2026; 2-4(2026) | pp.166-177

**Health and Medical Research Advances**

E-ISSN: 3121-9411 |P-ISSN: 3121-942X

Volume 2, Issue 4 | October-Dever mber, 2026
(An Academians Publishers of Research & Academic Resources)

Review Article

# Interaction Between Dental Restorations and Periodontal Health: A Review Study

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**Abstract:** Restorative dental treatments are essential for restoring lost tooth structure, masticatory function, and dental aesthetics. However, treatment success depends not only on the quality of the restoration but also on the maintenance of periodontal health. The interaction between dental restorations and the periodontium, particularly at the gingival and interproximal margins, may be influenced by restoration design and adaptation, margin location, surface characteristics, proximal contacts, and cleansability. Poorly designed or inadequately executed restorations, including excessive overhanging margins, inappropriate subgingival margins, inadequate proximal contacts, and rough surfaces, may promote plaque accumulation and impair oral hygiene, thereby increasing the risk of gingival inflammation and periodontal complications. Conversely, pre-existing periodontal conditions may negatively affect the prognosis and longevity of restorative therapy.

This review aimed to examine the interaction between dental restorations and periodontal health, identify the major factors influencing periodontal responses to restorative procedures, and highlight clinical considerations for preventing periodontal complications and improving the longevity of dental restorations. Relevant scientific literature was reviewed, with emphasis on restoration margin location, adaptation and contour, proximal contacts, surface characteristics, and factors associated with plaque accumulation and periodontal inflammation. The findings were synthesized and interpreted with emphasis on the relationship between restoration quality and periodontal health, as well as relevant clinical and preventive considerations.

***Keywords:*** *Dental restorations; periodontal health; periodontium; gingival inflammation; microbial plaque; restoration margins; periodontal diseases.*

## 1. Introduction

Periodontal health is a fundamental determinant of tooth preservation, masticatory function, and the long-term success of dental treatment. The periodontium comprises specialized tissues, including the gingiva, periodontal ligament, root cementum, and alveolar bone, which collectively provide the teeth with support, attachment, and stability. Because restorative procedures are performed in close anatomical proximity to periodontal tissues, the design, fabrication, adaptation, and location of dental restorations may directly influence periodontal health. Accordingly, the relationship between restorative dentistry and periodontology should be considered an interdependent biological and clinical relationship rather than two separate treatment domains (Sharma et al., 2024; Gargiulo et al., 1961; Feng et al., 2006).

The primary aims of restorative dentistry are to restore lost dental structures and re-establish appropriate tooth form, function, and aesthetics. However, the success of a restoration cannot be determined solely by its mechanical performance or aesthetic outcome. A properly designed restoration should also be biologically compatible with the surrounding periodontal tissues and permit effective plaque control and oral hygiene. Defective margins, inadequate adaptation, and inappropriate restoration contours may facilitate plaque accumulation and contribute to gingival inflammation and other periodontal complications. Clinical evidence has demonstrated an association between marginal discrepancies and adverse periodontal parameters, particularly around subgingival restorations (Felton et al., 1991; Orkin et al., 1987; Harish et al., 2015).

Several interrelated factors influence the periodontal response to dental restorations. These include the location of the restorative margin, marginal adaptation, restoration contour, surface characteristics, the presence of restorative overhangs, proximal contact relationships, and accessibility of restored surfaces for plaque control. Excessive contours, defective margins, and overhangs

Received: 18 August 2026 | Revised: 22 September 2026 | Accepted: 08 October 2026 | Published: 15 October 2026
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may create plaque-retentive areas and make oral hygiene more difficult, which may contribute to localized gingival inflammation. The biological effects of these factors are also influenced by the patient's pre-existing periodontal condition and ability to maintain adequate plaque control (Felton et al., 1991; Valderhaug et al., 1993; Harish et al., 2015; Aishwarya & Sivaram, 2015).

The location of restorative margins is of particular clinical relevance. Supragingival margins are generally more accessible for plaque control and professional maintenance and are therefore preferable whenever clinical circumstances permit. In contrast, subgingival margins may complicate plaque removal and periodontal maintenance. Orkin et al. (1987) reported greater gingival bleeding and recession associated with subgingival crown margins than with supragingival margins, supporting a clinical preference for supragingival margins whenever feasible. The biological implications become particularly important when a restorative margin approaches or encroaches upon the supracrestal tissue attachment, historically referred to as the "biologic width." The dimensions and organization of this tissue attachment were established histologically by Gargiulo et al. (1961), while subsequent studies have emphasized its importance in restorative and periodontal treatment planning (Gargiulo et al., 1961; Feng et al., 2006).

Restoration of proximal anatomy is another important consideration in maintaining periodontal health. Inadequate proximal contacts may contribute to food impaction and impair effective interdental cleaning, whereas excessive proximal contours and gingival overhangs may facilitate plaque retention and localized gingival inflammation. Appropriate restoration of proximal contacts, embrasures, and physiologic contours therefore contributes to maintaining a cleansable periodontal environment. Furthermore, the distance between the proximal contact point and the alveolar crest is an important determinant of the presence or absence of the interdental papilla, particularly in the anterior region (Tarnow et al., 1992; Aishwarya & Sivaram, 2015).

The periodontal response to restorative procedures is also strongly affected by the pre-existing condition of the periodontal tissues. Restorative therapy in the presence of uncontrolled gingival inflammation or periodontal disease may complicate periodontal management and compromise long-term tissue stability. Long-term clinical observations in patients treated with fixed dental bridges have demonstrated the importance of oral hygiene and periodontal conditions in maintaining restored dentitions (Valderhaug et al., 1993). Therefore, periodontal evaluation and control of local inflammatory factors should be incorporated into restorative treatment planning, especially when procedures involve the cervical or subgingival regions (Valderhaug et al., 1993; Aishwarya & Sivaram, 2015).

