Gingival Displacement Materials

A multicentre randomized clinical trial by Desclos-Theveniau et al. compared Racegel used alone, Racegel combined with cord, and Racestypine combined with cord. The study demonstrated differences in horizontal displacement among the techniques, while vertical displacement did not show the same degree of differentiation.[10]

The findings are clinically relevant because they indicate that the performance of a cordless product cannot necessarily be predicted from the behaviour of a cord-assisted technique using the same basic material.

Recent research therefore supports a product-specific approach. The term “cordless” describes the absence of a cord but does not define a single material or mechanism. Pastes, expanding silicones and other injectable materials can behave differently.

Surgical Gingival Retraction

Surgical retraction differs fundamentally from mechanical displacement because tissue is physically removed to create access to the preparation margin.

The principal surgical techniques include:

- rotary curettage;
- electrosurgery; and
- laser-assisted gingival troughing.

These methods may be useful when excess tissue interferes with margin access, particularly when the gingival architecture is favourable and an appropriate biological indication exists.

However, surgical methods are irreversible compared with temporary mechanical displacement. Excessive tissue removal may result in gingival recession, alteration of gingival contour or injury to adjacent periodontal structures. Therefore, surgical retraction should not be selected simply because it produces rapid exposure. The anticipated biological and aesthetic consequences must also be considered.

Laser-Assisted Gingival Retraction

Dental lasers have emerged as an alternative method for soft-tissue management around prepared teeth. Laser troughing can simultaneously provide tissue removal and haemostasis, potentially reducing the need for mechanical packing.

Sorrentino et al. reviewed the use of lasers for gingival retraction in fixed prosthodontics and described their potential advantages in haemostasis and postoperative patient comfort.[18] Nevertheless, the authors emphasized the need for additional clinical research concerning laser parameters, tissue effects and comparison with established techniques.

Diwan et al. conducted a prospective split-mouth clinical study comparing impregnated retraction cord and laser treatment for subgingival margins. The investigation evaluated gingival attachment level and pain perception, providing clinical evidence from an Indian patient population.[11]

More recently, Tamim et al. performed a systematic review of laser-assisted gingival troughing. Nine in-vivo studies were included. The review reported favourable displacement and haemostatic outcomes with laser techniques, but also emphasized the need to interpret these findings in the context of variation in laser systems and clinical protocols.[20]

Laser treatment should therefore be viewed as a technique with specific indications rather than as a universal replacement for conventional retraction.

Gingival Retraction for Digital Impressions

The introduction of intraoral scanners has changed the impression-making process but has not eliminated the requirement for gingival displacement.

With conventional impressions, the clinician must create sufficient sulcular space for impression material to enter and record the finish line. During digital scanning, the scanner instead requires direct optical access to the cervical preparation.

Consequently, blood, saliva, crevicular fluid or overlying gingival tissue can interfere with scanning even when no impression material is required.

The traditional 0.2-mm displacement benchmark was developed in relation to conventional impression materials. It should therefore not automatically be regarded as a universal minimum value for digital scanning.[1,2,5]

The clinically relevant endpoint in digital dentistry is whether the entire finish line is visible and continuously captured in the scan.

Conventional Versus Cordless Retraction for Intraoral Scanning

Gupta et al. evaluated conventional and cordless displacement techniques specifically in relation to intraoral scanning. The clinical study included 20 participants and assessed immediate horizontal displacement together with plaque and bleeding indices. The authors reported less gingival trauma with the cordless material and considered it compatible with intraoral scanning.[19]

These findings support the concept that the optimal displacement technique for a digital workflow may not necessarily be identical to the technique preferred for conventional impression making.

El Ashry et al. conducted a randomized clinical trial involving 32 participants undergoing maxillary premolar crown preparation. Four approaches were compared: impregnated retraction cord with astringent, an astringent cordless paste, a cordless expanding material without astringent, and diode laser troughing. The cord group produced the greatest horizontal and vertical displacement, while the investigators also observed greater gingival height loss after one month in this group.[12]

The study illustrates an important clinical principle: maximum displacement and maximum biological preservation are not necessarily equivalent outcomes.

