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Review Article

Prosthodontic Determinants of Peri-Implant Tissue Health: A Narrative Review

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ABSTRACT

Peri-implant tissue health is a critical determinant of long-term implant success and patient satisfaction. While osseointegration remains the biologic foundation of implant dentistry, prosthodontic factors significantly influence the maintenance of peri-implant hard and soft tissues. Contemporary evidence suggests that restoration design, implant-abutment connection, emergence profile, retention type, occlusal loading, restorative material, and maintenance protocols collectively affect the incidence of peri-implant mucositis and peri-implantitis. This review summarizes current evidence regarding prosthodontic considerations that contribute to peri-implant tissue stability and discusses contemporary strategies to minimize biologic and mechanical complications. Special emphasis is placed on emergence profile design, cement excess, prosthetic contours, occlusal overload, restorative material selection, and maintenance therapy. Understanding these factors enables clinicians to optimize peri-implant health and improve long-term treatment outcomes. [1–5]

INTRODUCTION

Dental implant therapy has become a predictable and widely accepted treatment modality for the replacement of missing teeth. Over the last five decades, implant dentistry has evolved remarkably owing to advances in implant surfaces, prosthetic materials, digital workflows, and biologic understanding of osseointegration. Pjetursson et al. reported substantial

improvements in implant survival and reduction in complications in newer implant literature compared with earlier publications. Similarly, Buser et al. highlighted the transition of implant dentistry from a surgically driven approach toward a prosthetically and biologically integrated discipline. [1,2]

Despite high survival rates, biologic complications such as peri-implant mucositis and peri-implantitis

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remain major concerns. The 2017 World Workshop classified peri-implant mucositis as a reversible inflammatory lesion confined to soft tissues, whereas peri-implantitis involves inflammation associated with progressive supporting bone loss. Prosthodontic factors are now recognized as major contributors to these conditions. [3–5]

Modern implant prosthodontics therefore aims not only to restore function and esthetics but also to maintain long-term peri-implant tissue stability. This review discusses current evidence regarding prosthodontic determinants of peri-implant tissue health and presents contemporary clinical considerations for successful implant rehabilitation.

Biology of Peri-Implant Tissues

The peri-implant mucosal seal acts as a protective barrier against bacterial invasion. Berglundh et al. first described similarities and differences between peri-implant mucosa and periodontal tissues, noting that peri-implant tissues possess fewer vascular structures and collagen fibers oriented parallel to the implant surface. [7]

Abrahamsson et al. and Hermann et al. further demonstrated the establishment of biologic width around implants. The biologic width around implants generally consists of junctional epithelium and supracrestal connective tissue attachment. Disturbance of this biologic dimension by restorative components may lead to marginal bone remodeling and inflammatory reactions. [8–10]

Peri-Implant Diseases

Peri-implant mucositis is characterized by bleeding on probing without radiographic bone loss, whereas peri-implantitis includes inflammation associated with progressive bone destruction. Schwarz et al. emphasized that plaque accumulation is the principal etiologic factor, but prosthetic design may significantly influence plaque retention and disease progression. [4]

Heitz-Mayfield and Salvi reported that peri-implant mucositis is reversible when plaque control is improved. However, untreated inflammation may progress to peri-implantitis. [5]

Table 1: Differences Between Peri-Implant Mucositis and Peri-Implantitis

Feature	Peri-implant mucositis	Peri-implantitis
Inflammation	Present	Present
Bleeding on probing	Present	Present
Suppuration	Occasional	Common
Bone loss	Absent	Progressive
Reversibility	Reversible	Irreversible
Main treatment goal	Plaque control	Infection control and defect management

Prosthetic Contour and Emergence Profile

Restorative contour strongly influences peri-implant plaque accumulation and cleansability. Katafuchi et al. demonstrated that convex restorative contours were associated with a significantly increased risk of peri-implantitis. Similarly, Yi et al. found that overcontoured prostheses and inadequate cleansability correlated with peri-implant disease prevalence. [16,17]

Chan et al. described the importance of emergence profile in preserving peri-implant tissues. Excessive emergence angles may compress soft tissues and hinder oral hygiene procedures. [18]

Figure 2: Ideal vs Overcontoured Emergence Profile

[Insert comparative illustration: A. Ideal emergence profile with cleansable contour B. Overcontoured restoration causing plaque retention]

Clinical Recommendations

- Emergence angle should ideally remain below 30 degrees.
- Avoid excessive convexity in subgingival contours.
- Design restorations that facilitate plaque removal.



