

Perio-Prosthodontics Interrelationship: A Review

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Abstract

For a comprehensive dental treatment the interdisciplinary approach has been a trend. Within modern dentistry, periodontics & 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 & prosthesis.

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I. Introduction

Multidisciplinary approach is the “*sinequanon*” for attaining long term therapeutic target of comfort, good function, treatment predictability, longevity & ease of restorative & maintenance care.¹Of 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.²

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.³

The signs of active periodontal inflammation include pocket formation, the presence of bleeding on probing or suppuration, and tissue changes of gingiva. 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. Regular periodontal maintenance is a key to reduce the incidence of tooth or implant loss following prosthetic therapy.³

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.³

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. 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.³

Prostho-Perio interrelationship

Restorative clinicians must understand the role of biologic width in preserving healthy gingival tissues and controlling the gingival form around restorations. They must also apply this information in the positioning of restoration margins, especially in the esthetic zone. The dimension of space that the healthy gingival tissues occupy above the alveolar bone is identified as biologic width. A clinician is presented with three options for margin placement: supra-gingival, equigingival and sub-gingival. The greatest biologic risk occurs when placing sub-gingival margins.⁴

When determining where to place restorative margins relative to periodontal attachment, it is recommended that patients' existing sulcular depth be used as guideline in assessing the biologic width requirement for that patient. If the sulcus probes 1.5 mm or less the restoration margin should be placed 0.5 mm below the gingival tissue crest. If the sulcus probes more than 1.5 mm, margin should be placed half the depth of the sulcus below the tissue crest. If sulcus greater than 2mm is found, gingivectomy can be performed to lengthen the tooth. If a patient experiences tissue discomfort when the restoration margin levels are being assessed with a periodontal probe, it is a good indication that the margin extends into the attachment and that a biologic width violation has occurred. A more positive assessment can be made clinically by measuring the distance between the bone and the restoration margin using a sterile periodontal probe. The probe is pushed through the anesthetized attachment tissues from the sulcus to the underlying bone. If this distance is less than 2mm at one or more locations, a diagnosis of biologic width violation can be confirmed. This assessment is completed circumferentially around the tooth to evaluate the extent of the problem.⁴

Pre prosthetic periodontal evaluation phase

The periodontal examination of a patient for any type of prosthetic treatment is important for the prognosis and success of treatment. The periodontal examination must include the status of oral hygiene, status of bacteriaaccumulation, degree of reversible and irreversible damage to periodontal tissues, gingival biotype, functional and static occlusion and mobility of teeth. The objective at this stage is to diagnose any periodontal conditions that would either compromise the construction of the denture or compromise the prognosis for a successful therapeutic outcome.⁵

Pre prosthetic periodontal procedures

Non-Surgical Procedures

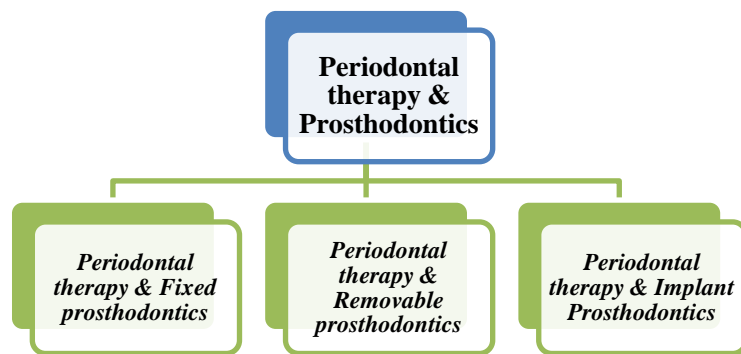
Routine non-surgical periodontal care has two basic components: Effective daily plaque removal by the patient and Supportive periodontal therapy (SPT) every 2 to 6 months. Generally patients are not able to remove all the plaque from all surfaces of teeth throughout the day but a good immune system can resist detrimental effects of residual plaque. Being the most conservative and non-invasive periodontal treatment, Scaling and root planning (SC/RP) is also termed as the basic supportive periodontal therapy (SPT). This therapy can give the greatest level regain of the clinical attachment loss as compared to any other therapeutic technique. It also aids in an improvement in oral microbial composition which in turn, helps in reduction of pocket depth and also reduction in bleeding sites. It is cost effective and has minimal side effects in comparison to surgical techniques.⁵