The relationship between restorative dentistry and periodontal health is bidirectional. Inadequate restorations may negatively affect the periodontium, whereas an inflamed or altered periodontal environment may compromise restorative procedures. Gingival inflammation, bleeding, tissue enlargement, and changes in periodontal architecture may interfere with moisture control, tissue management, restoration procedures, and accurate recording of restorative margins. Predictable long-term outcomes therefore require consideration of the remaining dental structure, restoration quality, and biological status of the supporting periodontal tissues (Aishwarya & Sivaram, 2015; Perakis et al., 2004; Galgali & Gontiya, 2011).

An integrated treatment approach is therefore essential to restorative care. During diagnosis, treatment planning, clinical execution, and maintenance, periodontal anatomy, restorative design, tooth preparation, margin placement, surface cleansability, and soft-tissue management should be considered together. Particular attention is required when restorative margins are placed subgingivally, because unnecessary encroachment upon the supracrestal tissue attachment or excessive manipulation of gingival tissues may increase the risk of periodontal complications (Gargiulo et al., 1961; Feng et al., 2006).

Several clinical procedures performed during restorative therapy may themselves affect periodontal tissues. These include rubber dam placement, tooth preparation, matrix placement, gingival retraction, impression procedures, electrosurgery, and other techniques used to obtain adequate access and isolation. The periodontal consequences of these procedures depend on the technique used, the intensity and duration of tissue manipulation, the initial periodontal condition, and operator proficiency. Evidence concerning gingival retraction and fixed prosthodontic procedures indicates that inappropriate tissue manipulation may result in temporary or more persistent periodontal changes under adverse circumstances (Laufer et al., 1996; Galgali & Gontiya, 2011; Phatale & Marawar, 2010; Wilhelmsen et al., 1976; Miao et al., 2021).

Despite advances in restorative materials, adhesive techniques, and clinical and digital workflows, biological compatibility between restorations and periodontal tissues remains a key factor in treatment success. Evaluation of restorative treatment should therefore extend beyond strength, aesthetics, and function to include marginal integrity, restoration contour, surface characteristics, cleansability, compatibility with periodontal health, and the patient's ability to maintain adequate oral hygiene. Failure to control these factors may increase the risk of gingival inflammation and periodontal complications, particularly when restorations are located in areas that are difficult to clean (Felton et al., 1991; Valderhaug et al., 1993; Harish et al., 2015; Aishwarya & Sivaram, 2015).

In this context, a comprehensive understanding of the interaction between dental restorations and periodontal health is essential for achieving predictable and

sustainable clinical outcomes. Examination of the available evidence may help clinicians identify biological and clinical factors influencing periodontal responses to restorative procedures and select approaches that minimize iatrogenic complications. Therefore, the present review aims to synthesize the available evidence concerning the interaction between dental restorations and periodontal health, with particular emphasis on restorative margin location, restoration design, soft-tissue management, impression procedures, and other clinical factors that may affect periodontal health and long-term treatment outcomes.

## 2. Methodology

### 2.1 Study Design

This study was conducted as a narrative literature review to assess the relationship between dental restorations and periodontal health. The review focused on the biological and clinical effects of restorative therapy on periodontal tissues and on factors that may alter periodontal responses to restorative procedures.

Particular emphasis was placed on the location of the restorative margin, supracrestal tissue attachment, marginal adaptation, restoration contour, proximal contacts, restorative overhangs, surface characteristics, plaque accumulation, tooth preparation, rubber dam isolation, impression techniques, and periodontal maintenance. The review also considered patient-related factors, including pre-existing periodontal disease, oral hygiene practices, plaque control, and gingival phenotype.

The review was designed to synthesize findings from clinical trials, experimental studies, systematic reviews, narrative reviews, and other relevant scientific literature and to interpret their clinical implications for restorative treatment planning and maintenance.

### 2.2 Literature Search Strategy

Structured literature searches were conducted to identify scientific publications relevant to the relationship between dental restorative therapy and periodontal health. Searches were performed using MEDLINE, Scopus, Web of Science, and Google Scholar.

The search strategy combined controlled vocabulary and free-text keywords related to restorative dentistry and periodontal health. The principal search terms included:

1. "dental restorations" AND "periodontal health"
2. "restorative dentistry" AND "periodontium"
3. "restorative margins" AND "gingival health"
4. "subgingival margins" AND "periodontal inflammation"
5. "supracrestal tissue attachment" AND "restorative dentistry"
6. "biologic width" AND "restorative margins"
7. "crown margins" AND "periodontal health"
8. "restoration overhang" AND "gingival inflammation"
9. "proximal contacts" AND "periodontal health"
10. "gingival retraction" AND "periodontal health"
11. "impression procedures" AND "periodontal tissues"
12. "restorative procedures" AND "periodontal tissues"

Additional relevant articles were identified through manual searches of the reference lists of key publications and review articles. The search focused mainly on literature addressing the biological response of periodontal tissues to restorative therapy and clinical factors influencing the long-term stability of teeth.

### 2.3 Study Selection

The identified literature was initially screened by title and abstract to determine its relevance to the objectives of the review. Publications considered potentially relevant were subsequently examined in greater detail. Articles were selected if they provided evidence regarding the biological response of periodontal tissues to restorative procedures or described clinical factors that may affect restoration-related periodontal health.

As this was a narrative review rather than a systematic review with quantitative meta-analysis, study selection was based primarily on relevance to the clinical topics and objectives of the review.

### 2.4 Ethical Considerations

As this study involved only the review and synthesis of previously published scientific literature and did not involve direct recruitment, examination, intervention, or collection of identifiable information from human participants, institutional ethical approval was not required.

