Time-Dependent Intraoral Ecologic Changes and Prosthodontic Interventions

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Ecology is the branch of biology that deals with the relationships between organisms and their environment. In the oral cavity, bacteria are the organisms, and their populations increase with the formation of biofilm and plaque accumulation. This may lead to pathologic conditions. Further, a patient's behavior (oral hygiene), habits (food, smoking), systemic health (medications), genetic disposition, and age may have an impact on the oral milieu.

In this ecologic system of the oral cavity, interactions occur between organisms and oral tissues (soft and hard). Prosthetic reconstructions and their specific materials, such as crown margins, posts, dental implants, and clasps, may have a direct impact on these tissues. Thus, the ecologic system of the oral cavity is modified by dental restorations and prostheses. With prosthetic reconstructions, particularly removable prostheses, special niches in the oral cavity are created.

Clinical manifestations of changes include caries, endodontic problems, gingivitis, and periodontitis, which altogether lead to a cascade of negative effects such as tooth migration and loss, tooth wear, loss of vertical dimension of occlusion, atrophic jaws, instable occlusion, and wear of reconstructions. These changes are complex, multifactorial, and not independent from each other, often resulting in a cumulative pathologic effect.

Age-Related Changes

Age-related alterations in the tissues (bone, teeth, oral mucosa, glands) can be observed on a histologic and cellular level. Aging is often accompanied by changes in general health and intake of medications that reinforce a dry mouth effect.[1] The decrease in salivary flow and changes in the composition of saliva result in a reduction or loss of multiple functions of the saliva, such as its antimicrobial effect, body water balance, buffer capacity, and agglutionation. The biologic aging process and health-dependent effects may additionally accelerate intraoral changes and modify their clinical manifestations.

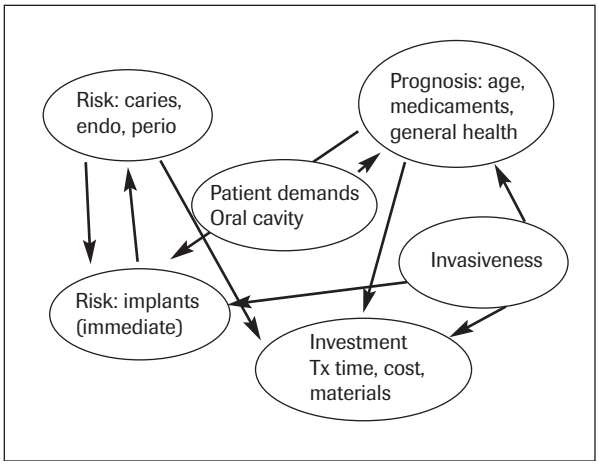

Fig 1 Treatment planning with regard to patient demands, oral ecology, and prosthetic interventions.

Management and Prosthetic Interventions

On one hand, prosthodontic reconstructions in the oral cavity modify or accelerate changes; on the other hand, they compensate for the sequelae of changes. Managing problems consists of understanding, reaction, and prevention.

Understanding means obtaining a correct diagnosis in order to know why ecologic changes occur and whether they are predictable. Reaction, ie, treatment planning, requires a set of reliable criteria for decision making. Prevention is based on a cause-effect relationship, but may also be symptomatic. Patient management and treatment should be based on the best evidence available that encompasses basic research, clinically relevant studies, and the patient's goals. Decision making is not a vertical cascade of logical steps, but rather a broad network of considerations (Fig 1), which can be summarized by the following decisions: whether to extract or maintain the teeth, whether to use implant therapy, whether to use fixed or removable prostheses, which materials and technologies to use, and whether the chosen procedure is too risky or invasive.

Caries

Aging poses a high risk for caries development,[2] and many studies have clearly shown that caries is the most frequent age-related dental problem. Overdentures using root support is a well-accepted treatment modality,[3] but can make caries difficult to control. There is a large body of evidence that overdentures supported by implants perform well and increase quality of life compared to complete prostheses.[4] The long-term use of removable prostheses in partially edentulous patients is associated with an increased risk of caries, periodon-

tal problems, and poor acceptance.[5] A comparison of fixed prostheses, removable prostheses, or no treatment for small gaps found the best result for adjacent teeth if no treatment was performed.[6] Similar results were observed if the gap was closed by an implant.[7] Although fixed prostheses with tooth and implant support appear to be successful,[8,9] various studies also indicate that caries is the most frequent cause of failure in fixed prostheses.[10–12]

