

**The Restorative And Periodontal Intersection. A Myth or Reality.**

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**Abstract**

Preservation of a healthy periodontium is the fundamental prerequisite for the sustained success of treatment. As the esthetic dental expectation of patients is rising, the aim is for teeth to be retained, it is now apparent to confront difficult clinical presentations, such as critical tooth-tissue loss, advanced periodontal disease, tooth loss, and significant esthetic difficulties. In spite of enhanced importance on the perio-restorative interface in restorative dentistry, many dentists have been unable to follow the concept of biologic width in the regular clinical practice.

Relevant publications regarding periodontal restorative interface and management were identified up to 2017 using manual and electronic database search in Medline, Embase, Directory of Open Access Journals and Google Scholar. This review discusses the considerations for a periodontal restorative interface along with various methods of interventions.

**Keywords:** Biologic width; crown lengthening; periodontal health

## Introduction

The relationship between periodontal, oral health and the restoration of teeth is closely acquainted and inseparable. Preservation of a healthy periodontium is fundamental for the long-term success of prosthetic restorations.<sup>[1]</sup> It is imperative that periodontal tissues are healthy before prosthodontic treatment commences, and additional periodontal treatment is commonly indicated to facilitate improved prosthodontic treatment outcomes.<sup>[2]</sup> Predictable prosthesis longevity is dependent on the cleansability of the restored tooth or teeth and the relationship between prosthodontics and periodontics when planning and performing the prosthodontic treatment.<sup>[2]</sup> In spite of an increased significance on the perio-restorative interface in restorative dentistry, many dentists have been unable to follow the concept of biologic width in the regular clinical practice.<sup>[3]</sup> A thorough understanding of the relationship between periodontal tissues and restorative dentistry is mandatory i.e., multidisciplinary treatment is essential. This includes simultaneous and coordinated periodontal and prosthodontic care to ensure to ensure adequate form, function and aesthetics, the comfort of the dentition, patient satisfaction.

The purpose of this review to describe the considerations and interventions in the periodontal and restorative interface that dictate the various interdisciplinary approaches for improved oral health and overall wellbeing of the patient.

### Considerations for periodontal-restorative interface

**Gingival display and contour:** It is considered as the standard for treatment planning that could help in achieving good health and aesthetics. Significant physiological variation exists between individuals; gingival morphological variables may be better considered as guidelines for treatment planning that could aid in achieving optimal health and esthetics, rather than rigid

criteria.<sup>[2]</sup> The gingival display can influence all phases of prosthodontic treatment.<sup>[4]</sup> Gingival display varies between individuals and it depends on the lip line during the function. High lip line: most challenging to manage clinically, Average lip line: considered to be the most esthetic, Low lip line: the least demanding.<sup>[4]</sup>

**Biologic Width:** The term 'biologic width' was introduced by Cohen to describe the space over the tooth surface that is occupied by the connective tissue and epithelial attachments, this parameter being equivalent to the distance between the bottom of the gingival sulcus and the alveolar bone crest.<sup>[5]</sup> In the oral cavity, the ectodermal natural protective barrier that develops around teeth, protecting the alveolar bone from bacteria and other foreign materials, is known as the biologic width. A study on human necropsy material established the dimensions and meant the value of 0.69, 0.97 and 1.07 mm for the gingival sulcus, junctional epithelium, and connective tissue attachment, respectively.<sup>[6]</sup> At least 3 mm of sound tooth structure should be preserved between the restorative margin and alveolar bone. Violation of this dimensions results in, enhanced gingival inflammation, [Figure 1], attachment loss<sup>[7,8]</sup> and gingival recession<sup>[9]</sup>.

