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Oral ecological response and RPD: A review

[1]Dr. Neha Sachdeva, BDS, MDS, Consultant Prosthodontist, New Delhi, India

[2]Dr. Nidhi Nagar, BDS, MDS, Associate Professor, Department of Conservative Dentistry &Endodontics, School of Dental Sciences, Sharda University, Greater Noida (U.P.), India

[3]Dr. Nitin Kumar, BDS, MDS, Sr. Lecturer, Department of Oral & Maxillofacial Surgery, Inderprastha Dental College, Ghaziabad (U.P.), India

Corresponding Author: Dr. Nidhi Nagar, BDS, MDS, Associate Professor, Department of Conservative Dentistry &Endodontics, School of

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Abstract

One of the objectives of prosthodontic treatment is to preserve the remaining teeth and periodontal tissue in a state of health. Placement of removable prostheses in the oral cavity produces profound changes of the oral environment that may have an adverse effect on the integrity of the oral tissues. An understanding of the oral environment and microbial interactions leads to understanding the main causes for the onset of oral diseases. Root caries & gingival recession are most commonly observed on abutment teeth after placement of removable prosthesis. Designing RPD with hygienic principles, patient's motivation for maintenance of oral hygiene and long term follow up have shown considerably reduce the deteriorating response of oral ecology to RPD.

Keywords: Oral microflora, Hygienic principles, Removable partial Denture, Stagnation sites, Saliva.

Introduction

Microbes and saliva are the two major components of oral ecological system. Though both have the capability to be harmful, they are, very beneficial and necessary in our immune system's ongoing battle to keep our bodies healthy and protected. Saliva keeps the ecosystem of our mouth in balance. It contains its own bacterial enzymes that are beneficial to our health. An example of this is lysozomes. These antibacterial agents in saliva kill bacteria in our mouths and protect from potentially dangerous diseases. The main function of saliva is to flush out all of the micro-organisms that could potentially threaten our health. Saliva influences the microbial ecology since it is an important source of nutrients for microorganisms and contains proteins and glycoproteins [1]. The saliva is also essential in the formation of an insoluble film called salivary pellicle which coats the teeth and has receptors to which adhesins on the surface of

specific microorganisms can bind to. Desquamation (shedding of epithelial cells) in the mouth ensure that only bacteria which adhere strongly are allowed to remain in the mouth and thereby limit bacterial colonization.

Oral microbiome is a complex ecological system where approximately 600 species of microorganisms that have been identified [2]. Some of the predominant groups present in the mouth include Streptococcus, Neisseria, Veillonella, Actinomyces and other obligate anaerobes. Streptococci make up a large part of oral bacteria. While some of the bacteria in our mouths are harmful and can cause serious illness, much of our oral bacteria are actually beneficial in preventing disease. An understanding of the oral environment and microbial interactions leads to understanding the main causes for the onset of oral diseases. Oral microflora is most commonly found in gingival crevices, coronal plaques, tongue dorsum, buccal mucosa and saliva [2, 3].

Influence of RPD on oral ecology

One of the objectives of prosthodontic treatment is to preserve the remaining teeth and periodontal tissue in a state of health [4]. RPD prostheses serve as an excellent means of replacing missing teeth, may pose a serious threat to patient's remaining teeth [5]. Many partial denture designs currently in use contribute to increased or altered oral bacterial flora and formation of dental plaque [6]. The presence of the prosthesis in the oral cavity decreases the capacity of cleaning exercised by the saliva, slowing down the process of elimination of substances such as carbohydrates [7]. Acrylic partial dentures tend to adversely affect periodontal parameters when teeth are in contact with the resin base. This affect is increased with longer duration of wear [8]. A RPD may increase the incidence of caries, damage the periodontium and increase the amount of stress on the natural teeth [5]. The relationship between periodontal disease and RPD is of major importance in the long-term oral health of a patient. RPDs have the potential to negatively impact on different aspects of oral health. The effect of physical changes such as the introduction of so-called stagnation sites which are created where a RPD meets hard and soft tissues. Stagnation sites are followed by increase in plaque accumulation [6].

Traditionally RPD design has focused on biomechanical aspects such as stability, retention, loading of supporting tissues & mechanical durability. However, in addition to these, it is of fundamental importance that RPDs be designed so that they interfere as little as possible with plaque control and do not damage the oral tissues. Such design parameters are termed secondary prophylactic aspects by Marxkors. They are called Hygeinic principles [9]. Placement of removable prostheses in the oral cavity produces profound changes of the oral environment that may have an adverse effect on the integrity of the oral tissues.

