Relationship Between Periodontics and Prosthodontics: The Two-Way Street

Abstract

The interdisciplinary approach has been a trend for a comprehensive dental treatment. Within modern dentistry, periodontics and prosthodontics share an intimate and inseparable relationship in multiple aspects, including treatment plan, procedures execution, outcome achievement and maintenance. By controlling inflammation and preparing sites for proper prosthetic prostheses, periodontists no doubt can provide a solid foundation for successful prosthetic outcomes. On the other hand, prosthodontists could construct proper restorative margin, shapes and contacts that benefit the harmony of periodontium and prosthesis. This article was aimed at addressing the key relationship between prosthodontics and periodontics. The impacts of healthy periodontium on longevity of prostheses were addressed. In addition, how the restorative factors such as biologic width violation, retraction techniques and defective restorations, influenced on periodontal peri-implant tissues were also discussed. This systematic review also comprised the association between the presence of residual cement and the occurrences of peri-implant diseases. In short, frequent and efficient communications are essential between periodontists and prosthodontists through the entire treatment procedures to ensure an overall successful treatment since both specialties share a common goal: to create pleasing esthetic with a harmonious stomatognathic system.

Keywords: Periodontics, restorative, prosthodontics, implant, biologic width, inflammation

Introduction

Comprehensive dental therapy is founded on team works. Of all disciplines within modern dentistry, periodontics and prosthodontics have the strongest and the most intimate connections. For prosthodontics, periodontal health plays an important role on the longevity of restorations. On the other hand, defective prostheses may contribute to progression of periodontal diseases. To achieve successful treatment outcomes, periodontists and prosthodontist should cooperate in treatment plan, per-
formance and maintenance.

This review attempted to address the key relationship between periodontics and prosthodontics. The interaction between periodontal health and prosthetic factors were discussed as well as the recent hot issues related to dental implants.

The impacts of periodontal/implant health on prosthetic therapy

Prior to treatment plan, tooth prognosis should be addressed both on individual tooth and the overall dentition. Several periodontal prognostication systems have been introduced based on either periodontal stability or certain parameters, such as furcation involvement, tooth mobility, the severity of bony destruction, etc. Through identifying the etiology and contributing factors of periodontal diseases, these prognostication systems indicate the possibility of tooth sustainability in short term and long term. As an integral portion of dental practice, determination of individual teeth prognosis allows a virtual approach on interdisciplinary conversation for treatment strategies. Overall prognosis is beneficial to communications between lay people and professionals.

Active periodontal/peri-implant diseases and contributing factors should be eliminated or controlled prior to prosthetic constructions. The signs of active periodontal inflammation include pocket formation, the presence of bleeding on probing or suppuration, and tissue changes of gingiva. Without controlling the existing periodontal inflammation, a cascade of adverse events of periodontal destruction would take place and cause persistent inflammation, bone resorption and eventually tooth loss. In other words, function and lifespan of the prosthesis will be compromised if periodontal diseases remain uncontrolled after delivery. In addition, periodontal inflammation results in soft tissue changes in terms of texture, color, size and gingival consistency. It then leads to impaired esthetic outcomes by deteriorating the harmony between periodontium and prosthesis.

In addition to inflammation control, periodontists could offer a hand for soft and hard tissue management to prepare sites for successful prosthetic treatments. Surgical procedures, such as ridge and bone augmentation as well as sinus lifting, could be performed for future implant sites to correct existing ridge deformities. Although the effects of mucogingival defects on periodontal/peri-implant inflammation remained inconclusive, mucogingival procedures may also benefit esthetic outcomes and oral health maintenance.