## 3. Physiological Dimensions of the Periodontium and Biologic Width

An understanding of the anatomical and physiological characteristics of the periodontal tissues is fundamental to successful restorative and prosthodontic treatment. One of the most important concepts in this context is the biologic width, traditionally referring to the dimension of the soft-tissue attachment located coronal to the alveolar bone crest. In contemporary periodontal literature, the term supracrestal tissue attachment (STA) has increasingly been adopted because this region represents an organized soft-tissue complex rather than a fixed dimensional "width" (Cohen, 1962; Gargiulo et al., 1961; Feng et al., 2006).

The term biologic width was introduced by Cohen (1962) to describe the dimensions of the connective tissue and epithelial attachment located coronal to the alveolar bone crest, based on the histological observations of Gargiulo

et al. (1961). Gargiulo et al. (1961) reported mean dimensions of approximately 0.69 mm for the gingival sulcus, 0.97 mm for the epithelial attachment, and 1.07 mm for the connective tissue attachment. The combined epithelial and connective tissue attachments were therefore approximately 2.04 mm, which became widely recognized as the classical biologic width (Gargiulo et al., 1961).

However, these values should not be considered universal or invariant dimensions applicable to all individuals and all regions of the oral cavity. The dimensions of the dentogingival complex may vary according to anatomical characteristics, tooth position, periodontal phenotype, tooth surface, and local clinical conditions. Differences may also exist between facial and interproximal surfaces because of variations in alveolar bone crest morphology and interdental soft-tissue architecture (Gargiulo et al., 1961; Feng et al., 2006).

The height and morphology of the interdental papilla are likewise influenced by the relationship between adjacent teeth and the position of the alveolar crest. Appropriate proximal contact and a favorable relationship between the contact point and alveolar crest are important for maintaining the natural interdental papilla. These anatomical characteristics are particularly relevant to restorative and prosthodontic treatment because reconstruction of proximal contours and contact surfaces should be compatible with the surrounding soft and hard tissues (Tarnow et al., 1992).

Tarnow et al. (1992) demonstrated that the distance between the contact point of adjacent teeth and the alveolar bone crest is an important determinant of the presence or absence of the interdental papilla. When this distance was 5 mm or less, complete filling of the interproximal space by the papilla was observed in most sites, whereas increasing distances were associated with a progressively lower probability of complete papillary fill. These findings have implications for proximal restoration design because contact location, proximal contour, and emergence profile may influence interdental soft-tissue architecture.

The dentogingival junction is an organized complex of interconnected tissue structures that helps create a protective interface between the oral environment and deeper periodontal tissues. It includes the gingival sulcus, junctional epithelium, basement membrane, and gingival connective tissue attached to the tooth surface. Attachment of the junctional epithelium to the tooth surface is mediated by specialized structures, including hemidesmosomes and the internal basal lamina (Gargiulo et al., 1961; Feng et al., 2006).

The junctional epithelium differs structurally and functionally from other gingival epithelium and plays an important role in maintaining the epithelial interface around the tooth. The gingival sulcus is adjacent to this region, and its environment is influenced by microbial composition, gingival crevicular fluid, and oral hygiene. Maintaining the integrity of the dentogingival complex is important for periodontal homeostasis and for limiting inflammatory challenges to the underlying tissues (Gargiulo et al., 1961; Feng et al., 2006).

Because the epithelial and connective tissue components of the dentogingival complex are located close to the alveolar bone crest, encroachment of a restorative margin into the supracrestal tissue attachment may be associated with inflammation and periodontal tissue alterations. Excessive apical extension of a restorative margin may increase the risk of localized inflammation, bleeding, discomfort, changes in the gingival margin, and, in some clinical situations, remodeling or loss of periodontal supporting tissues (Felton et al., 1991; Harish et al., 2015; Aishwarya & Sivaram, 2015; Feng et al., 2006). Respecting the anatomical relationship between the restorative margin and the supracrestal tissue attachment should therefore be considered an important principle in restorative treatment planning.

From a clinical perspective, disruption or injury to periodontal attachment tissues may occur through several restorative procedures or design-related factors. Important considerations include:

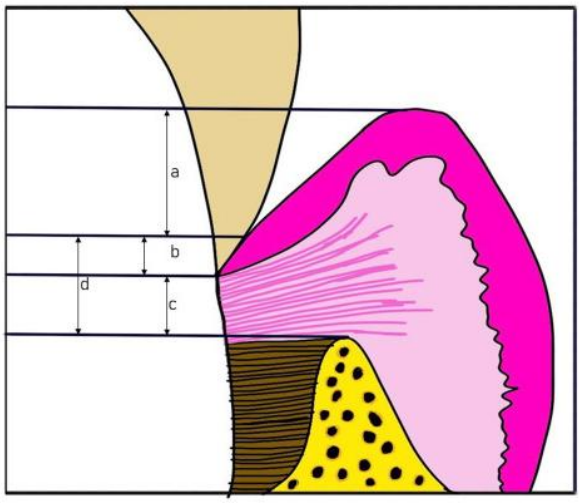
- placement of the restorative margin excessively close to the alveolar bone crest;
- excessive restoration contour or an inappropriate emergence profile;
- mechanical trauma to soft tissues during tooth preparation;
- tissue injury during gingival retraction or impression procedures;
- rough, irregular, or difficult-to-clean restorative surfaces; and
- inappropriate proximal contacts or contours that interfere with effective plaque control (Felton et al., 1991; Aishwarya & Sivaram, 2015; Laufer et al., 1996; Galgali & Gontiya, 2011; Phatale & Marawar, 2010).