Surgical Procedures

Surgical periodontal therapy is indicated in cases where

1. Continued bone loss in a patient who has had SC/RP and is on a 2- to 3-month periodontal maintenance schedule
2. The need for making more cleansable gingival contours.
3. The need to clean root surface that are in accessible non-surgically.

Though Surgical periodontal therapies help maintain a healthy periodontal status however they have their own biological costs. If health of periodontium is not maintained by a regular SPT, any type of surgical procedure may fail to give favorable outcomes.⁵



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I. Periodontal therapy & Fixed prosthodontics

1. *Use of retraction cord and effect on periodontium*

There is direct relationship between the time that retraction cord is in the sulcus and the potential for adverse gingival responses such as recession. It has been suggested that total cord retraction time ideally should not exceed 15 to 20 minutes. Factors other than time deserve consideration in using retraction cord and attempting to minimize soft tissue trauma. Too large a retraction cord or too many cords can cause excessive trauma. With healthy tightly adapted anterior gingival tissue, one small diameter cord usually produces adequate retraction without excessive trauma. Placing retraction cord in the gingival sulcus often severs the epithelial attachment, but healing occurs in a few days with no prolonged harmful effects if the procedure was carefully executed. The use of excessive instrument pressure when placing cord into the sulcus can produce extensive damage and recession.⁷

2. *Impression procedures*

An impression must provide detailed information about the prepared teeth, surrounding teeth, and associated soft tissues. The impression must record the form of all prepared surfaces and some of the unprepared tooth cervical to the finish line. Impression making of tooth preparations that extend subgingivally with an elastic material also has the potential for soft tissue abuse. Adequate gingival retraction is essential for predictable impression making. Although techniques for retraction have often been debated, the use of retraction cord has proved to be an effective method of soft tissue management during the impression phase. The placement of retraction cord and cotton strings into the gingival sulcus may cause injury to the sulcular epithelium. The damage inflicted to the soft tissue depends upon the chemical agent with which the cord has been impregnated, the force used in packing the cord and the length of time the cord is left in place within the sulcus. The force used to place the cords should be minimal to avoid forcing the cord into the subepithelial connective tissue. Most importantly prior to its removal, the cord should be moistened to avoid tripping the sulcular epithelium.^{8,9}

3. *The provisional restoration*

Provisional restorations serve many purposes, one of which is to preserve the position, form, and color of the gingiva while the definitive restoration is being made. To accomplish this goal, the soft tissue must rest in its normal location against a provisional restoration that is properly contoured, is well adapted to the finish line, and has smooth surface. Provisional fixed partial dentures must exhibit all of these attributes plus pontic and cervical embrasure forms that provide access to the soft tissue by oral hygiene aids. Gingival recession has been associated with improperly contoured provisional crowns and rough surfaces have been shown to promote plaque accumulation.¹⁰

4. *Pontic design*

Pontics and their relationship to soft tissue health have been described. Pontic design as found to be the most important factor in obtaining inflammation-free pontic-ridge relationships. Minimal soft tissue contact designs are biologically advantageous and the sanitary or hygienic design should be used whenever esthetics permit. Embrasures should be opened as much as practical to permit access with oral hygiene aids. Stein has described the ideal pontic design as "modified ridge lap" in the posterior region and a "lap facing" in the anterior region. Some authors prefer glazed porcelain for ridge contact whereas others indicate that after months there is no difference in soft tissue response to either porcelain gold or resin.⁴

