

Maintenance of Dental Implants: A Review

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Abstract

Objective: Successful bonding of a dental implant to bone, which was referred to as osseointegration by Branemark has been well documented. However, long-term prognosis of an implant depends on adequate maintenance and long-term care. An effective maintenance program is required to preserve the health of peri-implant tissues. Several techniques have been suggested for this purpose; but it is not clear which is more efficient.

Review of Literature: This review evaluates the literature regarding implant care and factors affecting the peri-implant soft tissue and describes the required measures for assessment of peri-implant status and treatment of reversible peri-implant diseases.

Conclusion: Data shows that several measures can be taken to maintain the health of peri-implant tissue and ensure the long-term prognosis of dental implants.

Key words: Dental implant, Long-term prognosis, Maintenance.

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Introduction:

Importance of dental implant care and maintenance and its effect on the course of treatment:

At present, use of a dental implant for replacement of a lost tooth is a standard treatment option (1). Intraosseous titanium implant, referred to as root form implant, is an evidence-based method for replacement of a lost tooth (2). The surgical phase of implant therapy (primary stability and osseointegration) has been emphasized for long-term success of implants. However, at present, implant success not only depends on surgical factors but also location of fixture placement, prosthesis and esthetics (3).

Maintaining the health of soft tissues is as critical as the osseointegration in long-term success of implants (4). Prevention of peri-implant disease is an important issue for the clinician and patient and requires regular check-ups (5). Long-term implant success depends on team work between the dental clinician and the patient (6).

Maintenance of pre-implant health is critical. However, it may be a difficult task for some patients. In such cases, another reliable method may be required for preserving periodontal health (7). Primary microbial accumulation on the implant surface must be prevented; At least 85% of microbial plaque should be eliminated by the patient to maintain long-term implant

success (8).

Structure and function of peri-implant tissue:

The interface between the mucosa and implant is critical for creation of a barrier to protect the intraosseous part of the implant from the oral environment (9). The external surface of soft tissue is mostly covered by keratinized squamous epithelium similar to gingiva (10). However, defects in the healthy keratinized tissue have no negative effect on implant success (11). This epithelial barrier has a thickness of a few cell layers. This cell thickness is approximately 2mm apical to the soft tissue margin. At this site, hemidesmosome attachments are present mimicking the appearance of the basal membrane including lamina lucida and lamina densa (12). The connective tissue called “cuff” is in close contact to the epithelial attachment around the implant. This connective tissue is collagen rich and relatively acellular with no blood vessels. Histologically, it looks like scar tissue (13). Non-submerged implants are different in biologic width from submerged implants (14). The total sum of attached epithelial sulcus depth and peri-implant connective tissue is not variable. This fixed amount indicates that biologic width is a physiologically formed structure that remains intact over time (15).

Vascular peri-implant system:

The vascular system of peri-implant mucosa is exclusively supplied by suprapariosteal blood vessels; blood supply from the periodontal ligament does not exist (16).

Peri-implant disease:

Due to decreased blood supply around implants, they may be more prone to plaque-related inflammation. Immediately after exposure of an implant to the oral cavity, dental plaque forms on the implant surface (17). The composition of dental plaque on the implant and natural teeth is similar (18). In edentulous patients, bacterial colonies on the implant surface originate from the microflora (19). However, they may cause

peri-implantitis in partially edentulous patients (20). Periodontal pathogens are found around implants 3 months after their exposure into the oral environment (21). Studies suggest that periodontal pathogens such as spirochetes can migrate from the residual teeth to the implants 6 months after placement (22, 23).

Although biofilm formation and inflammatory response are similar between dental-gingival and implant-gingival structures, studies have shown that pattern of inflammation is different between the two (17, 24). It has been reported that peri-implant mucosa is less effective than the gingiva in prevention of progression of plaque-related lesions into the adjacent tissue and bone. Progression of inflammation leads to peri-implantitis, which per se can cause implant failure (25).

Microbial plaque of dental implants:

Using software and digital programs, the percentage of abutment surfaces covered with plaque was measured. This value varied from 52.06% for air power abrasion to 55.29% for plastic scalers (26).

Initiation of dental implant maintenance and care:

After completion of implant treatment, follow up sessions for maintenance and care should be scheduled based on a timetable with 3 to 4-month intervals in the first year (27). Then, based on patient’s specific needs, the next follow up appointments may be scheduled (28). Patients with good oral hygiene do not need as many periodic follow ups; whereas, patients with poor oral hygiene require more periodic professional care (5). After one year if the patient is clinically stable follow up session time intervals every 6 months suffice (24).

Care and maintenance of dental implants by the dentist:

Maintenance programs for implant patients should be case-specific (28). It should be noted that the patient’s ability and motivation for oral hygiene maintenance may affect the implant’s

prosthetic design (29). Failure to adhere to oral hygiene instructions can be a contraindication for implant placement (30). Before the prosthetic phase, several factors namely the quality, quantity and health of peri-implant soft and hard tissues, stability of implant, position of implant, selection of abutment and oral hygiene status should be evaluated (31). Studies have demonstrated that mucositis 3 months after microbial plaque formation shows apical progression (32).