Factors Influencing Selection of a Retraction Technique

The choice of gingival retraction method should consider several clinical factors.

1. Periodontal condition

Inflamed tissues bleed more readily and are more susceptible to injury. Periodontal stabilization should therefore precede definitive impression making whenever possible.[1,2]

2. Gingival phenotype

Thin gingival tissues are generally less tolerant of aggressive manipulation, particularly in aesthetically visible areas.

3. Sulcular depth

A shallow sulcus may not accommodate a double-cord technique safely. In such situations, a carefully selected paste or single-cord technique may be more appropriate.

4. Margin position

Supragingival margins may require only isolation and fluid control. Deeper but biologically acceptable margins generally require greater tissue displacement.

5. Haemostasis

When bleeding is the primary obstacle, an appropriate astringent or haemostatic technique may be required in addition to mechanical displacement.

6. Impression modality

The requirements for conventional elastomeric impressions differ from those of intraoral scanning. The digital workflow places particular importance on visual accessibility of the preparation margin.

7. Patient comfort

Pain and sensitivity are relevant clinical outcomes and may influence acceptance of repeated or extensive retraction procedures.

8. Operator experience

Technique-sensitive procedures such as cord packing, laser troughing and management of deep subgingival margins require appropriate training and clinical judgment.

Gingival Retraction in Multiple-Abutment Fixed Partial Dentures

Management becomes more challenging when several teeth are prepared for a fixed partial denture.

Each abutment must be adequately exposed while maintaining control over moisture and tissue rebound. If one preparation is retracted significantly earlier than another, the displaced tissue may begin to return toward its original position before the impression or scan is completed.

Interproximal areas require particular attention because gingival tissue may be simultaneously influenced by adjacent preparations. Excessive pressure in these regions can distort or injure the papilla.

For conventional impressions, the clinician should coordinate cord removal and impression loading so that all prepared margins are adequately exposed at the time of recording. For digital workflows, scanning should proceed promptly after adequate exposure and haemostasis have been achieved.

Common Clinical Errors

Several errors can reduce the effectiveness of gingival retraction:

1. Performing retraction in the presence of uncontrolled gingival inflammation.
2. Using a cord diameter that is excessive for the sulcus.
3. Packing the cord with excessive pressure.
4. Leaving the cord in position longer than required.
5. Removing a dry cord forcefully.
6. Depending solely on haemostasis without achieving lateral displacement.
7. Assuming that every cordless paste produces the same degree of displacement.
8. Using surgical techniques without adequate periodontal assessment.
9. Scanning before bleeding or crevicular fluid is adequately controlled.
10. Accepting an apparently complete digital scan without checking the continuity of the finish line.

These errors emphasize that the success of gingival retraction depends on both material selection and clinical execution.

III. Discussion

The literature demonstrates that gingival retraction should be viewed as a balance between access and tissue preservation rather than as a competition between individual materials.

Traditional cord techniques remain clinically important because they provide predictable mechanical displacement and can be combined with haemostatic agents. Their major limitation is the possibility of tissue trauma when excessive pressure is applied or when the cord is placed too deeply.

Cordless systems were developed partly to address these concerns. They may be easier to apply and more comfortable for patients, and several studies have demonstrated useful haemostatic effects. However, their displacement capacity can be less predictable in situations requiring substantial lateral or vertical tissue separation.[3-5]

The evidence also demonstrates why direct comparison between studies can be difficult. Investigations have used different sulcular sites, margin depths, materials, measurement techniques, clinical conditions and follow-up periods. Some studies measure horizontal displacement, whereas others assess vertical displacement, gingival height, inflammation, bleeding or patient discomfort. Consequently, a technique that performs favourably according to one outcome may not demonstrate the same advantage according to another.

The recent literature has increasingly incorporated digital workflows. This is clinically relevant because intraoral scanners require unobstructed visualization of the preparation margin. Digital technology therefore changes the method of recording the margin but does not remove the biological requirement for appropriate tissue management.[19]

The 2025 randomized trial by El Ashry et al. is particularly relevant because it simultaneously evaluated displacement during digital impressions and subsequent gingival height changes. The greater displacement produced by the cord technique was accompanied by greater gingival height loss at one month.[12] Such findings illustrate why the ideal clinical endpoint should not simply be maximum displacement.