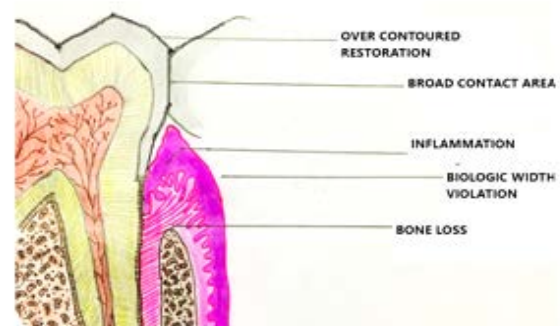


Figure: 1 Biological width violation due to over contoured restoration.

During margin placement for fixed prostheses, one should ideally follow the gingival contour and not extend deeper than 0.5 mm into the sulcus.<sup>[10]</sup>

## Methods for Evaluation of Biologic Width Violation

**Clinical method:** If a patient is aware of tissue discomfort when the restoration margin levels are being evaluated with a periodontal probe, it is a good sign that biologic width neglect has occurred.<sup>[3]</sup>

**The diagnostic wax-up:** The prime objective of the diagnostic wax-up is to assist with planning the most feasible, achievable, conservative and practical treatment option.<sup>[11]</sup> Prosthodontic, periodontic and orthodontic treatment can be included in the diagnostic wax-up.<sup>[12]</sup> The completed wax-up will serve as a three-dimensional blueprint for the absolute treatment.<sup>[13]</sup>

**Bone sounding:** It aims to establish the osseous architecture under the gingival tissues and so that the amount of bone reduction can be quantified. The measurements from the occlusal surfaces of the teeth to the estimated level of the alveolar crest using this technique accurately reflected the actual distances measured after surgical exposure of the alveolar crest at these sites.<sup>[14]</sup> Bone dehiscence and fenestration can be challenging to detect, and a thick gingival biotype will result in a more precise assessment.<sup>[15]</sup>

**Radiographic evaluation:** Radiographic elucidation can discover interproximal violations of biologic width. Parallel Profile Radiography (PPR) technique is used to measure the dimensions of the dento gingival unit (DGU). It is non-invasive and a reproducible method.<sup>[16]</sup>

**Three-dimensional imaging:** It allows an accurate, practical, non-invasive three-dimensional evaluation of the alveolar bone without traumatizing the overlaying soft tissues.<sup>[17]</sup> Moreover, root anatomy and bone dehiscence and fenestration can be precisely outlined.<sup>[2]</sup>

**Interventions:** They can be classified into two: 1] subtractive, and 2] additive. A complete extra-oral and intra-oral examination, supplemented with radiographic

analysis, is mandatory to select the most suitable approach for any situation.

**Subtractive methods:** Simpler and more predictable.<sup>[18]</sup> Subtractive methods involve increasing the clinical crown length by removing soft tissues, with or without osseous modifications.<sup>[19]</sup> Moreover, lengthening a short clinical crown increases the retention and resistance forms. This is obligatory if the clinical crown height is < 3 mm.<sup>[3]</sup>

**Crown lengthening procedure:** The etiology of the dental problem will direct the approach to the crown-lengthening procedure regarding extension, invasiveness, and sequence.<sup>[2]</sup>

**Indications:**<sup>[20]</sup>

1. Insufficient clinical crown for retention due to widespread caries, sub-gingival caries or tooth fracture, root perforation, or root resorption in the cervical 1/3rd of the root in teeth with sufficient periodontal attachment.
2. Small clinical crowns.
3. Subgingival restorative margins
4. Irregular, redundant or unaesthetic gingival levels
5. Designing veneers or crowns on teeth with the gingival margin coronal to the cemento-enamel junction
6. Teeth with excessive wear of occlusal or incisal portion.
7. Teeth with short interocclusal space for conventional restorative methods due to supraeruption.
8. Restorations which disrupt the biologic width.
9. In combination with tooth demanding hemisection or root resection.
10. Assist with impression precision by placing crown margins further supragingivally.

**Contraindications:**<sup>[20]</sup>

1. Deep caries or fracture demanding redundant bone removal.
2. Post surgery producing unaesthetic outcomes.
3. Tooth with small crown root ratio (ideally 2:1 ratio is preferred)

4. The tooth that cannot be restored.
5. Tooth with an enhanced chance of furcation involvement.
6. Extreme compromise on alveolar bone support.

