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Are Dental Implants For Ever: Where Do We Stand In 2016?

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Abstract

Oral reconstruction using dental implants has improved the function and quality of life for many patients. High success rates for dental implants have been reported, however, failure of implants, although rare, is a reality. This review aims to discuss the factors that contribute to implant failure and peri-implant diseases.

Keywords: Dental implants; Implant failure; Peri-implantitis; Periodontitis; Implant success; Implant survival; Risk factors

Introduction

Dental implants have been in use for almost thirty five years. They are a major advance in restoring oral health, esthetics and masticatory function, as well as improving the quality of life for millions of people around the globe [1]. Although high success rates of dental implants have been reported in the literature [2], implant failure has also been reported and several causative factors have been proposed for failure. These factors include bone quality and quantity, overload, infection, tissue trauma, iatrogenic factors and host factors [3]. The criteria for dental implant success were defined and adopted by the International Congress of Oral Implantologists Consensus Conference for Implant Success in Pisa, Italy, October 2007 [4]. The consensus conference proposed dividing the health scale for dental implants into four groups: success (optimum health), satisfactory survival, compromised survival, and failure (clinical or absolute failure) [4]. Clinical success of any treatment modality is the ultimate criterion for patient satisfaction, and establishes guidelines for improvements in treatment. However, a proper classification of peri-implant disease has not been identified. Thus, decisions on therapeutic techniques have been made without scientific evidence [5]. Objective estimates of peri-implant disease prevalence have been hindered by lack of universally accepted classification of peri-implant disease. Froum and Rosen [5] proposed a simplified objective criterion for this classification, which is accepted by the American Academy of Periodontology as a working classification system [6]. They suggest that a healthy implant should be fully integrated, have an absence of inflammation with adequate keratinized attached tissue seal, and should be in full occlusal harmony with rest of the teeth. There should be no mobility and no bleeding on probing, and no bone loss after the first year of implant loading. Osseointegration of implants is considered a pre-requisite for their longevity and the health of soft and hard tissues. However, osseointegration can be affected by peri-implant diseases such as peri-implant mucositis and peri-implantitis. Peri-implant mucositis is defined as the inflammation of peri-implant soft tissue caused by bacterial plaque and biofilms, and it is reversible with proper hygiene and use of antimicrobials [7]. Peri-implantitis is characterized by progressive bone loss, and results in debilitating defects, and huge costs for the redevelopment of implant sites and proper rehabilitation of oral function [8]. Bone loss within one year of placement or restoration is due to establishment of biological width and is considered normal. However, progressive bone loss over many years could be due to infection, parafunction or trauma [9]. While the prevalence of peri-implant mucositis was reported to occur in 31% - 59.6% of subjects [10-14], the prevalence of peri-implantitis was reported to be 11% - 47% [10-18]. The noted disparity in the reported prevalence of peri-implant mucositis and peri-implantitis can be attributed to lack of consensus for the case definition and criteria used in these reports. Environmental factors such as heavy smoking and alcohol consumption have been linked to higher risk of peri-implant disease [19]. Systemic conditions like uncontrolled type II diabetes and osteoporosis are also considered risk factors for implant failures [7]. Uncontrolled type-II diabetes was reported as a major risk factor for periodontitis [20], and patients with type-II

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Figure 1: A clinical example showing inadequate keratinized attached gingiva, shallow vestibule and inadequate bone width in an implant failure: a recipe for the initiation of peri-implant disease.