Accordingly, biologic width should not be regarded solely as an anatomical measurement; it should be directly related to the design, construction, and clinical implementation of restorative treatment. Appropriate margin location, contour, marginal adaptation, surface properties, and cleansability are all important considerations for maintaining periodontal health. The biological relevance of these factors becomes particularly important when restorative margins are placed close to gingival tissues or the alveolar bone (Felton et al., 1991; Harish et al., 2015; Aishwarya & Sivaram, 2015; Feng et al., 2006).

In contemporary clinical practice, the concept of supracrestal tissue attachment also emphasizes that periodontal tissues should not be managed according to a single predetermined numerical value. Instead, the

relationship between the restorative margin, gingival tissues, alveolar bone crest, and individual periodontal phenotype should be assessed on a case-by-case basis. This approach supports conservative restorative planning and may help minimize unnecessary periodontal trauma and inflammatory complications (Aishwarya & Sivaram, 2015; Feng et al., 2006).

**Figure 1. Normal Dimensions of the Dentogingival Complex**




*Source: Adapted from Gargiulo et al. (1961) and Nugala et al. (2012).*

(a) Gingival sulcus, with an approximate depth of 0.69 mm;
(b) epithelial attachment, with an approximate height of 0.97 mm;
(c) connective tissue attachment, with an approximate height of 1.07 mm; and
(d) the biologic width, representing the combined dimensions of the epithelial and connective tissue attachments (approximately 2.04 mm).

## 4. Restorative Procedures and Their Relationship with Periodontal Health

### 4.1. Rubber Dam Isolation

Rubber dam isolation provides a dry and controlled operative field by isolating the treated tooth from the oral environment. Its principal advantages include moisture control, reduced soft-tissue interference, prevention of contamination, and improved access and visibility. Evidence from a Cochrane review suggests that rubber dam isolation may improve the short-term survival of some direct restorations compared with cotton-roll isolation, although the available evidence remains limited (Miao et al., 2021).

From a periodontal perspective, appropriate clamp selection and positioning are important to avoid unnecessary gingival compression and tissue trauma. Excessive or prolonged pressure, inappropriate clamp placement, or excessive tension of the dam may cause localized tissue irritation, particularly when the clamp is positioned close to the gingival margin. Therefore, rubber dam isolation should provide adequate stability while minimizing unnecessary soft-tissue pressure (Aishwarya & Sivaram, 2015; Miao et al., 2021).

### 4.2. Cavity Preparation and Crown Preparation

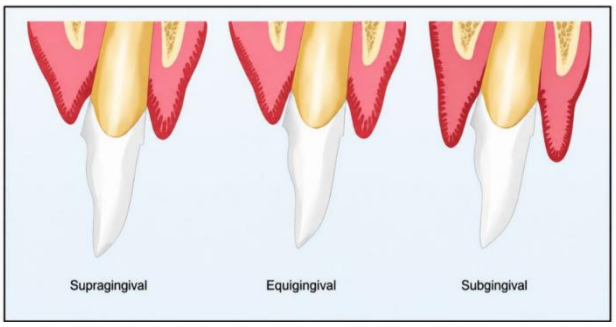
Tooth preparation may expose dental and periodontal tissues to mechanical and thermal stresses. Appropriate instrument selection, controlled pressure, careful preparation of gingival margins, preservation of sound proximal structures, and proper wedge placement can help minimize iatrogenic periodontal injury (Sharma et al., 2024; Aishwarya & Sivaram, 2015).

During crown preparation, the finishing-line location and configuration are particularly important. Excessively apical margins may interfere with the supracrestal tissue attachment, whereas rough, irregular, or poorly adapted margins may facilitate plaque retention. Thus, preparation should satisfy both the mechanical requirements of the restoration and the biological requirements of the periodontal tissues (Felton et al., 1991; Valderhaug et al., 1993; Nevins & Skurow, 1996; Orkin et al., 1987; Harish et al., 2015).

### 4.3. Location of the Restorative Margin

Restorative margins may be classified as supragingival, equigingival, or subgingival according to their relationship with the gingival margin. Margin location is clinically important because it affects plaque control, professional maintenance, and the interaction between the restoration and periodontal tissues (Felton et al., 1991; Valderhaug et al., 1993; Nevins & Skurow, 1996; Orkin et al., 1987; Harish et al., 2015; Aishwarya & Sivaram, 2015).

**Figure 2. Classification of restorative margins according to their relationship with the gingival margin**




*Source: Adapted from Sharma et al. (2024).*

(A) Supragingival; (B) Equigingival; and (C) Subgingival margin.

#### *4.3.1. Supragingival Margin*

Supragingival margins are generally preferred when clinically feasible because they remain outside the gingival sulcus and facilitate plaque control, marginal assessment, finishing, and oral hygiene. Advances in tooth-colored restorative materials and adhesive systems

have also increased their feasibility in aesthetically demanding areas (Smulker & Chaibi, 1997; Aishwarya & Sivaram, 2015; Shayeb et al., 2014).

#### *4.3.2. Equigingival Margin*

Equigingival margins are located approximately at the level of the free gingival margin and represent an intermediate position between supragingival and subgingival margins. Their periodontal acceptability depends not only on their location but also on marginal adaptation, surface characteristics, contour, and the patient's plaque-control ability (Felton et al., 1991; Aishwarya & Sivaram, 2015; Shayeb et al., 2014).

#### *4.3.3. Subgingival Margin*

Subgingival margins may be necessary in selected clinical situations, particularly when restorative or aesthetic requirements demand extension into the sulcus. However, deeper margins may complicate plaque control, professional assessment, finishing, and maintenance and may increase the risk of gingival inflammation, particularly when the margin approaches the supracrestal tissue attachment (Felton et al., 1991; Valderhaug et al., 1993; Nevins & Skurow, 1996; Orkin et al., 1987; Harish et al., 2015; Aishwarya & Sivaram, 2015).

