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Implant Maintenance

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Endosseous root-form implants have become an integral part of dental reconstruction in partially and fully edentulous patients. It has been estimated that approximately 300,000–428,000 endosseous implants are placed annually in the United States [1]. The success of dental implants is highly dependent on the integration between the implant and intraoral tissues, hard and soft. The successful integration of the osseous tissue structures to titanium implants, termed "osseointegration" by Dr. Per-Ingvar Branemark, has been well documented [2–4]. Current knowledge indicates that the maintenance of a healthy soft tissue barrier is as important as osseointegration itself for the long-term success of an implant-supported prosthesis [5]. The long-term prognosis of an implant is related directly to routine assessment and effective preventive care. To maintain healthy tissues around dental implants, it is important to institute an effective maintenance regimen. Different regimens have been suggested, but it is unclear which are the most effective [6]. This article evaluates the literature regarding implant maintenance. Factors affecting the soft tissue surrounding endosseous root-form implants also are discussed, and procedures for assessment of the implant and the treatment of reversible disease in implant maintenance are outlined.

Structure and function of the peri-implant tissues

It is important to have a basic understanding of the peri-implant soft tissue structures. The interface of the soft tissue with the implant is critical in sealing the intraoral environment from the endosseous part of the dental implant [7]. This biologic soft tissue seal, which is analogous to the epithelial attachment of the tooth, protects the implant–bone interface by resisting the challenge of bacterial irritants and the mechanical trauma resulting from restorative procedures, masticatory forces, and oral hygiene maintenance [5]. The soft tissue (perimucosal) seal that forms around the coronal

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part of a dental implant is about 3 mm in corono-apical direction and consists of two zones, one of epithelium and one of connective tissue [8]. The outer surface of the peri-implant mucosa generally is covered by keratinized stratified squamous epithelium that is analogous to the gingiva. Although keratinized tissue may be less susceptible to bacteria at the implant–soft tissue interface [9], lack of keratinization has been reported to have little adverse effect on implant survival [10], especially in areas of healthy tissue. The barrier epithelium, only a few cells thick, is continuous with outer surface tissue and terminates about 2 mm apical to the soft tissue margin. Both epithelia harbor hemi-desmosomes and have the appearance of a basal lamina [11].

The vascular system of the peri-implant mucosa derives solely from the alveolar supraperiosteal blood vessels because there can be no contribution from a periodontal ligament [12]. The remaining 1 to 1.5 mm of soft tissue margin, between the apical portion of the barrier epithelium and the alveolar crest bone, is composed of connective tissue. These connective tissue bundles originate from the alveolar crest and run parallel to the abutment surface. Unlike periodontal attachment surrounding natural teeth, there is no insertion of connective tissue fibers into the implant surface. The connective tissue "cuff" is held in close approximation to the epithelial attachment that surrounds the implant. In the presence of keratinized mucosa, the connective parallel fibers are woven with circular fibers running circumferentially around the implant. The connective tissue immediately adjacent to the implant is rich in collagen and is relatively acellular and avascular, making it histologically similar to scar tissue [13].

Many authors have discussed biologic width and implants. When comparing the collective measures in biologic width of sulcus depth and the dimensions of junctional epithelium and connective tissue contact, the results of studies of natural teeth [14,15] and those of implants remain dimensionally stable. There are differences in the ratios for nonsubmerged [16] versus submerged implants [13,17]. Although a healthy connective tissue seal can be achieved on both types of dental implant systems, the epithelial attachment is more apically located on submerged implants because of the presence of the so-called "microgap" [18]. Although the actual measure of the separate components of the biologic width around implants can change at different times after insertion, the overall sum of the sulcus depth, junctional epithelium, and connective tissue contact surrounding the implant does not change. This stability indicates that the biologic width is a physiologically formed and stable structure over time [19]. Biologic width is one of many factors to consider when monitoring the progress of osseointegration and health of peri-implant tissues during the first critical year after placement and afterwards during maintenance visits.

