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## Dental implant management and maintenance: How to improve long-term implant success?

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Although dental implants are proven to be a predictable long-term treatment for patients, it is important to realize that not all implants that survive are necessarily successful. Successful implants are those that remain fully functional and healthy within the oral cavity. Peri-implantitis is a disease that is associated with implant failure, and is becoming rather prevalent. Assessing risk factors and stabilizing existing oral disease prior to the placement of implants will aid in preventing implant disease and failure. After implant placement, a strict follow-up

regime with a dental professional should be implemented in order to monitor the implant and surrounding teeth for disease. The dental professional should continually encourage the patient to adhere to consistent homecare to prevent peri-implantitis from occurring, and in turn increase the success of their implants. Early diagnosis and elimination of inflammatory processes around the implants will improve the long-term prognosis as well. (*Quintessence Int* 2016;47:417–423; doi: 10.3290/j.qi.a35870)

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Dental implants are a popular treatment option for today's dental patient. Survival rates for implants in the mandible, for example, are as high as 92.6%.<sup>1</sup> With high survival rates, dental implants are seemingly an obvious answer to restore a fully or partially edentulous dentition. However, we should recognize the difference between implant failure or survival, and actual implant success.<sup>2</sup> Implants that have remained in the oral cavity are considered to be survived implants. This means that diseased implants that may not be functioning or surrounded by healthy tissues are considered survived implants for many of the published evaluations.<sup>3</sup> Deter-

mining the success of a dental implant is more complicated. Successful implants are defined based on criteria; however, there is not one universal set of criteria being used.<sup>4</sup> Due to the variability in defining a successful implant, it is difficult to accurately assess the number and rates of successful implants.

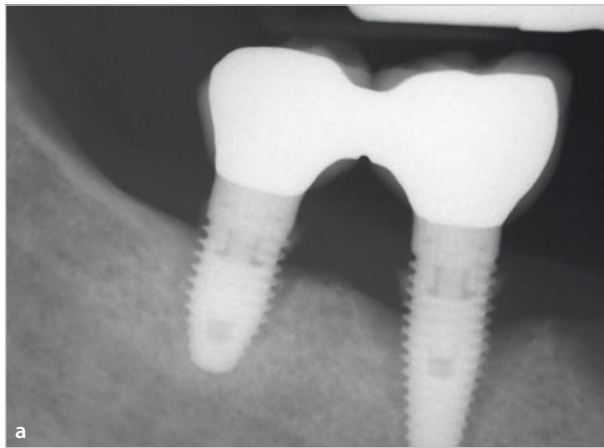
### DIFFERENCES IN ANATOMY BETWEEN TEETH AND IMPLANTS

A natural tooth is encircled by mucosa with keratinized tissue surrounding the crown of the tooth.<sup>5</sup> When bacteria accumulates, this tissue becomes inflamed and gingivitis develops.<sup>5</sup> When an implant is placed, these tissues are now considered peri-implant tissues.<sup>5</sup> When these tissues become inflamed and bone loss occurs in the natural dentition, it is known as periodontal disease. When bone loss is experienced around a dental implant, the disease is known as peri-implantitis. Natu-

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**Figs 1a and 1b** Peri-implantitis is a growing concern surrounding the placement of dental implants.

ral teeth that are not restored have a pulp chamber in the center that provides sensory feeling to the tooth. When disease occurs, patients may feel pain via the nerves within the tooth. This pain can prompt patients to visit a dental professional. Implants do not have any nerves and, as a result, disease can go unnoticed by patients. Natural teeth also have a periodontal ligament that supports the tooth and keeps it stable.<sup>5</sup> Implants do not have attachment of the periodontal ligament and, as a result, rely on significant support from the bone. While plasma cells and lymphocytes dominate in both types of lesions, neutrophil granulocytes and macrophages occur in larger proportions in peri-implantitis than in periodontitis. A “self-limiting” process exists in the tissues around teeth, which results in a protective connective tissue capsule that separates the lesion from the alveolar bone. Such a self-limiting process does not occur in peri-implant tissues, and the lesion extends to the bony crest.<sup>6</sup> Together, these anatomical differences make the implant much more susceptible to bacterial invasion and inflammation, warranting special care prior to and following dental implant placement. This review addresses some of the important aspects of implant management and maintenance.

## RISK FACTORS FOR PERI-IMPLANT DISEASE

Peri-implantitis is a growing concern surrounding the placement of dental implants (Fig 1). Peri-implantitis is characterized by changes in the level of the crestal bone in conjunction with bleeding on probing with or without concomitant deepening of peri-implant pockets. Pus is a common finding in peri-implantitis sites.<sup>6</sup> A study published in 2016 analyzed 588 implant patients for the prevalence of peri-implantitis.<sup>7</sup> The study defined peri-implantitis as bone loss over 0.5 mm and bleeding on probing.<sup>5</sup> An astounding 45% of patients presented with the disease.<sup>7</sup> A concept review published in 2015 found the prevalence of peri-implantitis to have a range of 4.7% to 43% at the implant level.<sup>8</sup> Peri-implantitis is a concern that needs to be addressed and considered both prior to and following implant placement. The most important and crucial cause for peri-implantitis is bacterial plaque accumulation around the implantation site.<sup>9</sup>