**Other methods include:**

External bevel gingivectomy,<sup>[21]</sup> Internal bevel gingivectomy,<sup>[22]</sup> Apically repositioned flap with and without osseous resection,<sup>[23]</sup> Forced eruption of multiple teeth,<sup>[24]</sup> The restorative Alveolar Interface (RAI) technique.<sup>[1]</sup>

**The Restorative Alveolar Interface (RAI) technique** is defined as the part of the root surface that is extending from the alveolar crest apically to the restorative margin coronally. RAI consists of transforming the restorative margin position into a healthier environment, respecting the biological width and therefore allowing effective plaque control.<sup>[1]</sup> According to Novaes et al.<sup>[25]</sup>, the RAI procedure alters the interproximal col, progressing from a concave non-keratinized to a convex keratinized epithelium. Anyway, these procedures can sequel in loss of hard and soft tissues, as well as an increase in root sensitivity and the crown-to-root ratio. When several teeth are involved, there will be a risk of loss of interdental papillae and development of black triangles<sup>[2]</sup>.

**Modifications:** Crown-lengthening surgery aims to reduce bone reduction interproximally. This can be advantageous when a distance of 4–5 mm remains between the bone crest and the contact point. To ensure an adequate interdental papilla, the distance of up to 1.5mm between the adjacent roots are sufficient.<sup>[26]</sup> Orthognathic and plastic-surgery procedures would need to be considered in case of significant gingival exposure as a consequence of face height or lip length. In the case of gingival enlargement, confine the surgery to the soft tissues by taking the CEJ as a guide for the contour modifications. When simultaneous crown lengthening is

indicated in conjunction with prosthodontic treatment, the latter must be completed first followed by former.<sup>[2]</sup> Where multiple teeth are involved in the esthetic area, vice-versa is done, which provides improved visualization.<sup>[27, 28]</sup>

**Alternative methods to achieve longer teeth:**

Alternatively, increasing the vertical dimension of the occlusion or by retruding the mandible to the centric relation position prosthodontically, helps us to achieve longer teeth.<sup>[3]</sup> In subgingival defects, forced eruption merge with localized fibrotomy and intensive root planing may be indicated.<sup>[29, 30]</sup>

**Additive methods:** These correct gingival level and contour by augmenting the gingival tissues by increasing the width of the attached gingiva and decreasing the height of the clinical crown.<sup>[31]</sup> The available techniques are a free gingival graft, a connective tissue graft or a coronally positioned flap.<sup>[32]</sup> Clinically, it is advisable to have an even, the thick band of attached gingiva about 5 mm wide.<sup>[2]</sup>

**Evaluation of Edentulous Area:** Evaluating the edentulous area before placing a fixed prosthesis is essential to reduce potential problems. Biologically, a pontic must have a design that minimizes inflammation and allows oral hygiene methods to be done quickly.<sup>[2]</sup> The pontic design does not predict tissue inflammation. Instead, good oral hygiene status includes, persistent plaque and calculus removal have been shown to predict proper tissue health.<sup>[33]</sup> Open and rounded embrasure contours aids in better cleaning of the fixed dental prosthesis by the patient. Narrowing the width of the pontic may moreover increase the chance of food impaction around the pontics.<sup>[34]</sup> The least cross-section suggested for metal fixed dental prosthesis frameworks is 3 mm X 3 mm, and for ceramic frameworks is 4 mm X 4 mm.<sup>[35]</sup>

Treatment of morphological ridge deficiency can be accomplished by surgical modification, prosthetic camouflaging with a gingival-colored ceramic to recreate gingival contours.<sup>[36]</sup> The patient should be fully aware of the esthetic outcome anticipated following placement of gingival-colored ceramic.<sup>[2]</sup> The gingival-colored ceramic helps in achieving a harmonious gingival contour; however, this frequently results in pontics that have increased tissue contact.<sup>[37]</sup>