Peri-implant disease

Implants, like teeth, are susceptible to bacterial plaque accumulation and calculus formation. In fact, because of a lack of connective fiber insertion and decreased vascular supply around the implant, there may be greater susceptibility to plaque-induced inflammation [20]. Plaque will form on implant surfaces as soon as they are exposed to the oral cavity. The initial pellicle formation on implants is similar to that on natural teeth, but the initial adhesion rate of specific bacteria may vary [21]. The composition of bacterial plaque is similar on implants and natural teeth [22]. Gram-positive facultatively anaerobic rods and cocci were found around periodontally healthy teeth and successful implants. In edentulous patients, bacteria colonizing the implant surface are derived from the microflora in saliva, which in turn are derived from various oral niches such as the dorsum of the tongue and tonsillar crypts [23]. In partially edentulous patients opportunistic periodontal pathogens such as *Actinobacillus actinomycetemcomitans*, *Prevotella intermedia*, *Peptostreptococcus micros*, and *Fusobacterium nucleatum* have been identified in association with peri-implantitis [24]. Periodontal pathogens identified in pockets before implant placement can be detected at implant sites 3 months after exposure to the oral environment [25]. Other data suggest that periodontal pathogens such as spirochetes may be transmitted from residual teeth to implants within 6 months of implant placement [26,27]. Proliferation of these pathogens can result in an inflammatory response and may lead to peri-implant infections.

The term ‘‘peri-mucositis’’ refers to the reversible inflammation of the soft tissue surrounding the implant and is somewhat analogous to gingivitis. ‘‘Peri-implantitis’’ is defined as an inflammatory process affecting the bone surrounding the osseointegrated implant and may be viewed as somewhat analogous to periodontitis [28]. Supragingival calculus is more common on implants than subgingival calculus, which is seldom seen. Calculus that forms on implant surfaces may be less tenacious than calculus around natural teeth and is easier to remove because the low surface energy of the titanium abutment surface attracts proteins with low surface affinity [29]. When the surface of the abutment fixture is exposed to the oral environment, any calculus attachment is much more adherent and difficult to remove [29].

The mucosa surrounding the implant exhibits an inflammatory response to plaque formation similar to that seen in the gingiva that surrounds the natural teeth. Although the formation of biofilm and the initial inflammatory response between the dento-gingival structures and the gingivo-implant structures are similar, studies have shown that the pattern of spread of inflammation differs [20,30]. Because of the smaller numbers of fibroblasts in peri-implant tissues, inflammatory cell infiltrate extends into the bone marrow spaces of the alveolus. Thus, it has been suggested that the peri-implant mucosa is less effective than the gingiva in preventing further progression of the plaque-induced lesion into the surrounding bone. This progression can lead to peri-implantitis and potential failure of the implant [31]. It is, however, difficult to reconcile these theoretical constructs with the remarkably high success rates observed in numerous implant outcomes studies. Peri-implantitis seems to be a rather uncommon condition, but it is prudent to implement maintenance measures that will reduce the incidence of these infections further, because implant loss often involves significant morbidity, expense, and inconvenience.

Clinical signs and symptoms of peri-implant disease include edematous tissue and bleeding after gentle probing with a blunt instrument, with a potential of suppuration [9]. Discrimination must be made between reversible peri-mucositis, with no loss of supporting bone, and irreversible peri-implantitis, in which there is progressive loss of osseointegration. Radiographic evidence will show vertical bone destruction with an associated peri-implant pocket. Pain is not a typical feature of peri-implantitis and, if present, usually is associated with an acute infection. The final stage of peri-implant disease is mobility of the fixture or a continuous radiolucency around the implant. The overall frequency of peri-implantitis is in the range of 5% to 10% [32]. The actual need for surgical removal of the implant is reported to be much lower and to occur mostly during the first year after placement [33]. Even with signs of infection, implant loss could remain low if appropriate preventive and interventional treatment strategies are followed after closely supervised monitoring and diagnosis. Indeed, reversal of peri-implantitis and reintegration of surface-enhanced implants recently has been demonstrated in an experimental peri-implantitis model [34]. In that study, significantly greater reintegration was noted with a sandblasted, acid-etched surface than was seen with smooth-surfaced implants.