The historical concept of "extension for prevention" encouraged extension of cavity preparations toward areas considered susceptible to recurrent caries. Contemporary restorative dentistry favors a more conservative approach that emphasizes preservation of sound tooth structure and effective plaque control rather than unnecessary extension of restorations (Shillingburg et al., n.d.).

When subgingival margins are unavoidable, their depth should be determined according to the anatomical and periodontal conditions of the patient. Smooth, well-adapted, and cleansable margins should be established while unnecessary invasion of the supracrestal tissue attachment is avoided (Felton et al., 1991; Valderhaug et al., 1993; Nevins & Skurow, 1996; Orkin et al., 1987; Harish et al., 2015; Aishwarya & Sivaram, 2015; Shayeb et al., 2014).

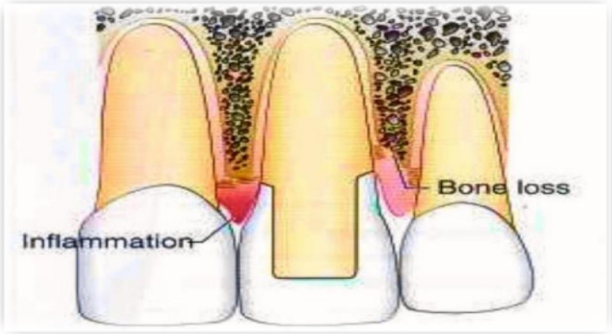
### 4.4. Biologic Width Violation

Violation of the biologic width, or supracrestal tissue attachment (STA), may occur when a restorative margin encroaches upon the space required for periodontal attachment. The resulting periodontal response may include persistent inflammation, gingival recession, apical displacement of the gingival margin, or alveolar bone remodeling. The clinical response varies according to factors such as periodontal phenotype, alveolar bone morphology, pre-existing inflammation, restorative margin location, restoration quality, and plaque control (Felton et al., 1991; Nevins & Skurow, 1996; Feng et al., 2006).

Subgingival margins have been associated with less favorable gingival findings than supragingival margins, including increased bleeding and changes in gingival-margin position (Orkin et al., 1987). Poor marginal adaptation, rough surfaces, excessive contours, and plaque-retentive factors may further contribute to persistent inflammation (Felton et al., 1991; Valderhaug et al., 1993; Orkin et al., 1987; Harish et al., 2015).

When STA interference is diagnosed, treatment should aim to establish a biologically compatible relationship between the restoration and periodontal tissues. Depending on the clinical situation, corrective treatment may involve surgical crown lengthening or orthodontic extrusion. Prevention through appropriate margin positioning, preservation of periodontal tissues, and proper restoration contour and cleansability is preferable to treatment of established complications (Felton et al., 1991; Nevins & Skurow, 1996; Orkin et al., 1987; Harish et al., 2015; Aishwarya & Sivaram, 2015; Feng et al., 2006).

**Figure 3. Gingival inflammation and bone changes associated with violation of the supracrestal tissue attachment**




*Source: Adapted from Harish et al. (2015).*

### 4.5. Assessment of Biologic Width Violation

Assessment of STA violation requires integration of clinical findings, periodontal measurements, and, when indicated, radiographic examination (Felton et al., 1991; Nevins & Skurow, 1996; Feng et al., 2006).

Clinical assessment includes evaluation of the restorative margin, gingival sulcus, inflammation, bleeding on probing, probing depth, discomfort, and plaque-control difficulty. However, these findings alone do not confirm STA violation because they may also result from biofilm-induced inflammation or other local factors (Felton et al., 1991; Valderhaug et al., 1993; Nevins & Skurow, 1996; Orkin et al., 1987; Harish et al., 2015).

Bone sounding can help determine the relationship among the gingival margin, periodontal attachment, alveolar bone crest, and restorative margin. The findings should be interpreted according to individual periodontal anatomy rather than against a single fixed measurement (Gargiulo et al., 1961; Feng et al., 2006).

Radiographic assessment may provide complementary information regarding the alveolar bone and interproximal relationship between restorative structures

and periodontal tissues. However, conventional two-dimensional radiography has limitations in evaluating facial and soft-tissue relationships.

The Parallel Profile Radiographic Technique described by Gouri and Sushama is mentioned in the source manuscript; its original reference should be verified before final publication.

Overall, diagnosis should integrate clinical examination, periodontal probing, bone sounding, and appropriate radiographic evaluation (Felton et al., 1991; Nevins & Skurow, 1996; Feng et al., 2006).

### 4.6. Matrix Placement

Proper matrix placement contributes to appropriate proximal anatomy, contact formation, contour, and marginal adaptation. The matrix should be selected and positioned according to the cavity, gingival margin, tooth anatomy, and restorative material.

Excessive cervical contour, inadequate proximal contact, abnormal concavities or convexities, and gingival overhangs may interfere with interdental cleaning and facilitate biofilm accumulation. In particular, gingival overhangs may create plaque-retentive areas and contribute to localized gingival inflammation.

Systematic-review evidence indicates that matrix-system selection may influence proximal contact tightness, with sectional matrix systems generally producing tighter contacts than conventional circumferential systems in direct Class II composite restorations (Alshardan et al., 2023). Therefore, successful proximal restoration requires not only filling the cavity but also establishing appropriate contact, contour, marginal adaptation, and cleansability.

### 4.7. Gingival Retraction

Gingival retraction is used during indirect restorative procedures and impression making to expose the preparation margin, provide space for impression material or scanning, and control gingival crevicular fluid and bleeding. Because mechanical and chemical manipulation may injure the sulcular and junctional tissues, retraction should be performed conservatively (Laufer et al., 1996; Phatale & Marawar, 2010).