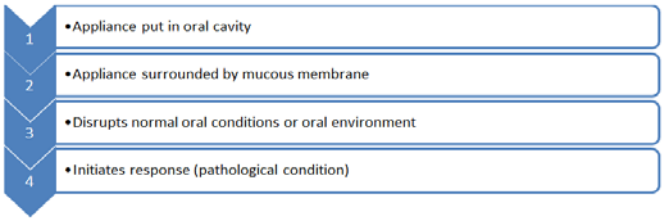

Figure 1

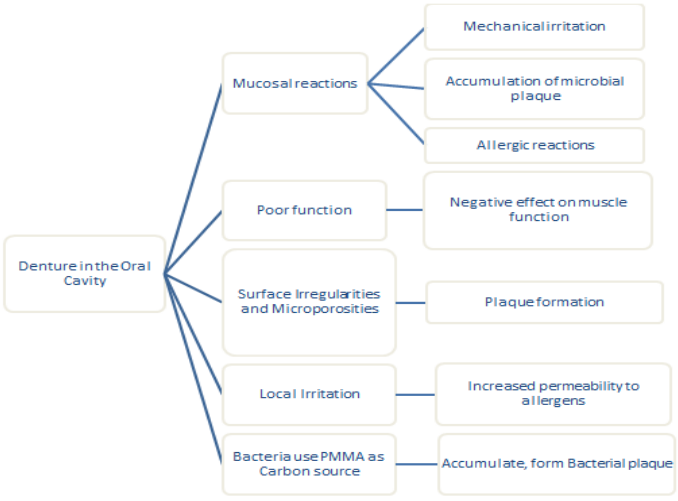

Figure 2

- If the plaque is left undisturbed, it initiates gingivitis in one to three days.
- Preventive measures should be aimed at preventing the accumulation of plaque near the roots.

How RPD influences the oral ecology

When chemicals are introduced into oral ecological system, they often act as pollutants. One obvious example is sucrose which promotes streptococcal growth and plaque formation. Similarly, the effect of physical changes such as introduction of so-called stagnation sites which are created where a RPD meets hard & soft tissues. An increase in number of stagnant sites is followed by an increase in plaque [6]. Pattern of plaque formation is dependent on presence or absence of dentures. Clasps, rests, denture bases interfere with physiologic clearance of food from the oral cavity and introduce new retentive sites for bacterial attachment. On the tooth surfaces in contact with clasps – plaque starts forming along the clasp arms. And from there, it spreads outward from point of clasp-tooth contact. The surface between the clasps and gingivae in particular shows a conspicuous increase of plaque. Proximal surfaces facing denture bases – plaque formation starts in a similar fashion. Greater amount of plaque formation is seen on proximal surfaces facing distal-extension bases than on vestibular (proximal) tooth surfaces. Vestibular surfaces adjacent to denture bases – border of plaque formed moved from gingival margin towards the incisal or occlusal regions [6]. More plaque deposition is seen in proximal surfaces adjacent to edentulous spaces, particularly if teeth are in contact with RPD. Higher plaque scores, gingival inflammation, probing depths and gingival recession have all been reported to be greater in patients wearing RPDs [10]. Gingival coverage and a close relationship between the parts of the RPD and gingival tissues increase the risk of complications, and it is suggested that design of RPDs should focus on open/ hygienic principles rather than biomechanical considerations. In a study by Mine et al (2009), it was found that the microbiological risk of periodontitis of abutment teeth is greater than that for non-abutment teeth in RPD wearers. Root caries is mainly observed in abutment teeth. It was found patients wearing rpds may be particularly susceptible to root caries, even if they have reasonably good oral hygiene [10]. Fluoride therapy is therefore important in RPD wearers, especially for combating root caries. [6]

Specific microbes and their association to RPD

Dental prostheses introduce in the mouth an inert non – shedding surface that provides a site for colonization by microbes. Some bacteria can use the PMMA as a carbon source and hence the accumulation of bacterial plaque at the interface of the denture and mucosa causes several negative effects [11]. S. Mutans has been noted to colonize acrylic resins. Implantation & growth of the streptococci microflora happens initially in grooves & depressions of the acrylic resin surfaces. Increase in S. Mutans level in saliva suggests the influence of hard surfaces such as the base of acrylic resin and increase of retentive areas in oral cavity with RPD [7, 12]. In a study by Mihalow & Tinanoff (1988), it was found that 6 months after receiving RPD, the mean percentage of S. Mutans in the patient's saliva was significantly increased [12]. In a study by Rocha et al (2003), a significant increase in number of S. Mutans in saliva was found after installation of RPD. The intensive treatment with a properly formulated chlorhexidine was effective in reduction of S.mutans, between 24 h and 82 days after its application [7]. Bacterial colonization beneath a close fitting denture is enhanced and leads to caries, due to microbial plaque of Streptomyces and Actinomyces (predominantly). Caries activity is found to be high in patients with RPD since total number of microbes'

increase [13]. Onisi & Kondo (1965) reported an increase in in the number of lactobacilli in a 2 year follow up study after fitting RPDs in patients [14]. It has been reported patients with RPDs had significantly higher levels of lactobacilli than patients with fixed prostheses [15]. It is found that rpds do not influence the composition of subgingival plaque [10]. RPD may influence the surrounding periodontal plaque population. Levels of red-complex bacteria (one's causing periodontal disease) have found to be increased but, there is no alteration in the relative proportion of morphotypes [4]. Thus, increase in bacterial counts might be because of increase in plaque accumulation. Incidence of periodontal disease is minimized with improved oral hygiene & plaque control measures [16].