Maintenance regimens for dental implants

Maintenance programs for implants should be designed individually because there is a lack of data detailing precise recall intervals, methods of plaque and calculus removal, and appropriate antimicrobial agents for maintenance around implants [35]. The first interaction with the implant patient in regard to maintenance should be a review of home care ability and motivation before the placement of the implant [36]. It is important that the patient understand his or her responsibility in caring for the implant. The role of the patient is that of cotherapist; the therapist and patient must form a therapeutic alliance, as in dental care that does not involve implants. The patient's motivation and skill in performing oral hygiene measures may influence the prosthetic design [37]. It has been suggested that a patient's inability to achieve adequate oral hygiene be considered a possible contraindication to implant placement [38].

The following post-placement parameters should be evaluated and considered before the restorative phase: quantity, quality, and health of soft and hard tissues, implant stability, implant position and abutment selection, and oral hygiene assessment [39]. Because peri-implant lesions result from opportunistic infections that may lead to loss of supporting bone, it is mandatory to monitor peri-implant tissues at regular intervals in hope of implementing early interventions when signs of disease are noted. Studies have shown that mucositis lesions can exhibit apical progression after 3 months of plaque buildup around implants [40]. Therefore a 3-month maintenance regimen is recommended within the first year of implant placement. Depending on risk factors, oral hygiene compliance, and assessments, the recall interval can then be extended to 6 months [41]. Because periodic evaluation of the dental implant is vital to its long-term success, the following factors must be evaluated at each maintenance appointment:

- Presence of plaque and calculus
- Clinical appearance of peri-implant tissue
- Radiographic appearance of implant and peri-implant structures
- Occlusal status, stability of prostheses and implants
- Probing depths and presence of exudates or bleeding on probing
- Patient comfort and function [39]

In addition to the evaluation, the maintenance appointment also should include

- A thorough review of oral hygiene reinforcement and modifications
- Deposit removal from implant/prosthesis surfaces
- Appropriate use of antimicrobials [42]
- Reevaluation of the present maintenance interval, with modification as dictated by the clinical presentation

Clinical assessment

Assessment of home care

Evidence from animal and human studies has established the importance of the microbial biofilm in the pathogenesis of peri-implant disease [30,43]. Therefore it is logical to monitor oral hygiene habits by routinely assessing plaque accumulation around dental implants. The amount of plaque around implants always should be evaluated and documented [44]. Two indices have been developed for such plaque assessments. Mombelli and colleagues [25] suggest numerical scoring (0 = no visible plaque, 1 = plaque recognized by running probe over smooth margin of implant, 2 = visible plaque, 3 = abundance of soft matter) of visible marginal plaque amounts, whereas Lindquist and colleagues [45] suggest a similar quantification (0 = no visible plaque, 1 = local plaque accumulation, 2 = general plaque accumulation greater than 25%) of plaque percentage. Another method of quantifying plaque accumulation is to compute a simple percentage of surfaces with plaque accumulations. Six areas of plaque (three buccal and three lingual) are recorded in the same manner used with natural teeth. A resulting percentage of identified surfaces can be calculated and compared with an established threshold set for acceptable oral hygiene. The clinician can decide whether to incorporate the use of dyes or stains. Although this method may take a little more time, it develops a record the presence of plaque on all individual implant surfaces that can be easily compared over time. Because the implant abutment surface is highly polished, calculus does not tend to accumulate as easily or as tenaciously on implants as on natural teeth [46].