**Design of the pontic:** Modified ridge lap and ovate design provide the esthetics and proper oral hygiene. For the posterior locations, the most suitable pontics are the sanitary, conical and modified ridge lap designs. The sanitary design encourages plaque control because the tissue surface remains clear from the gingiva.<sup>[2]</sup>

**Evaluation of Support from Periodontium:** It is mandatory for patients with the history of periodontitis, which can manifest clinically as an increase in the crown-to-root ratio and loss of teeth. A crown-to-root ratio of 1:2 has therefore been considered ideal but clinically, a ratio of 1:1.5 has been deemed suitable and a ratio of 1:1 is deemed to be minimal.<sup>[38]</sup> Periodontal support cannot be decided by the linear measurement of the crown-to-root ratio alone, but should also consider the anatomy and configuration of the root, the number of abutment teeth.<sup>[38]</sup> And the periodontal health when considering a multi-unit fixed dental prosthesis, Ante's Law as a guide to safe prosthodontic design. Ante's Law, which tells that the total peri-cemental area of all abutment teeth supporting a fixed dental prosthesis should be equivalent to or greater in peri-cemental area than the tooth or teeth to be replaced.<sup>[57]</sup>

It can, consequently, be concluded that as long as prosthodontic treatment is preceded by appropriate periodontal therapy, and that periodontal health is well maintained, it is unlikely that periodontal support will deteriorate with function when periodontal pockets are

less than 4 mm. The clinician should be aware, however, that increasing the span of the fixed dental prosthesis will increase the risk of non-periodontal complications.<sup>[2]</sup>

**Abutment Tooth Preparation:** The tooth preparation is prescribed by the aims of the final outcome instead of the initial tooth morphology. The marginal opening should be minimal to reduce the exposed cement line and subsequent leakage that will make the sequel in compromised oral hygiene [gingival inflammation]. Microscopically, all margins are open by about 100 µm, which is sufficient for penetration of bacteria.<sup>[39]</sup>

**The three determining features in the design of crown margin, are A) vertical location, B) horizontal width and C) shape.**

#### **A) Vertical placement**

**Supragingival margin:** The severity of gingival inflammation is synchronous to the vertical location of the crown margin. Whenever possible, margins should be supragingival because this is the most accessible location for evaluation.<sup>[40]</sup> Oral hygiene maintenance with the lowest gingival index scores,<sup>[32]</sup> atraumatic,<sup>[41]</sup> preparation of the tooth and finishing of the margin is easiest<sup>[42]</sup> and easy for detailing in an impression.<sup>[43]</sup>

**Ferrule Length:** Sorensen and Engelman 1990<sup>[44]</sup> redefined the ferrule effect as "a 360-degree metal collar of the crown encompassing the parallel walls of the dentine continuing coronal to the shoulder of the preparation." The restorative margin is encompassing 1 to 2 mm apical to the most apical extent of the foundation restoration or core buildup. [Figure 2]. This ferrule height may allow the masticatory forces to be dispersed onto the periodontal ligament instead of concentrating stresses at the post and core intraradically.<sup>[45]</sup> Libman and Nicholls 1995<sup>[46]</sup> recommended a ferrule of at least 1.5 mm. Some investigators have reported that a ferrule is not necessary.<sup>[47,48]</sup> They argued that the length of the post and

the type of cement used negate the concern about obtaining a ferrule.