Several risk factors are associated with the presence of peri-implant disease. The most significant risk factor is poor oral hygiene. There is evidence that poor oral hygiene is associated with peri-implant diseases with an odds ratio of 14.3.<sup>10</sup>

Smoking is a strongly associated risk factor regarding the prevalence of peri-implant disease.<sup>8,11,12</sup> The

consumption of tobacco smoke alters the microbiome in the peri-implant tissues and fosters the colonization of harmful bacteria.<sup>13</sup> Smoking also doubles the marginal bone loss observed versus that seen in nonsmokers.<sup>14</sup> Therefore, we should carefully contemplate the placement of implants in the smoking patient as smoking is strongly associated with peri-implant disease.

Patients with a history of periodontal disease or current periodontal disease are also at high risk for developing peri-implantitis.<sup>8</sup> According to a study published in 2016, patients with a history of periodontal disease had a 2.2-times greater risk for peri-implantitis than those who did not.<sup>15</sup> Periodontal disease has also been associated with peri-implantitis in earlier studies.<sup>16-18</sup> The periodontal pathogens associated with the disease are thought to colonize the tissues surrounding the implant leading to peri-implantitis.<sup>19,20</sup> Therefore, there should be special consideration prior to placing implants in a patient presenting with a history of periodontal disease. Careful treatment to resolve periodontal disease activity should precede implant placement, and a strict and frequent maintenance protocol should be adopted in those patients.

Cemented versus screw-retained implants may also present as risk factors for peri-implantitis. Implants that are cement-retained are shown to have an increased prevalence of peri-implantitis when compared to screw-retained implants.<sup>15</sup> This is most likely attributed to the presence of excess cement in the sulcus that enhances the bacteria's ability to colonize.<sup>21</sup> However, a study published in 2015 found that there was no difference in the prevalence of peri-implantitis in cement-versus screw-retained implants if the cement was properly removed.<sup>22</sup> If placing a cement-retained implant, it is crucial to utilize proper techniques in order to ensure appropriate removal of the cement or other plaque-retentive factors.<sup>23</sup>

Diabetes is a systemic factor that has been associated with increased risk for peri-implantitis. It is known that diabetic patients are more prone to periodontal disease and other infections; however, their susceptibility to peri-implantitis remains controversial. According to a study performed in 2006, diabetic patients with

poor metabolic control are considered high risk for peri-implant disease.<sup>24</sup> A patient who is supposed to receive implant placement should present with well-controlled diabetes in order to ensure the best prognosis of the implant. Risk factors, such as diabetes, that are associated with peri-implant disease are usually in case study research.<sup>25</sup> It has been pointed out that these studies have been useful for hypothesizing, but there remains a need for observational studies in order to further research the association between diabetes and peri-implantitis.<sup>25</sup>

Peri-implantitis can lead to implant failure. In order to maximize implant longevity and success, we need to assess patients for risk factors that may make them more vulnerable. From there, we can assess if implant placement should take place, and if so, provide the patient with management techniques in order to combat and control their risk factors. Those risk factors should be discussed and should be part of the consent process for implant placement.

## PLANNING STAGE

It is vital to enable good oral hygiene and long-term maintenance behavior. In order to ensure success of dental implants, it is important to include oral hygiene in the planning stage. Instead of treating peri-implantitis when it presents, we should be ensuring its prevention before the implants are even placed. Since periodontal disease is considered a risk factor for peri-implantitis, a patient's periodontal diagnosis should be noted. The patient's periodontal status should be stable prior to placing implants. This may involve introducing and enforcing an improved dental hygiene protocol. Nonetheless, professional preventative care is not sufficient in preventing peri-implantitis.<sup>26</sup> Mechanical plaque removal is the most effective preventative measure for successful implants.<sup>26</sup> Therefore, patient education about oral home care and long-term maintenance behavior is crucial, and ensuring the patient is complying with home care routines is imperative in order to maintain implant health. This should be achieved before implant placement occurs; patients



**Figs 2a to 2d** The two methods proven to be superior to floss are wood sticks and interdental brushes, which are the most effective method to mechanically remove interdental plaque. A single tufted brush could also help in some aspects.

should prove they are responsible and capable of maintaining oral health and plaque control in order to “win” the opportunity of receiving dental implants.