5. *Crown contour*

Restoration contour has been described as extremely important to the maintenance of periodontal health.^{21,22} Ideal contours provides access for hygiene, has the fullness to create the desired gingival form, and has a pleasing visual tooth contour in esthetic areas. Evidence from human and animal studies clearly demonstrates a relationship between overcontouring and gingival inflammation, whereas undercontouring produces no adverse periodontal effect. The most frequent cause of overcontoured restorations is inadequate tooth preparations by the dentist which forces the technician to produce a bulky restoration to provide room for the restorative material. In areas of the mouth where esthetic considerations are not critical, a flatter contour is always acceptable.⁴

6. *Interproximal papilla and embrasure design*

The interproximal embrasure created by restorations and the form of the interdental papilla have a unique and intimate relationship. The ideal interproximal embrasure should house the gingival papilla without impinging on it and should also extend the interproximal tooth contact to the top of the papilla so that no excess space exists to trap food or to be esthetically displeasing. Embrasure contours might be more important than facial or lingual crown contours. The interproximal papilla responds rapidly to overcontouring of the embrasure region. It becomes inflamed and hypertrophied as a result of poor oral hygiene when the interproximal embrasure is impinged upon by overcontoured adjacent crown surfaces. Other factors may contribute to the papillary inflammation, often seen as splinted restorations. The papilla is likely to be inflamed because of the presence of subgingival margin on either side and is often constricted in an occlusal-gingival direction by the interproximal soldered connection.⁴

A study to determine whether there were embrasure dimensions that were more favorable to the health of the gingiva and underlying mucosa concluded that oral hygiene exerted a more important influence than the height of the embrasure. The ideal size of the interproximal embrasure is one that permits the introduction of cleaning aids for the removal of plaque in this most vital area. Embrasures that are excessively opened impact negatively upon esthetics, impair phonetics, and allow excessive lateral food impaction. The patient with normal clinical crown length often presents a dilemma when one is designing an ideal embrasure form. Interproximal height is often not sufficient to allow space for an interproximal brush without weakening the interproximal connector.⁴

7. *Occlusal considerations*

The relation between periodontal disease and occlusion has been long debated. It is generally accepted that the inflammatory aspects of the case should be addressed first and resolved before any occlusal considerations. The rationale is that resolution of inflammation will change the tooth-tissue relationship including relationship of teeth to the opposing dentition. After resolution of inflammation, the occlusion can be evaluated and any negative consequences addressed.

Occlusal therapy can be used to decrease loading of teeth that have lost bone due to periodontal disease. Clinicians should develop the skills to diagnose occlusal status, use splints (bonded external appliances, intracoronal appliances, or indirect cast restorations) for occlusal stability and develop techniques for occlusal adjustment (coronoplasty). Before considering splinting, the clinician must identify the etiology of the instability. Excessive occlusal forces from parafunction or deflective tooth contacts are frequent causes of excessive mobility. Whenever occlusion is the cause, occlusal therapy is always performed first. Occlusal therapy on periodontally involved teeth must produce an occlusal pattern that differentially loads individual teeth according to each tooth's periodontal bone support.

In addition, any inflammation of the periodontal supporting apparatus must be controlled before making a decision on splinting.⁴

II. Periodontal therapy & Removable prosthodontics

1. *Effect of Removable Partial Dentures on Plaque*

RPD wearing has been associated with alteration in quantity and quality of plaque. Addy and Bates stated that, whether a denture design is either close fitting or self-cleansing, plaque accumulation is higher with patients that have poor oral hygiene.¹¹ In a series of studies Ghamrawy E. et al have stated that plaque formation is enhanced on abutment teeth with increase proliferation of Spirilla and spirochetes than other bacterial strains.¹² Thus special tooth brushing techniques must be advocated to patients wearing RPDs as they are at high risk of developing periodontal disease. Bissada evaluated gingival response to coverage by partial dentures.¹³ All the design features were similar for these dentures except the relationship of the gingival tissues to the palatal plate and the material of denture. The results of the study showed that the coverage of gingival areas by RPD without relief and the acrylic based dentures showed overt periodontal inflammation that is appreciable both clinically and histologically, whereas the areas left uncovered by denture were the least affected. Based on the

results of this study a minimum distance of 5 to 6 mm away from the free gingival margins for major connectors was proposed. Similar observations were made in other studies on plaque accumulation due to RPD use. They concluded that a meticulous and persistent level of oral hygiene is required for patients wearing patients.^{14,15}