Periodontitis

Countless studies in periodontology have shown that periodontal health is improved by specific therapeutic measures. However, some studies argue that while periodontal parameters (probing depths, attachment loss, gingival bleeding, etc) often improve after treatment, it is still unknown whether this prevents tooth loss.[13] Further, although distinctly different phenotypes of periodontal disease exist, there is no differentiation made regarding treatment.[14] From a prosthodontic point of view, periodontal studies often fail to discuss how periodontally involved teeth can be used after treatment for prosthodontic reconstruction and whether they meet criteria of esthetics, quality of life, and cost effectiveness. Many studies have applied periodontal measurements to assess implants and concluded the following: periodontal disease is progressive; periodontitis is a predictor of bone loss at implants; bone loss at implants correlates to previous bone loss at teeth; and an association between periodontal and peri-implant conditions exists.[15–18]

One recent study, however, found no association between a history periodontitis and peri-implant bone loss, nor did the implant surface, gender, or jaw site have any effect on bone loss in this study.[19]

Endodontic Treatment

From a prosthodontic point of view, endodontics can be considered only with a restoration as an integral part of treatment. The endodontic success of a tooth as expressed by a periapical index does not consider the biomechanical aspects of that tooth with regard to posts, cores, ferrul effect, cementation, and materials. The survival rate of endodontically treated teeth is reduced ($<$ 75%) if apical lesions are present,[20,21] and when used with posts, the teeth show an increased risk of fractures.[22] With regard to biology and technology, endodontics and implant osseointegration are completely different, and a direct comparison of the 2 treatment modalities is not valid.[23]

Prosthetic Interventions

There is an increasing trend toward the use of implants and fixed prostheses. Further, there is increased emphasis on esthetics, especially regarding single-tooth replacements and the creation of natural-looking soft tissue contour. These trends are accompanied by the introduction of new materials, such as all-ceramic restorations, and new technologies, such as computer-aided design/computer-assisted manufacture systems. The positive effects of these technologies should be underscored. They result in a more uniform quality and a reduction of time-consuming and invasive procedures. In the past, technology and biology were often considered to be in opposition. Today, this view must be corrected, since new materials exhibit good tissue compatibility and modern technologies enhance precision and passive fit of prostheses, thus contributing to stable ecologic conditions in the oral cavity.

Conclusions

Caries remains a problem, particularly in aging populations. In the field of periodontology, the etiology, diagnosis, cell biology, and treatment of this disease is being reconsidered. Genetic aspects are generating more attention. With regard to endodontics, one conclusion that may be drawn is that retreatment of endodontically failed teeth or endodontic surgery should not be considered for elderly patients.

Although there is a tendency to offer fixed prostheses to patients, this may change with demographic changes and an increase of elderly patients, who show reduced dentition and low socioeconomic wealth in many parts of the world.

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Implant Management of Posterior Partial Edentulism

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Table 1 Management Considerations for Kennedy Class I and II Partial Edentulism

Justification for intervention
Patient age and health of dentition in terms of function and esthetics
As an integral part of temporomandibular disorder/arthritis management
To avoid teeth-related sequelae: drifting, extrusion, wear, traumatic occlusion
Context for surgical considerations
Systemic health and smoking behavior
Proximity of anatomic structures: maxillary sinuses, inferior alveolar canals
Bone quantity and quality
Potential for increased force concentrations

A total deficit of the periodontal ligament can be reliably and routinely rectified with implant-retained/supported prostheses. This is possible because anterior edentulous zones are more likely to offer quantitatively and qualitatively favorable host sites with a virtual absence of anatomic challenges compared to posterior zones. Furthermore, an altered resultant pathogenicity in edentulous intraoral microorganisms appears to be favorably different from that of partially edentulous microorganisms, especially if the latter evolved in the context of a history of periodontal disease. Consequently, the loss of multiple teeth (as opposed to total loss), particularly in the posterior zones, used to be regarded as rather challenging. This is certainly not today's clinical mindset, given the abundant and promising literature, including meta-analyses, which attests to the successful implant management of posterior partial edentulism. This report highlights prosthodontic educators' ongoing concerns (Table 1) for managing edentulous posterior zones in an effort to provoke debate on the determinants of successful treatment outcomes with the osseointegration (OI) technique.

Review of Treatment Considerations

Between 1983 and 2005, the Implant Prosthodontic Unit multidisciplinary team at the University of Toronto documented clinical outcomes from all implant treatment interventions for both partially and completely