## ORAL HOME CARE

According to a set of clinical practice guidelines regarding dental implant maintenance, home care instructions should include educating patients on how to properly brush twice daily and use interdental aids.<sup>27</sup> The proper use of electric as well as manual toothbrushes was found to be effective in the mechanical removal of plaque around natural teeth, implants, and implant-borne restorations.<sup>28-30</sup> The use of the electric toothbrush was not detrimental to peri-implant health; however, the use of the electric toothbrush was not superior to a manual toothbrush.<sup>28-30</sup> Currently, there is not a universally superior method for tooth brushing;

however, the most popular method is known as the Modified Bass technique.<sup>31</sup> In regard to interdental cleaning, flossing has traditionally been considered the ideal method. A recent review in 2015 found that there is a lack of evidence surrounding the efficacy of flossing as a method of interdental plaque removal.<sup>32</sup> Two alternative methods proven to be superior to floss are wood sticks and interdental brushes, with interdental brushes being the most effective method to mechanically remove interdental plaque.<sup>32</sup> A single tufted brush could also help in some aspects (Fig 2). Instructing the patient how to effectively remove plaque around teeth and implants is essential and should be a routine part of treatment provided to all patients.<sup>33</sup> This should be verified and reinforced on a regular basis to ensure proper plaque control over the long term, and to enhance the prognosis of the dentition as well as the dental implants. If patients have several implant com-

ponents or complex restorations, a toothpaste containing 0.3% triclosan has also been recommended, as well as the use of chlorhexidine gluconate if indicated.<sup>27</sup>

## PROFESSIONAL CARE

### Disease control

Prior to placing dental implants, any current disease such as periodontitis should be managed in order to prevent failure of the implants. However, if disease occurs, such as peri-implantitis, after implants are placed the disease needs to be controlled as quickly as possible to prevent bone loss around the implants. Up to 6-months' recall is recommended for implant patients who have no complications and are in a maintenance phase.<sup>27</sup> If peri-implantitis is present, the recall interval should be increased in order to control the disease. Reviewing oral homecare may also be necessary if patient plaque removal is not sufficient. The professional care recall visits should include not only professional cleaning of the teeth and implants, but also recurrent oral hygiene instructions and reinforcement as well as evaluation of the overall oral health, to make sure we detect any pathology, including peri-implantitis, as early as possible.

### Health maintenance

A systematic review revealed that it is necessary for life-long professional maintenance from dental professionals for patients with implant restorations.<sup>34</sup> A study performed by Costa et al<sup>35</sup> found that patients diagnosed with peri-implant disease had more improvement in their peri-implant health if they received regular professional care versus patients who had no professional maintenance.<sup>35</sup> The recommended recall for a dental examination assessing oral health is 3 to 6 months for patients with implants.<sup>27</sup> However, factors that increase a patient's risk for disease such as home care habits, smoking, diabetes, periodontal disease background, and complications should dramatically increase recall frequency.<sup>27</sup>

During these recall visits, it is imperative that oral hygiene education is assessed and reviewed with the patient in order to maintain compliance.<sup>36</sup> The patient's

plaque removal efficacy should be determined, and areas for improvement should be recognized during these visits. Frequent recalls remind the patient about their responsibility in maintaining their implants and ensuring implant success. Full-mouth probing should be performed on a patient-centered basis, with a full-mouth probe occurring at least once per year in a periodontally healthy patient. Areas of concern should be probed at each recall appointment, and diseased pockets should be treated appropriately. Scaling procedures will also occur during the recall appointments in order to reduce the development of peri-implantitis. The use of a plastic curette on the implant is not recommended due to its ineffectiveness in removing biofilm.<sup>37</sup> Another disadvantage of using scalers that are softer than the titanium implant is the plastic remnants that are left behind on the tooth surface after the scaling is completed.<sup>38</sup> Minimal research is available regarding the optimal scaler for debriding implants. There is a need for further research regarding the most effective tool for professional mechanical debridement for implants. Nonetheless, it is clear that plaque and calculus should be removed effectively from implant surfaces as well as teeth, and therefore it seems reasonable to use regular metal scalers and curettes on implant restorations. It should be remembered that as long as the tissues are healthy around the implant, the curettes will not reach the implant surface that is covered with bone. When peri-implantitis is present, it is even more essential to remove the debris effectively. The use of more gentle curettes in these cases will probably not suffice and, as a result, regular metal scalers should be effective (Fig 3).

### Follow-up and evaluation of health and disease around implants

Important factors that should be considered during the follow-up of implant placement include oral health status and home care performance. Bleeding upon probing and marginal bone loss are defining factors of peri-implantitis, and should be assessed during the follow-up and recall visits. If no inflammation exists and the patient is participating in satisfactory home care, the implant is being maintained and should proceed to be successful.



**Fig 3** There is a need for further research regarding the most effective tool for professional mechanical debridement for implants. Nonetheless, it is clear that plaque and calculus should be removed effectively from implant surfaces as well as teeth, and therefore it seems reasonable to use regular metal scalers and curettes on implant restorations.

## CONCLUSIONS

Although dental implants are proven to be a predictable long-term treatment for patients, it is important to realize that not all implants that survive are necessarily successful. Successful implants are those that remain fully functional and healthy within the oral cavity. Peri-implantitis is a disease that is associated with implant failure. Assessing risk factors and stabilizing existing oral disease prior to the placement of implants will aid in preventing implant disease and failure. After implant placement, a strict follow-up regime with a dental professional should be implemented in order to monitor the implant and surrounding teeth for disease. The dental professional should continually encourage the patient to adhere to consistent home care to prevent peri-implantitis from occurring, and in turn to increase the success of their implants. Early diagnosis and elimination of inflammatory processes around the implants will improve the long-term prognosis as well.

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