



A CLINICAL GUIDE FOR MAINTENANCE, MONITORING AND ASSISMENT OF PERI-IMPLANT SITE

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ABSTRACT

Endosteal implants have become routine therapy for the replacement of missing teeth and have an excellent success rate. Proper patient selection prior to implant therapy and home-care are crucial to this success. An implant maintenance protocol with routine in-office implant evaluation and maintenance should be established for each implant patient. Clinicians must know how to assess and maintain peri-implants site with techniques and instruments.

Objectives: The overall goal of this article is to provide the readers with information on implant assessment, maintenance, and monitoring. Upon completion of this article, the readers will be able to do the following:-

- List the differences between natural teeth and implants.
- Describe how to assess an implant with a soft tissue assessment, know the protocol for probing/radiographic monitoring, and recognize the signs of a failing implant.
- List and describe the clinical knowledge required to set up a proper home-care routine with the patient.
- List and describe the considerations in performing safe implant maintenance and the instruments that can be used for instrumentation.

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INTRODUCTION

“Over the past 30 years, research has validated the success of osseointegrated implants as a viable alternative to fixed or removable prosthetic restorations.”¹ It is now well-accepted that the success rate for single-tooth endosteal implants is up to 97% over 10 years.^{2,3} Since implants have become a routine therapy, the entire team needs to understand how implants are placed and restored in order to be able to confidently talk to patients about implants as an option for tooth replacement.

Patient selection for implant therapy is based on a number of factors, including medical history, oral health, and hygiene status. To be considered for implants, a pre-surgical risk assessment should be undertaken for each patient and if general anesthesia is being considered the guidelines by the American Society of Anesthesiology on patient classification should be followed to assess the risk of complications during general anesthesia.⁴ The dentist may need to have a medical consultation with the patient’s physician to evaluate the current status of the patient’s health prior to recommending implant therapy. The patient’s health status must be considered in assessing the likelihood of successful implant therapy post-

surgically.

Patients with diabetes and periodontal disease, as long as these conditions are well controlled, are not contraindicated for implant therapy.^{5,6,7,8} Patients who are immune suppressed or who are taking anticoagulants or steroids may be contraindicated for implant therapy, and while more research is needed on bisphosphonate-related osteonecrosis of the jaw (BON) this may also be a contraindication.⁹ The risk of BON with oral bisphosphonates is significantly lower than with intravenous bisphosphonates.¹⁰ At this time the ADA states that “limited data regarding the effects of implant placement on patients taking oral bisphosphonates is available” and “treatment plans in patients taking bisphosphonates should be carefully considered since implant placement requires the preparation of an osteotomy site.”¹¹ Smoking is a further consideration, and is associated with a significantly higher implant failure rate and greater risk of implant complications.^{12,13}

Implants and Natural Teeth

There are three categories of implant design: Transosteal,

Endosteal, and Subperiosteal. A transosteal or staple implant is a titanium plate with five to seven parallel posts or dowels, two of which protrude through the mandible and function as abutments for an overdenture. Subperiosteal implants are used when there is not enough bone to place an endosteal implant, specifically for overdentures, and consist of a metal framework that lies on top of the jawbone. The focus of this article is on endosteal implants. These are the most commonly placed implants, replace the root of the tooth, and are typically cylindrical or root-form.



Figure 1a Endosteal implants

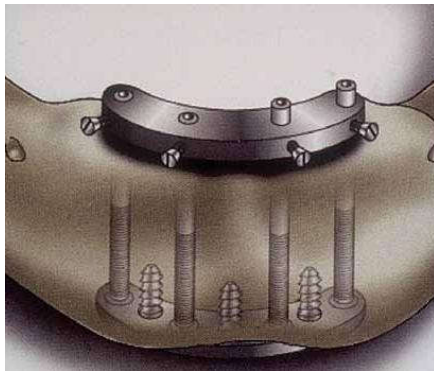


Figure 1b Transosteal implants



Figure 1c Subperiosteal implants

Endosteal implants are placed in the bone, an abutment is attached to the implant, and the prosthesis is then placed on the abutment. Alternatively, one-piece endosteal implants are available that do not require placement of separate abutments. In the presence of a tooth, force is transmitted to the surrounding bone, which stimulates and helps maintain it. Implants also stimulate bone and help to maintain and increase bone density in the absence of a natural tooth, which in turn can help preserve facial structure. The key benefits of implants are functional and esthetic: to enhance appearance, restore normal eating, improve removable denture retention, and in the case of single implants, replace teeth without the need for a bridge that may involve preparing virgin or minimally restored teeth.