The principal objectives are adequate horizontal and vertical access, complete exposure of the preparation margin, bleeding and fluid control, and minimal tissue trauma (Laufer et al., 1996; Galgali & Gontiya, 2011; Phatale & Marawar, 2010).

Mechanical pressure during retraction may temporarily affect gingival blood flow, and the degree of tissue response depends on the material, pressure, duration, and periodontal condition. Histopathological studies have also demonstrated varying degrees of epithelial injury associated with different retraction materials (Laufer et al., 1996; Phatale & Marawar, 2010).

#### *4.7.1. Methods of Gingival Retraction*

Gingival retraction methods include physical–mechanical, chemicomechanical, and surgical approaches (Phatale & Marawar, 2010).

##### 4.7.1.1. Physical–Mechanical Methods

Mechanical methods include retraction cords, copper bands or rings, temporary acrylic caps, and similar devices. Their effectiveness depends on appropriate adaptation and controlled pressure. Excessive pressure or prolonged contact may cause soft-tissue trauma (Laufer et al., 1996; Phatale & Marawar, 2010).

##### 4.7.1.2. Chemicomechanical Methods

Chemicomechanical techniques combine mechanical tissue displacement with an astringent or hemostatic agent. Retraction cords may be used with single- or double-cord techniques according to sulcus depth, gingival condition, margin location, and the degree of displacement required (Laufer et al., 1996; Galgali & Gontiya, 2011).

#### *4.7.2. Gingival Retraction Cord*

Retraction cord is widely used for temporary gingival displacement, bleeding control, and reduction of gingival crevicular fluid. Its effect results from mechanical pressure and, when impregnated, the additional chemical action of the selected agent (Laufer et al., 1996).

#### *4.7.3. Mechanism of Action*

The cord mechanically displaces the sulcular tissues. When combined with an astringent, it may additionally facilitate hemostasis and reduce gingival crevicular fluid. The clinical effect depends on the agent, concentration, duration of exposure, and tissue condition (Laufer et al., 1996).

#### *4.7.4. Agents Used for Gingival Retraction and Hemostasis*

Common agents include:

1. racemic epinephrine;
2. aluminum chloride;
3. alum;
4. aluminum sulfate;
5. ferric sulfate;
6. zinc chloride; and
7. tannic acid (Laufer et al., 1996).

The selection of an agent should consider gingival condition, degree of bleeding, duration of tissue management, and patient-related factors. Epinephrine-containing materials may be systemically absorbed, whereas non-adrenergic agents provide local hemostatic effects (Laufer et al., 1996; Shayeb et al., 2014; Phatale & Marawar, 2010).

#### *4.7.5. Characteristics of an Ideal Gingival Retraction Agent*

An ideal agent should provide controlled tissue displacement, effective hemostasis and fluid control, minimal periodontal injury, predictable duration of action, and compatibility with impression or restorative materials (Galgali & Gontiya, 2011).

#### *4.7.6. Considerations Regarding Epinephrine*

Epinephrine-containing cords require caution because systemic absorption may occur through the gingival sulcus. The degree of absorption may depend on cord length, concentration, duration of contact, and tissue condition (Shayeb et al., 2014; Phatale & Marawar, 2010).

Although clinically significant hemodynamic effects have not been consistently demonstrated in healthy individuals, systemic exposure remains relevant, particularly in patients with inflamed or injured tissues or relevant medical conditions. Non-adrenergic agents may therefore be considered when appropriate (Laufer et al., 1996; Shayeb et al., 2014; Phatale & Marawar, 2010).

Overall, gingival retraction should aim for the minimum tissue displacement necessary to obtain an accurate restorative record rather than maximal displacement (Laufer et al., 1996; Galgali & Gontiya, 2011).

### 4.8. Cordless Retraction Systems: Expasyl

Cordless systems such as Expasyl provide temporary tissue displacement and hemostatic control while reducing the need for mechanical cord placement. Expasyl contains an aluminum chloride-based astringent and acts through expansion of the paste within the gingival sulcus (Laufer et al., 1996; Galgali & Gontiya, 2011).

Although cordless systems may offer simple application and useful control of bleeding and sulcular fluid, they are not necessarily superior to conventional retraction cords. Some comparative evidence indicates that aluminum chloride-impregnated cords may provide greater horizontal tissue displacement than Expasyl. Other systems, including Magic Foam Cord and Traxodent Hemodent Paste, may also be used according to clinical requirements (Lang et al., 1992; Miao et al., 2021).

The choice of material should consider margin location, sulcus depth, periodontal condition, bleeding, and required tissue displacement (Laufer et al., 1996; Lang et al., 1992; Miao et al., 2021).

### 4.9. Laser Application in Gingival Retraction and Soft-Tissue Management

Diode and Nd:YAG lasers may be used in selected cases for limited soft-tissue management and hemostasis. Their effects depend on wavelength, power, exposure duration, tissue characteristics, and operator experience. Excessive energy may produce undesirable thermal effects.

Therefore, lasers should not be considered inherently safer or universally superior to conventional retraction techniques. Preservation of healthy periodontal tissues should remain the primary consideration, particularly when tissue removal is performed for restorative access.

### 4.10. Tissue Injury and Consequences of Gingival Manipulation

The periodontal response to gingival manipulation depends strongly on the initial condition of the tissues. Healthy tissues subjected to careful and limited manipulation generally have greater potential for recovery, whereas inflammation and pre-existing periodontal disease may increase the risk of adverse responses (Laufer et al., 1996; Wilhelmsen et al., 1976).