- Consider patient dexterity during prosthetic planning. [16–18]

Cement-Retained versus Screw-Retained Restorations

The choice between cement-retained and screw-retained restorations remains controversial. Wittneben et al. and Nissan et al. reported comparable survival rates for both retention systems; however, biologic complications were more common in cement-retained restorations due to residual cement. [6,14,15]

Wilson demonstrated a strong relationship between excess cement and peri-implant disease using endoscopic evaluation. Linkevicius et al. further showed that deeper restorative margins significantly increased the amount of undetected residual cement. [11,12]

Staubli et al., in a systematic review, confirmed that excess cement is an important risk factor for peri-implant disease. [13]

Table 2: Comparison Between Screw-Retained and Cement-Retained Prostheses

Parameter	Screw-retained	Cement-retained
Retrievability	Excellent	Limited
Esthetics	Moderate	Excellent
Passive fit	More technique sensitive	Better compensation
Residual cement risk	None	Present
Maintenance access	Easier	Difficult
Biological complications	Lower	Higher

Figure 3: Residual Cement Around Implant Restoration

[Insert clinical schematic showing:

- Cement extrusion
- Peri-implant inflammation
- Bone loss progression]

Clinical Implications

- Screw-retained restorations are preferred whenever feasible.
- If cementation is necessary, supragingival margins should be used whenever possible.
- Radiopaque cements and meticulous cement removal protocols are recommended. [11–15]

Implant-Abutment Interface and Microgap

Microgaps at the implant-abutment interface may permit bacterial leakage and micromovement. Zipprich et al. described the biomechanical implications of micromovement, whereas Dibart et al. demonstrated bacterial penetration across implant-abutment interfaces in vitro. [28,29]

Pessoa et al. reported that connection geometry influences stress distribution around implants. Platform switching and conical internal connections may reduce crestal bone remodeling. [30]

Figure 4: Implant-Abutment Microgap

[Insert illustration demonstrating:

- Microgap formation
- Bacterial colonization
- Crestal bone changes]

Restorative Materials and Surface Characteristics

The choice of restorative material affects soft tissue response and bacterial adhesion. Linkevicius and Apse reviewed the influence of abutment materials on peri-implant tissues and suggested favorable tissue responses around zirconia abutments. [20]

Scarano et al. and Roehling et al. reported lower bacterial adhesion on zirconia surfaces compared with titanium surfaces. Sailer et al. demonstrated excellent clinical outcomes for all-ceramic restorations in terms of esthetics and biologic compatibility. [21–23]

Table 3: Comparison of Titanium and Zirconia Abutments

Feature	Titanium	Zirconia
Strength	Excellent	Good
Esthetics	Moderate	Excellent
Bacterial adhesion	Higher	Lower
Soft tissue response	Favorable	Highly favorable
Cost	Lower	Higher

Figure 5: Titanium vs Zirconia Abutments

[Insert comparative image showing:

- Gray shine-through with titanium
- Improved soft tissue esthetics with zirconia]

Occlusal Considerations

Biomechanical overload may contribute to peri-implant bone loss and prosthetic complications. Misch emphasized the importance of implant-protected occlusion to minimize excessive stress. [24]

Fu et al. proposed clinical indicators of occlusal overload including screw loosening, porcelain fracture, and marginal bone loss. Isidor and Naert et al. discussed the relationship between overload and peri-implant bone changes, though evidence remains somewhat controversial. [25–27]

Principles of Implant-Protected Occlusion

- Axial loading whenever possible
- Reduced cusp inclination
- Narrow occlusal tables
- Elimination of premature contacts
- Controlled cantilever length [24–27]

Figure 6: Implant-Protected Occlusion

[Insert occlusal schematic illustrating:

- Axial force direction
- Reduced cusp inclination
- Narrow occlusal table]

Oral Hygiene and Maintenance Therapy

Maintenance therapy is essential for preventing peri-implant diseases. Serino and Ström found a strong association between inadequate plaque control and peri-implantitis. [19]

Costa et al. reported significantly lower peri-implant disease prevalence among patients enrolled in preventive maintenance programs. Monje et al. and Ramanauskaite et al. confirmed that supportive peri-implant therapy reduces implant loss and peri-implantitis incidence. [31–33]

Table 4: Components of Supportive Peri-Implant Therapy

Component	Purpose
Oral hygiene reinforcement	Plaque control
Professional debridement	Biofilm disruption
Occlusal evaluation	Reduce overload
Radiographic assessment	Detect bone loss
Prosthesis inspection	Identify mechanical issues
Risk factor modification	Smoking/diabetes control

Maintenance Recall Schedule

- Low-risk patients: every 6 months
- Moderate-risk patients: every 3–4 months
- High-risk patients: every 3 months [31–33]

Contemporary Trends and Future Directions

Digital dentistry has significantly improved prosthetic precision and emergence profile customization. CAD/CAM technology enables fabrication of individualized abutments and restorations with improved biologic compatibility. [2]

Current research is focusing on:

- Platform switching concepts
- Tissue-level implants
- Bioactive implant surfaces
- AI-assisted prosthetic design
- Digital occlusal analysis



- Personalized maintenance protocols

Long-term prospective clinical studies are still required to establish evidence-based prosthodontic guidelines for peri-implant tissue preservation.

CONCLUSION

Peri-implant tissue health is profoundly influenced by prosthodontic design and maintenance strategies. Restoration contour, emergence profile, retention mechanism, implant-abutment connection, restorative material, and occlusal loading collectively determine the biologic response around implants. [6,16–18,24–30]

Contemporary evidence strongly supports prosthetically driven implant planning with emphasis on cleansability, retrievability, soft tissue preservation, and maintenance accessibility. Screw-retained restorations, controlled emergence profiles, zirconia components, and regular supportive therapy appear beneficial in minimizing peri-implant disease risk. [11–23,31–33]

Successful implant therapy therefore requires a multi-disciplinary biologic and prosthetic approach aimed not merely at implant survival but at long-term peri-implant tissue stability and patient satisfaction.

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