Regular periodontal maintenance is a key to reduce the incidence of tooth or implant loss following prosthetic therapy. Due to limitation of routine home cares, regular professional maintenance therapy plays a key role on reduction of periodontal inflammation induced by plaque accumulation, especially in the subgingival space. For those patients who had history of periodontitis, regular supportive periodontal therapy is even more beneficial to prevent further disease progression. Previous studies showed that sites with treatment but without maintenance had a 2 times higher tooth loss than the sites with regular maintenance after periodontal treatment. A recent study even showed a 3 time higher tooth loss in the irregular compliers comparing with patients with regular maintenance over a 5-year observation period. Besides, the results also showed that the majority of these teeth were missing due to periodontal origins. In other words, regular compliance of periodontal maintenance is the key to prevent the recurrence of periodontal diseases and to maintain the integrity of treatment outcomes.

The impacts of prosthetic factors on periodontal/peri-implant health

Prostheses should be carefully designed and performed, in harmony with the surrounding periodontium, to maintain periodontal/peri-implant health. Defective restorations contribute to disease progression by increasing accumulation of dental plaque and retention of food debris. Invasion of biologic width may also result in periodontal inflammation.

Biologic width

The dimension of dentogingival complex, called “biologic width (BW)”, is a cuff-like barrier that acts as a protective physiological seal around natural teeth. It possesses a self-restoration capacity and dynamic adaptability. The compositions of BW include junctional epithelium and connective tissue attachment. The mean distance of epithelial and connective tissue components are 0.97mm and 1.07mm, respectively. However, the dimension is dynamic in particular the epithelial attachment, varying from individuals. Similar to natural teeth, a consistent width of peri-implant mucosa was found adhering to the surface of the
implant abutment. Histologically, it prevents further supragingival plaque formation via a zone of healthy connective tissue separating the inflammatory cell infiltration and alveolar bone crest.  

The violation of BW has been widely discussed as a contributing factor which jeopardizes periodontal health. BW invading could result from several reasons, such as extensive caries, subgingival restorations, short clinical crown, and teeth fracture. From human autopsies, Vacek and coworkers reported greater length of epithelial attachments around restored teeth than non-restored teeth. In the group with supracrestal amalgam restorations, BW violation would also lead to significant increases of gingival recession and crestal bone loss. Resulting from the breach of BW, histologically, attachment loss will be found to reestablish the certain dentogingival junction around restorations and lead to periodontal destruction. Clinically, the signs of BW violation consist of pain, gingival inflammation, localized gingival hyperplasia, pocket formation, and loss of periodontal apparatus. Therefore, further corrective procedures should be considered prior to restorative treatments if any qualms about BW violation, including orthodontic extrusion and surgical crown lengthening procedures.

Surgical crown lengthening could be performed via multiple techniques: gingivectomy, apically positioned flap surgery (APF), APF with osseous reduction. From periodontal point of views, several parameters should be taken into account for the feasibility of this surgery: esthetics, possible exposure of furcation involvement, remaining bony support and crown/root ratio for the future results. In spite of individual and sites variations, a minimum of 3mm distance from bone to the restorative margin has been suggested by most researches. The ferrule effect for the future prosthetic design should also be a key factor in determination of the surgical plan. Post-operatively, final prostheses should only be delivered once the tissue maturation was completed. A minimum of 6-8 weeks of healing period is highly recommended following surgical crown lengthening that without bone resection. From a total of 85 teeth of 25 patients, Bragger and coworkers found that 12% of teeth sites showed further apically marginal displacement between 6 weeks to 6 months post-operatively. As a result, 6 months of waiting period should be taken in those sites with high esthetic demands or sites with bone removal. Hence, communication prior to treatments between periodontists and prosthetists is essential to determine the treatment timeframe, feasibility of surgery and the locations of restorative margins.

Most researchers believe that BW is one of the causes of early implant bone loss. During the initial phase of implant healing, peri-implant bone remodeling is from the process of BW reformation to allow a stable soft tissue barrier. In addition, the locations of micro-gaps and smooth/rough-surface interfaces may be associated with the length of peri-implant BW. Thus, one of the strategies to prevent early implant bone resorption is control of biologic width and microgap. In 2006, Lazar and Porter introduced the concept of "platform-switching" for inward horizontal repositioning of the implant-abutment junction. Via connecting the implant fixture with a narrow-diameter abutment, the inflammatory cell infiltration could be limited around the implant neck with platform-switching design, instead of further apical migration. Previous studies suggested that platform-switching may benefit tissue preservation. On the other hand, limited effects of platform-switching on hard tissues have been claimed by some authors. The clinical significances of effects on marginal bone preservation may be questioned. In conclusion, the available data remained controversial and further longitudinal studies are still needed.