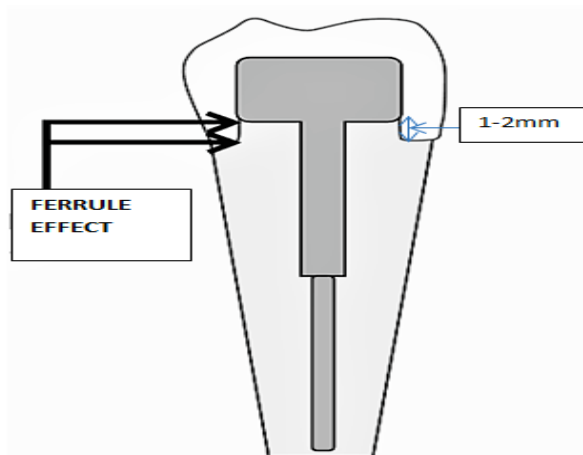


Figure 2: Ferrule Effect

**Subgingival margin:** Subgingival restorations can have damaging influences on the adjacent hard tissues and soft tissues, particularly when they infringe on the junctional epithelium and supracrestal connective tissue.<sup>[49]</sup> Subgingival restorations illustrated more qualitative and quantitative changes in the microbial flora, GCF, gingival recession, pocket depth, increased gingival and plaque index.<sup>[3]</sup>

Maynard and Wilson 1979<sup>[50]</sup> recommended a minimum of 3 mm of attached gingiva in the presence of subgingival restorative therapy. According to Valderhaug & Heloe 1977<sup>[51]</sup> after five years of treatment, there was significant caries around preparation margins that were extended subgingival (30%) than those extended supragingival (15%). Possible solutions to the exposed tooth–prosthesis junction, such as the use of collarless metal ceramic retainers.

**B] Horizontal width:** Teeth are elongated as a result of the gingival recession and clinically evident as narrower teeth cervically. Contribute the tooth preparation narrow and mechanically undermine. The operator should consider a more conservative preparation; a narrow metal

margin could be a suitable option to avoid creating plaque-retentive features.

(A) Conservative margin (0.5 mm) for metal. (B) A 1-mm-wide margin for all ceramic. (C) A wide margin (1.2–1.5 mm) for the metal-ceramic.<sup>[2]</sup>

**Design of The Tooth Preparation Margin:** The feather-edge margin is the least destructive margin preparation because it involves only axial reduction. This design is suggested if the preparation extends to the root surface. The feather-edge margin is also ideal for periodontally involved teeth with gingival recession.<sup>[52]</sup>

### C] Morphology of the prosthesis: [shape]

**Contour:** Over-contoured prostheses with large convexities sequel in amassment of food and gingival inflammation and under-contouring do not.<sup>[53]</sup> A straight profile in the gingival third facilitates the establishment of an accurately contoured prosthesis. Widening the profile gingivally is associated with over-contoured prostheses.

**Furcation Considerations:** Root anatomy and the coronal tooth structure are important factors to be considered when preparing teeth with furcation involvement. The dentist also should avoid removing bone in the furcation area.<sup>[54]</sup> The fabricated crown form should have a flat emergence profile coronally so that there is no undercut to trap food or plaque and the crown should recreate the contours of the furcation, to merge or blend with the coronal aspects of the crown to reduce cleaning difficulty in these areas.<sup>[2]</sup>

### Interproximal Contacts

The axial surface below the contact point should be flat to simplify the use of floss. Suitably contoured interproximal contact should be in the occlusal third. Very high interproximal contact can sequel food impaction. Wide and gingivally located interproximal contact will result from gingival inflammation.<sup>[55]</sup>

## Management of Gingival Recession

A way of resembling the gingival tissues is to use ceramic of a gingival color. Gingival colored ceramic can also be affixed to the gingival embrasure area where there are black triangles to simulate interdental papilla, it may also decrease or stop soft-tissue proliferation.<sup>[56]</sup>

## Hypersensitivity And Biocompatibility

All materials used in the oral cavity must be biocompatible,<sup>[2]</sup> alloys containing nickel, which must be bypassed in patients with a nickel allergy. However, in patients with lichenoid or erosive lesions locally related to the prosthesis, replacement of the prosthesis should be considered along with dermatologist consultation.<sup>[11]</sup>

## Conclusion

A healthy periodontium is a prerequisite for success of restorative treatments. Case selection is therefore essential, with patient compliance and motivation to maintain a disease-free mouth being particularly important. The endurance of the restorations and oral health maintenance were improved with regular recalls, patient co-operation, and motivation along with pristine periodontal health.

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