2. Effect of removable partial dentures on tooth mobility

Partial dentures are associated with increased tooth mobility of abutment teeth, which may be attributed to increase forces on abutments or dental plaque accumulation. Rigid Metal major connector directs less forces on abutment teeth than a non-rigid polymer based major connector. However care in planning and designing of RPD on a dental surveyor, selection of abutments and harmonizing occlusal contacts can decrease this harmful effect of RPDs on the natural teeth. If oral and denture hygiene are taken care of, forces from RPDs alone may not cause abutment tooth mobility.⁵

3. Effect of Components of removable partial denture on periodontal status of abutments

1. Direct retainer design

Direct retainers vary in shape, origin and materials according to the suitability and requirement of partially dentate situation. Direct retainers are considered to cause gingival recession and increase caries of abutment teeth. However if retainers are placed according to survey line and well supported by rests, they will not cause any harm to periodontal tissue. Some studies have showed that precision attachments are less damaging to periodontium than the clasp type retainers; this may be due to better vertical loading of abutments teeth. For distal extension bases mesial rest with I bar retainers were proven to be more favorable for longevity of abutment teeth. For periodontally compromised abutments bar retainers in the clasp type retainers and non-rigid retainers in the attachments type retainers were found to be favorable for periodontal health of abutment teeth than any other types of retainers. Newer composite materials have comparable retentive and mechanical properties as compared to cobalt chromium clasp.

Clasps made out of PEEK (Poly ether ether ketone) were found to have less flexural strength than cobalt chromium clasps, thus to achieve retention they would be made wider than cobalt chromium clasps, which may cause increase in plaque accumulation.⁵

2. Major and Minor connector design

A basic design principle for removable partial denture is to extend the dentures on to supporting tissues and minimize the coverage of marginal gingival tissues. Marginal gingiva that is loosely attached to the alveolar bone is prone to stripping from contact with denture components especially the major connectors. This stripping is due to the lack of well supported occlusal rests or excessive coverage of components over the gingival collar. As a design principle a minimum of 4-6mm of distance should be kept between marginal gingiva and borders of Major connector.⁵

3. Denture Framework materials

Traditionally metal has been used for denture framework for RPDs but with advent of new materials various non-metallic materials have been used for Denture framework such as PEEK . The advantage of PEEK over metal denture framework materials is that its modulus of elasticity closely matches to that of alveolar bone. In a study by Xin et al, it was shown that due to flexibility of framework made by PEEK, forces on abutment teeth were less than other metallic denture framework; however the forces on mucosa were increased specially in the distal extension bases. Thus for patients with poor periodontal status of remaining teeth, PEEK may be used as a denture framework but for distal extension bases it is not recommended. In another study, High impact denture resin was compared with cobalt chromium RPDs. There was no statistical and clinical difference in outcomes of periodontal health in both materials. However, Itoh et al concluded that rigidity of major connector is associated with decreased abutment mobility.⁵

4. Split Major Connectors

Stress breaking phenomena is of paramount importance in minimizing forces on abutment tooth. While various clasps are designed to disengage the abutment tooth during physiological movement of distal extension base; the Split Major Connectors or Stress breakers are designed to decrease torqueing forces to the abutment teeth during physiological movement of distal extension base dentures.⁵

Henderson and Steffen¹⁶ suggested a split lingual bar to redirect the torqueing forces on the abutment tooth. Photo elastic studies were done by Reitz et al. prove the efficacy of split major connectors in both maxillary and mandibular arch.^{17,18} For maxillary major connector he stated that the split palatal major connector reduced the forces directed to the distal-extension abutment and transferred to the regions underlying the denture base. For mandibular major connector he stated that^{17,18}

1. In short distal extension bases, there is no significant reduction of force on abutments by use of split major connector.
2. If the split of major connector extends to the midline, the stress on the distal-extension abutment is not only in a more vertical direction but also has less magnitude.
3. In the long distal extension denture bases, the stress was increased on the alveolar bone.