Measures to minimize the adverse oral ecological response to RPD

Important aspects that must guide the treatment with RPD-

- Motivation & subject's instruction in relation to the techniques of oral hygiene that best satisfy its need.
- Oral preparation for installation of RPD, to eliminate the areas which act as retention ranches, optimizing the hygiene.
- To respect the technical & biological principles that governs the making of RPD.
- The subject's orientation in relation to the dietary habits, once the restriction in the consumption of sugar allows the decrease of the occurrence of certain microbes eg. S. Mutans in the oral cavity.

Importance of long-term follow UP

Regular recall program together with an effective home care regimen improves the long-term success of RPDs [6, 9, 10,17,18]. This is demonstrated by the findings of a 10 year follow up study of patients treated with RPDs who received regular recall at least once per year, with regular motivation, oral hygiene instruction & prophylaxis & who exhibited no significant deterioration in the periodontal status of the remaining teeth [18]. Similar findings were reported in a study when patients were recalled annually over a 6 year period. The authors found no evidence to suggest that RPDs resulted in deterioration of periodontal status in a well-managed & motivated group of patients [10]. In a study by Bergman et al it was found that with careful planning of prosthetic treatment and with an adequate oral and denture hygiene, checked up at every clinical visit, little if any, damage will be caused to the remaining teeth [6, 9, 15]. It is important to note that the adherence of RPD patients to even extremely thorough oral & denture hygiene instruction tends to reduce as time goes by, indicating a requirement for continual reinforcement of oral hygiene messages [10].

Hygienic/Open Design RPD principles

Traditionally, RPD design has focused on biomechanical aspects such as stability, retention, loading of supporting tissues, mechanical durability [19, 20]. In addition to these, it is of fundamental importance that RPDs be designed so that they interfere as little as possible with plaque control & do not damage the oral tissues. Such design parameters are termed the secondary prophylactic aspects by Marxkors. They are also called hygienic principles [9].

In making Framework design, the dentist must consider the patient's comfort, esthetics, biomechanics of prosthesis and the prognosis of the abutments [21]. The basic principle of open hygienic RPD design is presented in German standards document that states in translation, 'If the base elements of the RPD do not contact either teeth or periodontium, it cannot cause any injuries to these structures [9]. The emphasis in contemporary RPD design should be placed on minimal tooth coverage by framework components & on the elimination of components whenever possible without compromising

biomechanical requirements. RPD components should be designed to uncover the gingival margins as often as possible [22]. Clasps should be placed as far as possible from gingival margins and that the number of minor connectors should be kept to minimum. A survey of expert prosthodontic opinion showed that the majority are in favor of a maximum of two direct retainers & a major connector of simple shape. Sublingual bar which maximizes the clearance of the gingival area has been described as an alternative to lingual bar [23]. In a study by Mc Henry et al the differences in gingival inflammation between plate and dental bar designs suggest that covering more gingival tissue promotes development of gingivitis, which may subsequently predispose the area to periodontal disease [5]. It should be stressed that any coverage of gingival area adjacent to abutments may have detrimental effect on their periodontal status [21, 24].

Minor connectors, in most situations can be extended directly from the base onto the proximal aspect of abutment tooth, allowing an open embrasure to be created. In molar region, the minor connector can be extended and shaped similar to sanitary Pontic in FPD. Where a minor connector has to enter a dental arch without any replacement tooth or denture base, it can cross the gingival margin at the midpoint of lingual/palatal surface [19, 25]. The improved stability which can be achieved in a partial denture by placement of indirect retainers needs to be weighed against their possible disadvantages. The latter include the biological disadvantages arising from increased coverage of soft & hard tissues of the mouth, and the fact that they may give rise to irritation of tongue or other oral tissues. A modified more hygienic design has been introduced by extending the minor connector around the lingual aspect of the abutment tooth, thus avoiding the need to cross the gingival margin [9].

Conclusion

The introduction of RPD into the oral cavity adversely affects the prevailing ecologic situation in terms of plaque formation. There is a clear evidence that RPDs increase plaque and gingivitis, particularly at abutment teeth (but no clear evidence for increased risk of periodontitis as a result of wearing RPD).The risk of caries (particularly root caries) appears higher in wearers of RPDs. The rehabilitative effect of a removable partial denture may be safeguarded by controlling plaque formation by strict personal hygienic measures on the part of the patient. In particular, proximal surfaces adjacent to denture bases should be pointed out to patients as surfaces which they must give special attention. Simplification of the design of RPD can reduce their damaging potentialities. Regular recall should be a part of the routine care of RPD wearers. Further prophylactic measures, such as topical application of fluorides and perhaps other chemicals, should be taken.

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