Clinical assessment and examinations:

Clinical examinations include visual assessment and probing. Visual assessment of color, texture and consistency of tissues (33), gingival margin position (34) along with peri-implant probing and radiography are measures for evaluation of implant status. Soft tissue can be evaluated for signs of inflammation and swelling and can be palpated for presence of edema, tenderness, exudate or puss. Peri-implant probing is used for the assessment of per-implant soft and hard tissue (35, 36).

Peri-implant probing:

Peri-implant probing should be done regularly during the maintenance phase (37). Also, it should be noted that the peri-implant tissue is more sensitive than the tissue around natural teeth (38). Thus, less force is recommended for peri-implant probing (0.2-0.3 N). Even probing with slight force may separate the epithelial attachment from the implant surface. However, this separation does not continue to the connective tissue. Five days after clinical probing, the epithelial attachment is reinstated (36). This event has no effect on soft tissue seal and does not compromise the implant survival (39). Advantages of probing make it an inseparable part of maintenance phase (40). The thickness and type of soft tissue may influence the depth of probing (41). Generally, the probing depth for successful implants is 3 mm. Pockets with more than 5mm depth provide a safe zone for the bacteria and are a sign of peri-implantitis

(42). The peri-implant probing depth has a close association with radiographic changes around implants (43). It should be noted that probing should not be done until 3 months after the abutment attachment in order not to compromise the healing process or the soft tissue seal (44).

Bleeding on probing:

Presence of bleeding on probing alone is a weak predicting factor in development of periodontal disease; but is more valuable for implants than teeth (45). However, its absence can be a negative predicting factor for absence of attachment loss (46). During the first year, BOP should be checked at all sites around the implants during peri-implant assessment. After the first year and stability of probing depth, examination is limited to the probing and evaluation of facial and lingual surfaces (5).

Presence of puss:

In some case reports, puss has been reported to be related to peri-implantitis. However, the role of puss as an indicator of initiation or progression of peri-implantitis has yet to be clearly identified (47-49).

Measurement of implant stability or loosening:

This index has low sensitivity and high specificity. Large volume of bone may have been lost around implant but it may still be stable; this indicates low sensitivity of this index (5). On the other hand, a highly mobile implant has failed (33, 47).

Evaluation of symptoms stated by patients:

In the follow up sessions, paying attention to patient comfort and function of the implant is especially important. Pain and discomfort can be the first signs of implant failure that are often associated with mobility and loosening (50).

Radiographic assessments:

Radiography has been confirmed as a valuable tool for assessment of implant success (51). In cases where due to space limitation or inadequate access probing is not feasible, radiography can be extremely helpful. Radiographs are especially important for the

comparison of bone loss over time (5). Panoramic radiography is only used for screening due to low resolution (52). Use of digital radiography can increase sensitivity but due to several reasons has little clinical application. The stable landmark used for assessment of the fixture is the implant shoulder in trans-mucosal one-step implant systems and the apical part of cylindrical implants in two-step submerged implants (53). A mean bone loss of 1.5 mm is usually seen in the first year following implant-prosthesis treatment. After the first year, a mean vertical bone loss of 0.1 mm occurs annually (54).

Evaluation of occlusion:

Excessive occlusal forces cause problems namely abutment screw loosening, implant failure and prosthetic failure. Occlusion should provide a mild contact in centric occlusion and no contact in lateral movements (55, 56) or lateral forces must be evenly distributed and not cause destructive forces (56, 57).

Instrument selection:

Selection of instrument depends on the design of instrument tip. The instrument should not be bulky. Its design should facilitate usage. Dentists should take into account the prosthetic design, location of calculi and their consistency when selecting the instrument. These instruments should be disposable or sterilizable and also be cost-effective. Instruments with stainless steel and titanium tips are suitable for smooth titanium implant surfaces (5) but can cause surface roughness (58, 59, 60). These instruments should be rigid enough to tolerate motions and have to be adaptable to the implant gingival sulcus (35). Plastic instruments are often very flexible and cannot adequately remove calculi (58, 60, 61). In 1990, it was reported that rubber cup with pumice paste creates the smoothest surface. Interdental brush, toothbrush with soft nylon bristles, plastic scaler, EVA plastic tip and rubber cup all provide similar surfaces rougher than the surface