Proximal relationship

Embrasure types, referring both horizontal and vertical dimensions of the interproximal spaces, show impacts on the presence of interproximal papilla. Loss of interproximal papilla results in impaired esthetics and promotion of food impaction, aggravating periodontal destruction. As for the distance from contact point to the alveolar crest, the maximum of the distance should not exceed more than 5mm to preserve the interdental papillae in natural dentition. This concept has also been confirmed by a retrospective study examining the vertical dimension between single implant restorations and a natural tooth. The demands for implant-support prosthesis are more strict: a minimum of 3mm of inter-implant distance is suggested to maintain the alveolar crestal level, preventing the possible papillary loss; whereas papillary loss would be expected if the verti-
cal dimensions between two implants is more than 3mm. Contact types between prostheses may also play a role on periodontal health. The relationship between open contacts and periodontal destruction has been a controversial issue since last century. To verify the impacts of open contacts on periodontium, Jenberg and colleagues conducted a cross-sectional study enrolling 104 patients with unilateral open contacts. In addition to greater prevalence of food impaction, the sites with open contacts presented greater pocket depth and clinical attachment loss although there was no significant difference for gingival index, bleeding and calculus index between contact types. Moreover, another cross-sectional study reported an increase of bone loss (2.4%) in the patients with initiate periodontitis. However, another classic study failed to approve the trend from a total of 1040 contacts. On the other hand, the authors suggested the increasing pocket depth may be in relation to the presence of food impaction. In spite of an indirect relationship between open contact and periodontal inflammation, it could be speculated from these studies that food impaction contributes to increasing pocket depth and clinical attachment level. Thus, clinicians should avoid to place open contacts between fixed prostheses. Meanwhile, through proximal cleaning should be addressed to patients.

**Restoration contours**

Adequate crown contours could provide protection of gingival margins, allow cleansing action of the musculature and facilitate the access for oral hygiene. Indeed, overcontour may have negative influence on periodontium since it increases plaque retention. Utilizing acrylic facings as standard overcontour, Sackett and Gildenhuys compared tissue changes at 42 pairs of experimental and control sites (adjacent teeth) over a period of 42-49 days. 59% of mandibular test sites and 70% of maxillary test sites showed significant gingival inflammation in relation to overcontour. Besides, more than 50% of these sites had increasing amount of gingival sulcular fluid compared with their controls.

Restorative overhang is also considered as a contributing factor of periodontal diseases. As a prevalent type of restorative defects, filling excess may aggregate the plaque accumulation which potentiates gingival inflammation and worsen the periodontal status. Evaluating 100 patients, Jeffcoat and Howell classified overhang into 3 sizes: small (<20% of the interproximal space), medium (20-50%) and large (>50%). A significant marginal bone loss affiliated to the restoration occupied more than 20% of interdental space. Vice versa, removal of overhang may also benefit the reduction of pocket depth and clinical attachment gain.

To sum up, restorative overhang should be prevented by the proper uses of matrix bands and wedges. Meanwhile, inadequate crown reduction for the restorative material should be avoided to prohibit the overcontoured crown.