Excessive manipulation of the sulcular epithelium and inappropriate retraction may contribute to changes in gingival-margin position and, in some situations, gingival recession. These changes should be interpreted in relation to tissue thickness, inflammation, pre-existing periodontal conditions, and the extent of mechanical trauma (Laufer et al., 1996; Wilhelmsen et al., 1976).

Consequently, restorative procedures should aim not only to obtain adequate access but also to preserve periodontal structures and support long-term periodontal stability.

### 4.11. Rotary Curettage (Gingival Curettage)

Rotary gingival curettage is an older technique used to enlarge the gingival sulcus and improve access to cervical preparation margins. Because it involves deliberate removal of gingival tissue, its use requires healthy periodontal tissues, adequate keratinized gingiva, appropriate sulcus depth, and careful control of tissue removal (Nugala et al., 2012).

Because less invasive techniques may provide adequate access in many situations, conservative approaches should generally be preferred. Rotary curettage may nevertheless be considered in selected cases when the periodontal conditions are favorable (Nugala et al., 2012).

### 4.12. Electrosurgical Retraction

Electrosurgery uses controlled electrical current to achieve limited soft-tissue removal with simultaneous hemostasis. It may be used when excessive gingival tissue interferes with access to the preparation margin or when limited tissue contouring and bleeding control are required (Wilson et al., 1992; Wilhelmsen et al., 1976).

**Advantages**

Potential advantages of electrosurgery include:

- relatively rapid and controlled soft-tissue removal;
- effective hemostasis;
- provision of a relatively dry operating field; and

- the ability to perform limited soft-tissue contouring (Wilson et al., 1992; Wilhelmsen et al., 1976).

**Disadvantages**

Potential disadvantages include:

1. dependence on operator skill and technical control;
2. risk of thermal injury when inappropriate settings or techniques are used;
3. potential damage to adjacent tissues from excessive lateral heat;
4. possible injury to cementum, periodontal attachment, or bone when the technique is improperly applied; and
5. difficulty in controlling the depth and extent of tissue removal (Wilson et al., 1992; Wilhelmsen et al., 1976).

#### *4.12.1. Indications*

Potential indications include:

1. excessive soft tissue around the preparation margin;
2. selected localized gingival enlargement or thickening; and
3. limited tissue removal when simultaneous hemostasis is desirable (Wilson et al., 1992; Wilhelmsen et al., 1976).

Electrosurgery should be used cautiously in inflamed periodontal tissues and should not replace treatment of the underlying cause of periodontal inflammation (Wilson et al., 1992; Wilhelmsen et al., 1976).

#### *4.12.2. Precautions and Contraindications*

Appropriate precautions are required in patients with implanted electronic devices, particularly certain cardiac pacemakers or other devices susceptible to electrical interference. The type of device, electrosurgical system, and manufacturer recommendations should be considered.

Electrosurgery should also be used cautiously where flammable materials or aerosols are present because electrical energy may create an ignition hazard.

### 4.13 Impression Procedures

Following tooth preparation and soft-tissue management, impression making is a critical stage in the fabrication of indirect restorations. Periodontal health should be considered alongside accurate recording of the preparation margin, as inaccurate or incomplete impressions may contribute to inadequate marginal adaptation and conditions favorable to plaque retention and periodontal inflammation (Aishwarya & Sivaram, 2015; Perakis et al., 2004; Galgali & Gontiya, 2011).

During impression procedures, periodontal tissues may be affected by mechanical and chemical factors, including tray pressure, mechanical trauma during insertion or removal, penetration of impression material into the gingival sulcus, and inappropriate manipulation or retention of impression material (Aishwarya & Sivaram, 2015; Perakis et al., 2004; Galgali & Gontiya, 2011). These effects are particularly relevant when subgingival margins require gingival displacement for accurate recording.

Although clinically significant complications are uncommon, residual impression material may occasionally remain within the gingival sulcus and contribute to localized periodontal inflammation. Therefore, the impression should be carefully inspected after removal to ensure its integrity and to confirm that no material remains around the gingival sulcus or restoration margin. Appropriate gingival retraction, adequate impression-material thickness, proper tray selection, and careful removal may reduce the risk of tissue injury and impression distortion (Feng et al., 2006; Laufer et al., 1996; Perakis et al., 2004; Marshak et al., 1987).

Overall, impression procedures should aim not only to reproduce the preparation margin accurately but also to minimize periodontal trauma and preserve tissue integrity. Accurate impressions are therefore an important component of both restorative precision and long-term periodontal maintenance (Aishwarya & Sivaram, 2015; Feng et al., 2006; Perakis et al., 2004).

## 5. Discussion

The relationship between restorative treatment and periodontal health is bidirectional. A healthy periodontium provides favorable conditions for restorative procedures and contributes to the long-term maintenance of restorations, while the design, location, and quality of a restoration may influence the condition of the surrounding periodontal tissues. Factors such as inappropriate margin placement, excessive restorative contours, overhangs, mechanical trauma, violation of the supracrestal tissue attachment, and inadequate biofilm control may disturb periodontal stability.

However, periodontal changes following restorative treatment should not be attributed to a single factor. Baseline periodontal status, gingival thickness and phenotype, biofilm accumulation, operator skill, restoration margin location, finishing and polishing, oral hygiene, and maintenance care may all influence the magnitude of the tissue response. Therefore, periodontal outcomes should be interpreted within the broader clinical condition of each patient rather than as the consequence of an isolated restorative factor.

### 5.1 Integrated Discussion and Clinical Considerations

The findings reviewed in this study indicate that several stages of restorative treatment may affect periodontal tissues. Rubber dam isolation can provide effective

moisture control and improved visibility, but inappropriate clamp selection or positioning may produce unnecessary pressure on the gingival tissues. Similarly, tooth preparation should be performed conservatively because excessive mechanical or thermal trauma and unnecessary extension toward the periodontal attachment may compromise tissue stability.