5. *Effect of splinting of abutments*

Few in-vitro photoelastic studies suggested that at least two abutment teeth should be splinted in distal extension bases for reduction of stresses especially when periodontal support is compromised.¹⁹ Carlson reported that in addition to splinting of abutments the other main factors included denture hygiene and gingival relief for successful RPDs. No clinical study was found on this subject.²⁰

6. *Periodontal Maintenance in recall appointments*

Recall appointments are necessary for both periodontal and prosthetic maintenance for patients wearing RPDs. However these are not well maintained in all the dental facilities especially where students' work. Periodic recall appointments aid in early diagnosis of a periodontal diseases or a prosthetic condition which are easier to control in the early stages. The frequency of these recalls depends on the need of individual patient, because of the variation in immune status, denture biomechanics and plaque control. Distorted or damaged components of dentures, ill-fitting dentures, changes in occlusion, and signs of Parafunction and poor denture hygiene can render the RPDs useless or even dangerous. Thus a timely intervention can save undesirable trauma to the remaining teeth and soft tissues.⁵

III. Periodontal therapy & Implant Prosthodontics

The primary criterion for successful implant therapy is osseointegration of the implant in a three dimensional prosthetically correct position. It has been proven that implant supported rehabilitations facilitate better quality of life and oral comfort and function.²¹ This is especially true in older individuals where the primary complaint is inability to eat food properly due to missing teeth. Perel has rightly said that "Geriatric dentistry should begin with implant dentistry so that implants are not used as merely a last resort".²²

Even though age is not a contraindication to implant treatment, it is essential to select a patient who can tolerate the surgical treatment.²³ The patient should also be mentally and physically healthy, and should have the mental and physical dexterity to be able to maintain adequate oral hygiene around the implants. It should also be possible for the patient to visit the dentist for recall appointments to prevent any biological and mechanical complications of the implant supported prosthesis.²⁴

Older adults are generally either partially or completely edentulous due to periodontal problems or tooth loss due to caries. Periodontitis propagates bone resorption which over longer periods of edentulism results in limited vertical and horizontal residual ridge.²⁵ It has been previously documented in literature that both bone quality and quantity are affected by ageing.²⁶ There is decreased cancellous bone and increase in the porosity of the cortical bone. Ridge augmentation and guided bone regeneration procedures may be too invasive in older adults and the results are generally unsatisfactory.²⁴ A long term retrospective study by Maiorana and co-workers have identified old age as one of the risk factors which negatively influenced implant survival in cases where dental implants were placed in resorbed jaws augmented using appositional bone allografts.²⁷ Instead Schimmel et al have suggested the use of ultra-wide 6 mm implants in cases of severe ridge resorption. They also suggest the use of narrow diameter implants in horizontal ridge deficiencies, thus avoiding concomitant augmentation procedures in older individuals.²⁴ Implants are generally used in geriatric patients as an option to removable prosthesis, to support the existing removable prosthesis after loss of supporting abutment teeth, for stabilization of partial dentures and complete dentures with the help of various attachments.⁶

A study by Petricevic et al have stated that implant supported fixed prosthesis were associated with better quality of life in older individuals as compared to tooth supported fixed prosthesis.²¹ When comparing crestal bone loss around implants in younger and older patients no significant differences were noted by Bryant and Zarb in their study. Also, to prevent peri-implantitis, screw retained restorations must be preferred over cement retained ones to avoid remnants of excess cement in the soft tissues.²⁸

IV. Conclusion

The relationship between prosthodontics and periodontics is intimate and inseparable. Robust supporting periodontal 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 periodontists 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.

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