diabetes were found to have 2.59 time higher risk of implant failure [21]. Additionally, partially edentulous patients show higher risk of implant failures due to infection from periodontally involved teeth [11], and implant fixtures placed in anterior region have shown different clinical outcomes compared to those placed in the posterior region [22]. Similarly, there are differences in the clinical outcome of implants placed in the maxilla and mandible, dependent on the quality of bone in the region of placement [23]. Considering the impact of peri-implant mucositis and peri-implantitis on the probability of implant failure, and the variety of risk factors associated with these diseases, research exploring the relationships between risk factors and peri-implant diseases is required. It is imperative that optimal long-term maintenance intervals be established. Availability of CBCT, digital impression technology and navigated implant surgery has made implant placement more precise, and produce excellent results in the short term. Impact of these technologies should not be underestimated. However, the question still remains regarding the impact of these advances on the longevity of implant treatment in a diverse population, where many systemic, local and clinical factors affect treatment outcomes. There is an open admission by the clinicians that at least ten percent of implants have to be removed due to failure of osseointegration [24], with implant survival and success rates in general dental practices found to be lower than those reported in studies conducted in academic or specialty settings [25]. In spite of advances in imaging technology and its ability to assess the bone volume, clinicians still rely on the subjective criteria of cutting torque to assess the quality of bone at the time of implant placement. We need an objective, non-invasive method to assess the quality of bone before the surgery is initiated. While the Osstell and Periotest devices are two tools that can be used to predict the success of implants [26-32], they only provide assessment of implant stability, and indirectly, the bone quality once the implant is placed. An established method that directly assesses bone quality prior to implant placement may contribute to improved implant placement sites, and potential for prolonged success of implants. Derks et al. [33-34] did a retrospective analysis on incidence of peri-implant disease and found that after nine years, 45 percent of patient's hadperi-implantitis and 14.5 percent presented with moderate/severe peri-implantitis. Using the same data, Derks et al. [35] reported on early and late implant loss. Early implant loss was found in 1.4% of the implants, while late implant loss was reported in 2% of implants. Smokers, subjects with periodontitis, implants shorter than 10mm and representing certain brands, showed higher odds ratio for early implant loss. As such, the remainder of this review will focus on discussing risk factors linked to the onset of peri-implantitis, and addressing the clinical failure of implants associated with peri-implantitis.

Risk Factors Associated with Peri-Implant Disease

Systemic factors

Etiology and pathogenesis of peri-implantitis is similar to periodontitis [36]. Heavy smoking is a known risk factor for periodontitis, bone loss and tooth loss [37-39]. As such, it is not surprising that smokers have a higher incidence of implant failure compared to non-smokers [40-44], and the effect of smoking on implant survival was more pronounced in patients with soft bone [45]. The adverse effect of smoking on the health of peri-implant tissue was found to be dose-dependent [46]. Deluca [47] reported implant failure to be 3.5%, 4.8% and 5.5% in individuals who smoked < 5cig/day, 6-14 cig/day and >15 cig/day, respectively. Of interest, smoking cessation programs may help to reduce implant complications. Bain [48] showed that the patients who smoked had higher incidence of early implant failure compared to patients who had never smoked, or who had stopped smoking at least 1 week prior, and 8 weeks following implant surgery. Similarly, Rinke et al. [12] found a significant difference in the prevalence of peri-implantitis in smokers with a history of periodontitis compared to non-smokers (53%) and healthy periodontium (3%). Bone quality as a result of systemic bone conditions is another impactful factor in implant failure. Osteoporotic patients with poor bone quality remain a concern for the success of implants in dental treatment [49]. In an animal study by Tsolaki [50], it has been shown that osseointegration in osteoporotic animals is 50% slower than controls. In human studies, the results of these comparisons are controversial and may be associated with the difficulty in comparing controls with osteoporotic individuals. It will be difficult to find age and sex matched controls without osteoporosis. Presently there is not enough evidence to avoid doing implants in patients taking oral or I/V bisphosphonates for treatment of bone loss, however, there should be a thorough discussion about risk of osteonecrosis of the jaw [51]. Additionally, it was reported that implants placed in previously failed implant sites had lower survival rate of 83.5% [52], which suggests that efforts should be made to minimize placement in compromised bone quality. Selective Serotonin Reuptake Inhibitors (SSRIs) used in the treatment of major depressive and anxiety disorders are also reported to have a negative effect on osseointegration of implants [53].