Restoration margin location remains one of the most important considerations. Supragingival margins are generally more favorable because they are easier to visualize, finish, maintain, and clean. Subgingival margins may nevertheless be required for specific functional, structural, or aesthetic reasons. In such situations, careful control of margin position, preservation of the supracrestal tissue attachment, appropriate marginal adaptation, and effective plaque control become particularly important. The reviewed evidence suggests that placing a margin beneath the gingiva should not be regarded as inherently advantageous and should be avoided when it is not clinically necessary.

The quality of the restoration is also important beyond the position of its margin. Excessive contour, inadequate proximal contact, cervical overhangs, and poor marginal adaptation may create plaque-retentive areas and make interdental cleaning more difficult. Thus, a restoration should be evaluated not only for its strength and overall appearance but also for its contour, proximal contact, marginal adaptation, and cleansability.

Gingival retraction and impression procedures represent another important interface between restorative treatment and periodontal tissues. Retraction provides access to cervical and subgingival margins but may produce tissue injury when excessive pressure, prolonged displacement, inappropriate chemical agents, or inadequate technique are involved. Likewise, impression procedures may affect periodontal tissues through mechanical manipulation, tray pressure, gingival displacement, or retained impression material. These procedures should therefore be performed only to the extent necessary to achieve an accurate restoration while minimizing tissue trauma.

Taken together, the evidence supports an integrated approach in which periodontal considerations are incorporated into every stage of restorative treatment. The principal factors can be considered in four groups:

1. **Restoration-related factors:** margin location and its relationship to periodontal attachment tissues.
2. **Design-related factors:** contour, proximal contacts, marginal adaptation, and restorative overhangs.
3. **Technique-related factors:** tooth preparation, rubber dam isolation, gingival retraction, matrix and wedge placement, and impression procedures.
4. **Patient-related factors:** baseline periodontal condition, gingival phenotype, biofilm control, oral hygiene, and regular maintenance.

Many periodontal complications associated with restorative treatment may therefore be prevented or minimized through appropriate treatment planning, conservative preparation, preservation of periodontal tissues, placement of margins in cleansable locations, accurate restoration design, minimal soft-tissue trauma, and effective biofilm control. In complex cases involving compromised clinical crown height, gingival recession, or potential violation of the supracrestal tissue attachment, coordination between restorative and periodontal care may further improve treatment planning and reduce complications.

Patient participation is equally important. Even a technically well-designed restoration cannot ensure long-term periodontal stability when plaque control and maintenance are inadequate. Oral-hygiene instruction, interdental cleaning, and appropriate periodontal follow-up should therefore remain part of post-restorative care.

### 5.2 Limitations of the Review

This review has several limitations. First, as a narrative review, the evidence was synthesized qualitatively rather than through meta-analysis, and differences in study designs, populations, interventions, follow-up periods, and periodontal outcomes limit direct comparison. Second, the literature includes both older foundational studies and more recent publications; therefore, some findings may not fully reflect contemporary restorative materials, adhesive techniques, and digital workflows.

Third, periodontal outcomes are multifactorial and may be influenced by baseline periodontal status, gingival phenotype, plaque control, restoration quality, clinical technique, and maintenance. Fourth, differences in outcome definitions and measurement methods may contribute to inconsistent findings. Publication, selection, language, and accessibility biases may also have influenced the evidence included in the review. Finally, the available evidence is insufficient to determine the independent long-term effect of individual restorative factors on periodontal outcomes. Further well-designed prospective studies using standardized periodontal outcomes and longer follow-up periods are warranted.

## 6. Conclusion

The interaction between restorative treatment and periodontal health is complex and bidirectional. The long-term success of restorative treatment depends not only on restoring tooth function, form, and aesthetics but also on maintaining the health and stability of the surrounding periodontal tissues.

The reviewed evidence indicates that inappropriate restoration margin placement, violation of the supracrestal tissue attachment, excessive restorative contour, overhangs, inadequate proximal contacts, trauma during tooth preparation or gingival retraction,

and improper impression procedures may contribute to periodontal inflammation and other undesirable tissue changes. However, the magnitude of these effects is also influenced by the initial periodontal condition, biofilm control, individual anatomical characteristics, and quality of clinical execution.

Accordingly, periodontal tissues should be considered an integral part of restorative treatment planning rather than a structure separate from the tooth and its restoration. Preservation of sound tooth structure and periodontal tissues, appropriate positioning of restoration margins, minimal tissue trauma, adequate contour and marginal adaptation, and effective cleansability should be considered throughout the treatment process.

Many periodontal complications associated with restorative procedures are potentially preventable through accurate diagnosis, appropriate treatment planning, conservative clinical techniques, careful soft-tissue management, and regular patient follow-up. In complex cases, integration of restorative and periodontal considerations may further improve treatment planning and reduce the risk of complications.

Overall, preservation of periodontal health should remain a fundamental objective of every restorative procedure. A biologically oriented and minimally invasive treatment approach, combined with appropriate restoration design and effective maintenance, may contribute to predictable long-term outcomes and preservation of both the restored tooth and its supporting periodontal tissues.

**Acknowledgements**

The authors gratefully acknowledge Mohammad Mohammadi (Fardin), Faculty Member, Faculty of Social Sciences, University of Herat, and Research Advisor at Hariwa University, for his academic support in the initial development of this study, including research proposal formulation, methodological guidance, and constructive feedback.

**Funding**

This research received no financial support from any organization, institution, or other funding body.

**Conflict of Interest**

The authors declare that they have no conflict of interest related to this research.

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