**The location of restorative margins**

Restorative margin locations should be established based on several factors, including extension of caries, retention/resistance forms, and esthetics. Using free gingival margin as the references, the supra- and subgingival restorations have their own pros and cons. With respect to periodontal health, the supragingival restoration is the most favorable design since it is easy to be cleaned. In spite of better esthetics, subgingival restorations were associated with greater periodontal inflammation in the sites with keratinized gingiva less than 2mm. In addition to tissue biotype, subgingival restorative margins may be harmful to periodontium/peri-implant tissues because of the following reasons. First, the margin has higher risk of BW invasion, enhancing further periodontal destruction. From 59 patients, Newcomb investigated a total of 75 anterior veneer crowns with subgingival margins. A strong positive correlation was found between gingival inflammation and the subgingival extension of restorative margins. The limited access is another possible cause when restorative margins are placed subgingivally. In particular amalgam or composite resin fillings, it is difficult for operative dentists to polish restorations and thereby produce rough surfaces underneath gingiva. Rough surfaces are more prone to accumulate dental plaque and, therefore, induce periodontal inflammation. Likewise, overhang and improper restorative margins could be ascribed to the progression of periodontal destruction due to the inclination of plaque accumulation. Even though subgingival cementation margin is a common procedure on the implant in esthetic zone, moreover, it is difficult to discover the excess cement residuals around subgingivally placed implants. Investigating the amounts of undetected cement following cleaning, Linkevicius and coworkers...
found significantly greater cement remnants were linked to deeper subgingival margin positions. The lack of perpendicular fiber attachment around dental implants may even facilitate the apical migration of cement excess and worsen the tissue inflammation. Furthermore, the efficacy of proper oral hygiene maintenance is questioned for extensively subgingival restorations. The penetration depths of plaque control methods for homecare is within 1-3mm subgingivally, such as mouth rinsing, toothbrushing, and interproximal cleaning. In regards to subgingival irrigation, American Academy of Periodontology (AAP) positioned paper suggested a 3mm of subgingival penetration or 50% of the probing depth.

To prevent periodontal destruction, in conclusion, supragingival restorative margins are highly recommended at the sites with less esthetic concerns. For the site that the subgingival margin is required, certain principles should be bear in mind including conservative subgingival extension of restorative margin, sufficient width of keratinized gingiva (at least 2mm of keratinized gingiva including 1mm of attached gingiva), smooth restorative surfaces with proper finished margin and the avoidance of BW breach. Adequate daily home care needs to be addressed to patients and regular professional maintenance is necessary.

**Trauma from occlusion**

As a functional unit, the tooth and its supporting structures bear the brunt of occlusal forces on the crown. In response to occlusal forces, the attachment apparatus may experience tissue changes, including injury, repair and adaptive remodeling of the periodontium. Several factors are relative to trauma from occlusion (TFO) including occlusal disharmony, parafunction (i.e. clenching and bruxism), and occlusal schemes. Although the role of TFO plays in periodontal/peri-implant diseases remains controversial, clinicians should perform prosthetic treatments with caution to avoid failure following TFO.

As a result of excessive force or reduced periodontal supports, teeth under TFO or occlusal trauma showed following clinical characteristics: tooth pain, increasing tooth mobility, sensitivity to percussion, fremitus, occlusal wear and even tooth fracture. The radiographic changes consist of PDL space widening, disruption of the lamina dura, root resorption and peri-apical or furcation radiolucency. Some researchers believe it may aggravate the existing periodontal destruction as a co-destructive factor along with inflammation. Previous studies also demonstrated a significant role of tooth mobility on progression of periodontal diseases. A cross-sectional study examined the signs of TFO and severity of periodontitis from 333 maxillary first molars of 300 patients. In comparison with teeth without TFO, the group with TFO had significantly greater probing depth, greater clinical attachment loss and less bone support. In the late stage, chronic TFO may cause tooth migration and loss of vertical dimension, enhancing impaired esthetics and the need of oral rehabilitation.

Occlusal overloading also causes biomechanical implant complications and marginal bone loss around dental implants. By creating supra-occlusion, Miyata and coworkers investigated the effect of occlusal overload on peri-implant tissue in a series of studies. It showed that the excess occlusal force could initiate marginal bone resorption even under the circumstance of healthy peri-implant tissue. In addition, the disease may not be reversed once it progressed. With the persistence of excessive force, loss of osseointegration is possible and end up with implant failure. Other clinical manifestations of biomechanical implant complications include fracture of prosthetic components and loosening of attachment or abutment screw. In addition to implant overdosing, several factors may contribute to biomechanical implant complications, including bone quality, implant designs, prosthetic design, and parafunction. To deal with mechanical complications, check occlusion is the first step to verify the etiologic factors. All possible contributing factors should also be controlled or eliminated before repair or replacement of loosening/fractured components. Non-surgical or surgical intervention may be considered in the treatment of marginal bone loss. Ultimately, the patient is highly recommended to wear the occlusal splint to prevent the recurrence of biomechanical complications.