cleaned by rubber cup and pumice paste. Metal scalers and Cavitron cause the roughest surface (62). In a study in 1992 a titanium implant abutment was evaluated under scanning electron microscopy and it was reported that treatment with metal scaler causes a rough surface but plastic scaler and rubber cup, rubber cup with SnO₂ and air power abrasion all yield a smooth titanium surface (63). In the same year, another study introduced plastic scaler as the instrument of choice for implant cleaning (64). In 1996, implant titanium surface was evaluated by laser scanning microscopy following hygienic products and it was reported that titanium curette and air abrasion can be recommended with some limitations and it has been confirmed that steel curettes and ultrasonic systems are not suitable for cleaning titanium implants (65). In 1997, titanium implant surfaces were evaluated by SEM following the use of different curettes and it was reported that after 16 years, gold platinum curette caused the roughest surface compared to resin-treated or untreated curettes (66). In an in-vitro study in 1998 on methods of cleaning implant surfaces it was found that implant surfaces cleaned with plastic scalers procure higher viable cells than surfaces cleaned with air abrasive system (67). Another study in 1998 reported that Cavitron jet air polish system, rubber cup, plastic curette and use of sonic scalers with soft plastic tip and titanium curettes are suitable for cleaning implant surfaces (68). In an in-vitro study in 1994, it was reported that Teflon tip sonic and ultrasonic scalers make it possible to use high frequency instruments for professional cleaning of implants (69). In 1997, electron microscopic analysis revealed that air abrasive system does not cause a significant change of implant surface; but scalers with alloy tips or high resin tips and scalers reinforced with graphite alter the surface, leave particles remaining on the surface or both (70). In 2004 it was stated that tin-coated abutments show less surface roughness following the use of

maintenance tools and the instrument residues less commonly remain on their surface (71). Another preliminary study in 2004 stated that ultrasonic was helpful for debris removal but compared to plastic scalers caused greater damage (72). A profilometry study in 2006 stated that although plastic curettes and air powder water spray cause less surface damage, they leave some deposits on the surfaces that can compromise the process of recovery (73). In an in vivo study in 2007, it was stated that piezoelectric scalers with nonmetallic tips are suitable for implant maintenance (74).

Oral hygiene instructions:

Ideally, assessment of home care should be done prior to implant placement. Patients receiving implants usually have a history of less than ideal home care resulting in their partial or complete edentulism. These patients may not perform adequate home care because they are afraid to traumatize the area or may over-do the home care to provide a plaque-free environment. Each of these situations can have unfavorable outcomes (75). High plaque index has a positive correlation with peri-implant mucositis and increased probing depth (76). Smoother implant surfaces cause less plaque formation (77). Thus, the important point is that home care devices should not alter the implant or abutment surface and have to be safe and effective (78). A variety of devices such as soft tooth brushes, dental floss and interdental brushes with a nylon-covered wire core may be used for this purpose (79, 80). Evidence shows that electric tooth brushes may be more suitable than manual brushing for many patients (81).

Similar to the tissue surrounding natural teeth, health of peri-implant tissue depends on inhibition of plaque formation, removal of available plaque and prevention of mucositis progression to peri-implantitis (82). It should be noted that if the surface becomes rough in any way, accumulation of microbial plaque is enhanced and colonization of pathogenic

bacteria occurs (47). If signs of inflammation, probing depth equal or less than 3 mm or insignificant amounts of plaque are observed, severe debridement of implant surfaces is not recommended (65). If only soft debris is present, plaque removal may be helpful. Use of rubber cup and tin oxide or use of prophylactic pastes with small particles designed for titanium surfaces are the safest cleaners (78). However, conventional rubber cups have a cleaning efficacy similar to that of conventional brushes and air polish (83). Since the air power abrasion system has a minimal effect on titanium surfaces, it can be effective for plaque and stain removal. However, it should be noted that excessive long-term use of air polish can cause significant unfavorable changes on the implant surface (81). Evidence shows that use of stainless steel (78) and titanium (84) instruments can cause surface roughness in titanium implants. Gold-plated instruments do not leave residues on the implant surface but they are abraded when used on rough surfaces. Studies have shown that plastic scalers do not cause significant changes on implant surface (81). Thus, they are recommended for use on the titanium implant surface; although they leave some residues on the surface as well. Some plastic instruments are very flexible and may not be able to adequately remove calculi. Plastic instruments are reinforced with graphite in order to become harder and sharper. In order to sharpen the graphite-reinforced plastic instruments, specific sharpening stones are used (73). Plastic probes are commonly recommended because they do not change the surface. Non-metal ultrasonic tips may be required for implant maintenance (85). Mechanical debridement with 0.12% chlorhexidine can decrease inflammation because it reduces plaque and peri-implant probing depth in cases of peri-implant mucositis (86). Chlorhexidine mouthwash can be applied around the implants using a cotton swab or toothbrush (87).

Patient assessment:

In some cases, it may be required to change the oral hygiene measures taken by the patient based on the patient's needs and abilities (88). Medical conditions such as arthritis may make some simple hygienic measures impossible to perform. Mechanical and automatic toothbrushes and mouth rinses are important in such patients. High-risk patients such as those with partial

edentulism or history of chronic periodontitis should be under constant control (89, 90). Other high-risk patients include those with a history of aggressive periodontitis (91), diabetes mellitus (92, 93), poor plaque control (94) and smoking (95, 96).

Conflict of Interest: "None Declared"

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