Examination of peri-implant soft tissue

The clinical appearance of peri-implant tissues is another evaluation that should be completed during a routine maintenance visit. Redness, swelling, and alterations of color, contour, and consistency of the marginal tissues may be signs of peri-implant disease. The appearance of peri-implant tissue also may be influenced by the characteristics of the implant surface [47,48]. Several suggested methodologies to evaluate the clinical appearance of the mucosa around implants involve measures of bleeding. Numerical indices by Mombelli and colleagues [9] and by Aspe and colleagues [49] are similar to the traditional gingival index but have been modified and adapted for application around dental implants. Another study recommends the use of the O'Leary index, a visual measure for periodontal tissue condition [50]. Using an index consistently is more important than the choice of index.

Radiographic examination

Radiographic interpretation of peri-implant alveolar bone has proven to be one of the most valuable measures of implant success [51]. Radiographic interpretation is particularly important when probing cannot be used to evaluate an area because of constricted implant placement or lack of access because of prosthetic placement. Radiographs are important when used to compare osseous changes over time. As with radiographic evaluation of natural teeth, there is low sensitivity in detecting early pathologic and bone remodeling, making the results confirmatory to a clinical diagnosis. Early lesions may not be noticed until they are more advanced [52]. In particular, panoramic radiographs with poor resolution can be used only for screening. Standardized periapical radiographs using long-cone paralleling technique are recommended [53], but panoramic films actually may be superior to intraoral exposures in some cases. In the final analysis, the choice of imaging modality must be tailored to the clinical and anatomic circumstances of the individual patient. Digital subtraction radiology can increase the sensitivity significantly but is seldom used in the clinical setting, for a variety of reasons [54]. A stable landmark, which should be identified for each fixture evaluated, is the implant shoulder (collar contour) for one-stage transmucosal implant systems or the apical termination of the cylindrical portion of the implant for two-stage submerged implant systems [55]. The implant threads on screw-type fixtures can be used as a reference to compare osseous peri-implant dimensional changes between on-going series of radiographs. When making measurements from radiographs, allowance must be made for dimensional distortion, which may vary considerably [56]. Normally, a postoperative radiograph is taken immediately after implant placement to verify position and provide a benchmark for future comparisons. Future imaging requirements would be based on the clinical situation of the particular patient. One interval that has been recommended (in the absence of obvious clinical problems) is 1, 3, and 5 years, with films obtained thereafter based on the clinical situation [57].

The radiograph should reveal bone in close apposition to the implant body. Anticipated crestal bone loss for the first year after insertion is approximately 1 mm, with an average 0.1 mm subsequent bone loss per year. This loss is seen primarily in submerged (two-stage) implants; it has been suggested that this crestal loss results from the existence and microbial colonization of a microgap. It has been reported that greater bone loss occurs in the maxilla than in the mandible, but this finding has not been universally observed [58]. Failing implants often exhibit a thin radiolucent space that may mimic a normal periodontal ligament space but may also exhibit larger, saucerlike defects at the alveolar crest. The periapical area also should be free of significant radiolucencies.

Rapid bone loss, which may not be radiographically evident, may be associated with fractured fixtures, initial osseous trauma during insertion, stress concentrated at the marginal bone by overtightening of fixtures during placement, trauma from occlusion, poor adaptation of prosthesis to abutment, normal physiologic resorption, and plaque-associated infection [58].

Occlusal evaluation

The occlusal status of the implant and its prosthesis must be evaluated on a routine basis. Occlusal overload can cause a host of problems, including loosening of abutment screws, implant failure, and prosthetic failure. The occlusal contact patterns should be evaluated, as should the mobility of the implant and opposing teeth. Successful implants are not perceptibly mobile. Indeed, failing implants are not mobile until all or most of the bone has been lost. The occlusion also should be evaluated at every maintenance appointment. There is little evidence available concerning implant survival and occlusion. Although it is not known if nonaxial loading is detrimental to osseointegration, it has been established that abnormal occlusal loading will negatively affect the various components of the implant-supported prosthesis [59]. Any signs of occlusal disharmonies, such as premature contacts or interferences, should be identified and corrected to prevent occlusal overload. The implant-protected occlusion should have light centric contact with no contacts on lateral excursions. A check of occlusion should hold shim stock only with hard clinched teeth. Implant prostheses should be examined when bruxism or other parafunctional habits are exhibited. Excessive concentrated force can result in rapid and substantial peri-implant bone loss [60].