**Gingiva retraction technique: the effects on soft tissue**

An acceptable impression was needed to avoid improper marginal adaptation that may cause periodontal tissue inflammation or the risk of recurrent caries. Management of the gingival tissue is essential for obtaining acceptable impression especially for subgingivally located restorations. Various gingival displace-
ment methods, such as mechanical, chemomechanical and surgical are available. Ruel and coworkers reported that gingival displacement methods may cause 0.1-0.2 mm gingival recession and the destruction of the junctional epithelium that took 8 days to heal\textsuperscript{[81]}. Chemical agents as well as the mechanical force of retraction cords could trigger temporary gingival recession and gingival inflammation\textsuperscript{[82,83]}. It has been shown that the different time intervals of the chemical retraction agent placement could cause different degree of tissue inflammation changes in the beginning\textsuperscript{84}. Hence, the proper manipulation different gingival retraction techniques such as materials and time-control are the key factors to avoid permanent tissue damage while impression-taking process is made.

Recently, cordless techniques have been introduced as an alternative to displacement cord methods because of several advantages, such as time-saving, ease of application, less pressure generation and enhanced patient comfort while being minimally invasive\textsuperscript{[85,86]}. Acar and colleagues evaluated the clinical performance and impression quality on the cordless and conventional displacement systems. The results demonstrated that all methods can give the comparable and clinically acceptable impression qualities except for the nonimpregnated cord group\textsuperscript{87}. Furthermore, a randomized clinical trial was conducted to assess the clinical and immunological factors related to conventional and cordless techniques. The results demonstrated the cordless method was less stress for patients and resulted in lower post-treatment levels of inflammatory cytokines\textsuperscript{88}.

**Current hot issue**

Peri-implant diseases are multi-factor diseases with signs of peri-implant tissue inflammation\textsuperscript{89}. Residual excessive cement around cement-retained implant-supported restorations is related to peri-implant complications\textsuperscript{90,91}. To investigate the association between residual cement and peri-implant diseases, Wilson used a dental endoscope to explore the subgingival spaces around implants with or without signs of peri-implant inflammation. The majority of diseases population (80.95%) had retained cement whereas controls showed none\textsuperscript{92}. The inflammation could be ascribed to the creation of rough surfaces by leaving excessive cement in the subgingival space, promoting the biofilm formation. The cement leaving more excess tend to have greater peri-implant bone loss and higher prevalence of peri-implant inflammation\textsuperscript{93}. Moreover, modifications on implant abutment and cementation techniques were also introduced to limit the amount of cement extending into the gingival sulcus of implant-retained crowns\textsuperscript{94,95}. Fortunately, most of the cement-associated peri-implant diseases could be solved following complete removal of residual cement\textsuperscript{92}. Recently, the use of zinc oxide-eugenol cement is advocated since the subgingival residuals could be dissolved in the sulcular fluid\textsuperscript{93}. Further studies are still needed to prevent the peri-implant inflammation induced by residual excessive cement.

**Conclusion**

The relationship between prosthodontics and periodontics is intimate and inseparable. Robust supporting periodontal/peri-implant tissues provide solid foundations for predictable prosthetic therapy. In addition, regaining stable periodontal conditions should rely on establishment of proper contact types, occlusal scheme and quality prosthesis. Frequent and efficient communications are essential between periododontists and prosthodontists through the entire treatment procedures, including plan, treatment procedures and maintenance, since both specialty share a common goal: to create pleasing esthetic with a harmonious stomatognathic system.

**References**