Laser-assisted techniques represent another developing area. Current evidence suggests that lasers can provide effective tissue troughing and haemostasis, with potentially favourable patient-related outcomes.[18,20]

Nevertheless, differences in laser type, wavelength, power settings and operator technique make broad generalization difficult.

Another important consideration is that many clinical studies are conducted on isolated teeth or specific tooth surfaces. The clinical situation of a multi-unit fixed partial denture can be more complex because several margins must be recorded simultaneously. Future investigations should therefore assess multiple prepared abutments and clinically relevant outcomes such as complete margin capture, repeat scanning, tissue recovery, postoperative recession and long-term periodontal stability.

Further research should also investigate digital-specific outcomes. Rather than simply measuring the amount of gingival displacement, studies should determine whether the technique improves scan completeness, reduces stitching errors, improves margin identification and contributes to clinically acceptable definitive restorations.

Evidence Gaps and Future Directions

Several limitations remain within the current literature.

First, there is substantial heterogeneity in the measurement of gingival displacement. Some studies evaluate sectioned casts, while others use conventional impressions, digital images or intraoral scans. These approaches do not necessarily measure identical clinical outcomes.

Second, follow-up periods are often short. Immediate displacement and postoperative gingival response provide valuable information but cannot completely predict long-term periodontal stability.

Third, gingival phenotype and margin depth are not consistently stratified. A technique that performs well in a thick periodontal phenotype may not provide the same biological response in a thin phenotype.

Fourth, digital impression studies are still relatively limited compared with conventional impression research. More randomized clinical trials are required to determine whether particular displacement systems consistently improve digital margin capture.

Finally, there is a need to distinguish surrogate outcomes from clinically meaningful restorative outcomes. Greater sulcular width does not necessarily translate into better marginal adaptation, improved prosthesis longevity or improved periodontal health.

Future investigations should therefore incorporate standardized definitions, reproducible measurement methods, patient-reported outcomes, periodontal parameters and longer follow-up periods.

Clinical Implications

Based on the available evidence, the following clinical principles can be proposed:

- Gingival health should be optimized before definitive impression making.
- Retraction should be performed only to the extent required for accurate margin recording.
- The smallest effective cord should be selected according to sulcular anatomy.
- Excessive packing pressure should be avoided.
- Astringents should be selected according to the clinical requirement for haemostasis.
- Epinephrine-containing materials should be used cautiously and selectively.
- Cordless materials can be considered when limited displacement and reduced mechanical manipulation are desirable.
- Deeper subgingival margins may require cord-based displacement or another technique capable of producing greater tissue separation.
- Surgical and laser methods should be selected only when their biological indications are appropriate.
- For digital impressions, the critical endpoint is clear and continuous visualization of the entire preparation margin.
- The quality of the impression or scan should be assessed together with the postoperative periodontal response.

IV. Conclusion

Gingival retraction remains an important component of fixed partial denture treatment whenever the preparation margin is positioned close to or within the gingival sulcus. The procedure must provide adequate access and haemostasis while minimizing injury to the marginal tissues.

Retraction cords continue to provide substantial and predictable mechanical displacement, particularly when deeper margins require significant tissue separation. Cordless pastes and expanding materials provide alternative approaches that may improve handling and patient comfort in selected situations. Surgical and laser-assisted techniques can provide effective tissue removal and haemostasis but require careful biological and technical control.

Current evidence does not support the universal replacement of one retraction technique by another. Instead, technique selection should be individualized according to periodontal health, gingival phenotype, sulcular anatomy, margin depth, haemostatic requirements, patient comfort and the method used to record the preparation.

The development of digital impression systems has not eliminated the need for gingival management. Rather, it has shifted the objective toward obtaining direct optical access to the preparation margin. Future research should therefore focus on standardized digital outcomes, multi-abutment fixed partial denture situations, long-term periodontal response and clinically meaningful restorative outcomes.

Ultimately, successful gingival retraction should be defined not by the greatest amount of tissue displacement, but by achieving sufficient and reproducible margin exposure with the least biologically harmful intervention.

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