A failed implant connected to a multiunit prosthesis may mask evidence of mobility, although such an implant would almost always exhibit significant bone loss on radiographic examination. It has been suggested that a fixed, multiple-unit, retrievable implant-retained prosthesis be removed periodically to assess mobility, gingival health, and hygiene status, although there is not universal agreement on this point. All prostheses should be evaluated for mobility during routine maintenance evaluation. Any movement would indicate possible lack of osseointegration of the fixture, possible failure of the cement bond between the superstructure and the retainer, or screw failure by fracture or loosening. Screw loosening is a common problem [50]. Either the screw that retains the abutment or the screw that retains the crown can be loose. In the case of the abutment screw, it is sometimes difficult to determine whether the actual implant or only the screw is loose. One useful hint is the presence of a parulis or fistula located within the keratinized mucosa in close proximity to the microgap. Once the abutment is loose, the microgap widens considerably, which results in heavier microbial colonization, often resulting in the formation of a fistula.

Other methods have been developed to assess the degree of bony support. One of the earliest devices known as the Periotest is designed to assess subclinical mobility [61], but the diagnostic significance of the resulting values has been questioned [62].

Peri-implant probing

Peri-implant probing depth should be measured routinely during maintenance appointments [63]. Measurement of probing depth around implants is more sensitive to force variation than around natural teeth [64]. Therefore less probing force (0.2–0.3 N) is recommended around implants. Even with this lesser force, it was found that the probe caused a separation between the surface of the implant and the junctional epithelium, but not within the connective tissue adaptation. Five days after clinical probing, healing of the epithelial attachment seemed to be complete. This finding suggests that clinical probing around osseointegrated implants does not have detrimental effects on the soft tissue seal or jeopardize the longevity of oral implants [65]. Concern has been expressed about the possibility of introducing pathogens into peri-implant tissues while probing. Indeed probe penetration increases with the degree of inflammation, exceeding the connective tissue adaptive level by a mean of 0.52 mm [63]. Even with the influence of variables such as the roughness of the implant body, difficult access, and location of the microgap in submerged implants, the advantages of probing (eg, the simplicity of the method, the immediate availability of results, and the ability to demonstrate topographic disease patterns) make probing an indispensable part of implant maintenance assessment [66]. Probing depths can be influenced by the thickness and type of mucosa/epithelium surrounding the implant. Shallow depths usually are associated with a keratinized collar, whereas deeper probing depths are associated with mobile alveolar mucosa surrounding the implant [67].

Use of a fixed reference point on the implant abutment or prosthesis for a reliable measurement of attachment levels is recommended [68]. Successful implants generally have a probing depth of 3 mm, whereas pockets of 5 mm or more serve as a protected environment for bacteria and can exhibit signs of peri-implantitis [69]. Peri-implant probing should be avoided during the first 3 months after abutment connection to avoid disturbing healing and establishment of the soft tissue seal [70]. The peri-implant probing attachment level correlates closely with radiographically measurable peri-implant bone changes. It is recommended that probing be a part of each maintenance recall appointment [54].

Bleeding on probing

Another suggested parameter for evaluation of the status of the implant during maintenance is the presence of exudate or bleeding on probing. Bleeding on probing indicates inflammation of soft tissue, whether around natural teeth or implants. Controversy exists as to whether bleeding on probing represents traumatic wounding of the tissue or demonstration of clinical inflammation [71]. Bleeding on probing alone has been found to be a poor predictor of progression of periodontal disease, but its absence at successive maintenance visits may be a reasonably good negative predictor of attachment loss [72]. A positive correlation has been found between bleeding on probing and histologic signs of inflammation at peri-implant sites [73]. Also, predictive values for disease progression are high when combining high bleeding on probing scores with positive microbiologic testing [74].