Presence of periodontitis

Periodontitis is a risk factor for peri-implantitis and for implant loss [54]. In addition, higher frequency of peri-implantitis was reported in patients treated for periodontitis than non-periodontitis patients [17-18,55-57]. The high incidence of peri-implantitis may jeopardize the long-term outcome of implant treatment in periodontitis susceptible patients [58]. It was reported that residual probing depth of ≥ 5 mm after active periodontal therapy is a significant risk for development of peri-implantitis and implant loss. In addition, periodontitis patients on supportive periodontal therapy (SPT) who developed re-infections are found to be at greater risk for peri-implantitis and implant loss than periodontally stable patients [59]. Occlusal loading and presence of periodontitis are definite risk factors for implant failures either due to peri-implantitis or breakage of implant or attachments.

Clinical factors

Skills of clinician [60], quality of bone [61], implant surface [62], placement of implant (submerged vs. bone level vs. above bone), shallow vestibule and absence of thick keratinized attached tissue [63] (clinical example shown in Figure 1), are all related to the success of implants. A study by Suarez-Lopez del Amo et al. [64] concluded that implants placed in an initially thicker peri-implant tissue have less marginal radiographic bone loss (MBL) in the short term.

Can we differentiate between survival and failure?

Presently an implant which has to be removed is considered a failure. All implants with some severity of peri-implantitis are considered surviving implants. It is true that early detection of diseases, timely treatment and proper maintenance can help to retain implants. Long term studies are needed to establish an optimal level of maintenance schedule. An implant that has advance bone loss on one or two surfaces and bleeding on probing, but does not have any mobility due to some remaining osseointegration should be considered a failure.

Current modalities to treat peri-implant disease and their efficacy

It is now known that in spite of advances in bone regeneration techniques and use of growth factors, the outcomes of peri-implant disease is not as certain as it is with treating a tooth with periodontitis [65-66].

Cost of failed implant

It is true that there are millions of dental implants placed in the last thirty-five years that are surviving with or without some presence of peri-implant disease [2,67].It is imperative that the dental profession reflects on the total failures and surviving diseased implants to determine universally accepted protocols. Full mouth rehabilitation or even a single implant in esthetic zone can cost thousands of dollars. The financial and psychological trauma on patients after implant failure is irreparable. Reconstructive therapy around failing implants is unpredictable [68-70]. Re-preparation of implant site following failure could be long, costly and even more traumatic for the patient [71]. It undermines the confidence in the dental profession. Most of the failures are due to inadequate site preparation, poor hard tissue and soft tissue quality and inadequate training of the clinicians. Let us bring the team approach back for the benefits of our patients, where all branches of dentistry work together to follow the best practices for long term sustainability of dental implants. As such, we should reflect and find a solution to this problem for the benefit of our patients who heavily rely on our professional judgment.

Recommendations for Long Term Sustainability of Dental Implants

It is well established that teeth affected by periodontitis can be treated and maintained successfully for long term [72-73]. However, it is also known that extraction of a problem tooth is more prevalent by the professional NOT having sufficient training in periodontology [74]. Teeth compromised because of periodontal disease or endodontic problems may have a longevity that surpasses the average implants [75-80]. Longitudinal studies are needed to establish optimal maintenance intervals and universal protocols for these visits. Special care should be given to select patients with significant risk factors, and enough time should be given to eliminate or reduce local risk factors (e.g. home care and smoking cessation). A team approach is required at the diagnostic and pre surgical preparation stage; enough time for soft and hard tissues to heal before loading the implants, esthetic considerations in maxillary anterior zone, strict adherence to maintenance program, and early detection and prompt treatment interventions are important issues to consider. These will go a long way to prevent frustration and financial costs. If the implant has started to fail then accept the reality, inform the patient, and take appropriate action in a timely fashion.

Conclusion

Proper case selection through comprehensive clinical and radiographic evaluations, a treatment plan that is based on knowledge of literature, clinical experience and consideration of patient's values are the prerequisites needed to ensure successful implants.

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