Several indices have been developed to assess marginal mucosal conditions around oral implants. One index scores the amount of bleeding on probing [9]. Another index scores various levels of tissue color and consistency [49]. Although several promising studies have addressed the use of peri-implant sulcus fluid analysis for markers of inflammatory mediators in peri-implant disease, at this time it can be stated only that a potential exists for using biochemical markers to monitor the host response during the supportive phase of implant therapy [55]. Also, too little is known presently to recommend the routine use of microbiologic assays in determining risk for peri-implant tissue loss. The value of microbiologic testing increases after signs of peri-implant disease have been detected. Such information may be helpful for the differential diagnosis of peri-implantitis and for treatment planning [7].

Subjective symptoms

It is important to discuss patient comfort and function at each maintenance appointment. Pain or discomfort may be one of the first signs of a failing implant, usually presenting with mobility [75]. There may be persistent discomfort before any radiographic changes are detected [76]. A fractured or loosened screw should be the first suspicion when a patient complains of a loose implant or discomfort. Function in regard to occlusal status, mobility, and presenting prosthetic conditions has already been discussed.

Patients should be placed on a regularly scheduled, individually designed maintenance program including monitoring of the peri-implant tissues, the condition of the implant-supported prosthesis, and plaque control [77]. An established protocol suggests a 3-month recall visit to limit disease progression and to allow treatment of disease at an early stage [50]. After the first year the maintenance interval can be extended to 6 months if the clinical situation seems stable [30].

Oral hygiene instruction

Based on the condition of the tissue and the assessment of the presence of plaque and calculus around implants, a thorough review of oral hygiene instructions should be implemented. Ideally a home care assessment has been made before the implant fixture is placed surgically [36]. Patients who have dental implants usually have a history of less-than-ideal home care, resulting in the partially or totally edentulous state. Also these patients may fall into the extremes of lack of home care because of postsurgical fear of causing damage, on the one hand, or overzealous home care trying to stay totally plaque-free, on the other. Either of these situations can lead to an undesirable outcome [78]. High plaque scores are correlated positively with peri-implant mucositis and increased probing depths around implants [79]. Smooth implant surfaces form less plaque than roughened surfaces [80]. Therefore it is important to use and recommend home care aids that do not alter the implant abutment surface and are safe and effective with daily use [81]. The clinical situation and the type of implant influence the timing of initiating home care measure. During healing periods, when mechanical plaque control is contraindicated, chemical agents (eg, chlorhexidine) should be used. A variety of devices, including soft-bristled brushes, dental floss, and interproximal brushes with a nylon-coated core wire, may be used. There is evidence that certain electromechanical brushes may be superior to manual brushing for many patients [82]. Smaller-diameter toothbrush heads such as end-tufted brushes or tapered rotary brushes may be of benefit in difficult-to-access areas. Besides the interdental brush, interproximal plaque may be removed by many types of floss (eg, plastic, braided nylon, tufted, coated, woven, yarn, and gauze). These products have been found to be safe for daily use, especially with multiunit or hybrid-type prostheses [83].

Just as with the tissues surrounding natural teeth, the health of the peri-implant tissues depends on inhibiting and preventing early plaque formation, removing existing plaque, and interrupting the progression of peri-implant mucositis to peri-implantitis [50]. The professional procedures and techniques for achieving such maintenance can vary considerably from those used for natural dentition. Maintaining the surface integrity of the transmucosal titanium abutment is crucial to avoid negatively affecting the surrounding soft tissue. Roughened surfaces can contribute to the accumulation of bacterial plaque and allow recolonization with pathogenic bacteria [84]. If there is no sign of inflammation, probing depths are 3 mm or less, and there is little plaque, it can be assumed that the area is sparsely colonized by nonpathogenic gram-positive bacteria, and the risk for peri-implant complications is low. In such cases, zealous instrumentation of the implant surfaces is contraindicated [72]. When only soft debris is present, deplaquing the surface is beneficial. The use of a rubber cup and tin oxide or a specially designed prophylactic paste for titanium with fine abrasive content is recommended as the safest modality [81], but regular rubber cup polishing was found to be equal in cleaning effectiveness to regular brushing and air-polishing [85]. Because air-powder abrasive systems may have minimal effect on titanium surfaces, they may be used in implant plaque and stain removal, but excessive and prolonged exposure air-polishing can cause significant, undesired alterations [86]. For titanium implant abutments, it has been demonstrated that scalers made from stainless steel [81], titanium [87], or titanium-tipped stainless steel [50] roughen implant surfaces, creating scarring and pitting. The same effect is seen when metal ultrasonic inserts are used on implant surfaces. Gold-plated instruments leave no initial traces of residue on smooth titanium surfaces, but when used on rough surfaces the gold coating wears down, exposing the underlying alloy and leaving an unsuitable surface [88]. Research has shown that the use of plastic scalers produced insignificant alteration of the titanium implant surface following instrumentation [87,89]. Therefore, plastic instruments are recommended for scaling titanium implant surfaces, even though residues from the instruments are left behind [88]. Some plastic instruments are very flexible and can be difficult to use when removing calculus from implant surfaces. Plastic instruments reinforced with graphite are more rigid and can be sharpened. It is best to use a dedicated stone for sharpening graphite-reinforced plastic implant instruments so that metal filings are not transferred to the plastic instrument from a previously sharpened metal instrument [90]. Plastic probes often are recommended to prevent surface alterations, although there is no compelling evidence that the use of metal probes is detrimental to health [91]. Nonmetal ultrasonic tips are suitable for implant maintenance [92]. Although many researchers have proven that surface alterations are generated with metal instruments and ultrasonic inserts, the literature does not show that implant complications increase as a result of such surface alterations [35]. Nevertheless, it seems prudent to recommend that plastic or nylon instruments be used for implant débridement until more definitive research findings offer guidance in this area.

With a goal of promoting optimal health by inhibiting plaque formation and by altering existing plaque from pathogenic to nonpathogenic microorganisms around implants, topical antimicrobials should be considered for use in maintenance procedures. It has been documented that topical antimicrobials such as products containing chlorhexidine digluconate (0.12%), plant alkaloids, or phenolic agents produce minimal implant surface alterations [81]. Mechanical débridement and mechanical débridement supplemented with chlorhexidine (0.12%) can reduce plaque, inflammation, and probing depths in patients who have peri-implant mucositis [93]. The chlorhexidine mouthrinse can be applied with a cotton swab or with a toothbrush around the peri-implant tissues when staining of esthetic restorations is a concern [94]. Antiseptic mouthrinses containing phenol-based therapeutic ingredients have been found to reduce plaque, gingivitis, and bleeding of peri-implant tissues significantly but do not improve probing depth or attachment level [95]. Although water is not classified as an antiseptic or antimicrobial agent, its use in a water-irrigating device on the lowest setting has been recommended, although there is insufficient published research to make recommendations in this regard [96]. Given the paucity of research in this area, it may be prudent to avoid the use of such irrigating devices.

Summary

Periodontal maintenance at individually established intervals is critical to the ongoing success of implant therapy. Periodic clinical assessment of the implant fixture, prosthesis, and surrounding tissue is critical to clinical success. Equally important is the professional removal of supragingival and subgingival deposits on a regular basis and counseling in home care techniques. Although further studies are needed before evidence-based protocols can be established, it seems prudent to recommend the routine implementation of an active maintenance program tailored to the circumstances of each individual implant patient. In most fields of medicine and dentistry, primary and secondary preventive strategies are usually superior to tertiary interventions, and this is likely to be true of dental implants as well [97].

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