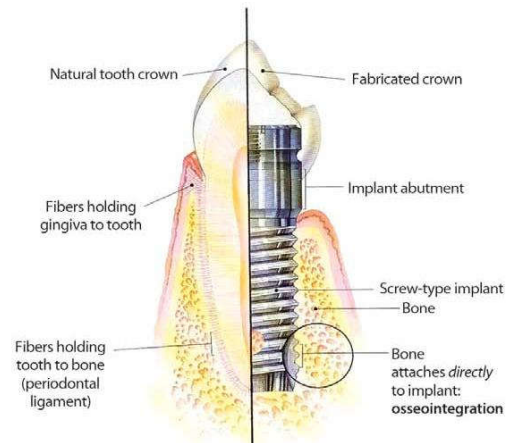


Figure 2 Natural teeth versus implants

A key point in discussing implants with patients is that an implant not only replaces the tooth, but also the root and this can help retain the facial structure for a more youthful appearance.¹⁴ Patients often ask the team about the surgical treatment involved in implants. The basic outline is as follows: the surgeon prepares the implant site by removing just enough bone the osteotomy to place the implant.¹⁵ The implant is then placed by threading or tapping it into the osteotomy. Over a period of several months, the implants will osseointegrate (the direct and intimate contact between living bone and the dental implant surface). The clinical manifestation of osseointegration is absence of mobility.¹⁵ the implants are restored with a crown, a bridge, or an overdenture.¹⁶



Figure 3 Crown and bridge restored implants



Figure 4 Hader clip bar and overdenture

Finally, the steps necessary for successful peri-implant maintenance must be taken: provide safe implant maintenance, and monitor the tissue and the bone level surrounding the implant. In-office maintenance protocols and home-care recommendations are crucial for the success of implants. This requires clinical knowledge on how to assess implants at maintenance appointments, how to safely instrument implants, and which products can safely be recommended for home care.

Table 1 Physical characteristics of natural roots and implants

Natural root	Implants
Surface-cementum	Titanium or coated
Held in by periodontal ligament	Osseointegrated (bone)
Heat sensitive; pulpitis possible	No sense of temperature
Mobility positive or negative (periodontal disease or occlusal trauma)	Mobility negative (loss of osseointegration)
Susceptible to decay	No decay possible

The signs and symptoms of failing implants must be recognized during the evaluation phase of maintenance appointments. A portion of the implant evaluation may include probing; it is important to know whether the dentist or periodontist wants the implant probed as in some cases this may not be recommended due to the concern that inserting the periodontal probe would disrupt the perimucosal seal (the junctional epithelium that separates the connective tissues from the intraoral environment around a dental implant).¹⁵ Once implants have been successfully placed, the patient must follow a proper home-care program and an implant maintenance protocol must be developed for the patient. Home-care recommendations should begin at the time of implant placement and should be re-evaluated each time the patient presents for implant maintenance therapy.

Implant Home Care

A daily meticulous home-care routine is essential for the long-term success of implants. An individual home-care routine should be developed that considers the type of implant prosthesis and the patient's dexterity, and should be kept as simple and as effective as possible for the patient. Post-surgically, good oral hygiene is necessary to maintain a healthy field as well as to help with healing, and the patient should do the following:-

- Drink only clear liquids for the rest of the day
- Take antibiotics and pain medication as prescribed and recommended
- Eat soft foods for the first few days of healing
- Avoid wearing a temporary prosthesis or denture to let the gum tissue heal (if the implant was not immediately loaded)
- Use an extra soft toothbrush to clean the dentition, pre-existing implants and the gingiva (and do not brush the incision area)
- Use salt-water rinses or an antiseptic rinse if prescribed or recommended.

Oral care for implants

Oral care for single-tooth implants involves a number of steps. The patient should be instructed to brush the implant(s) twice a day with a low-abrasive dentifrice, brushing as one would natural teeth to remove bacterial plaque. Using a low-abrasive dentifrice ensures that it will not scratch the surface or irritate the tissue cuff surrounding the implant.¹⁷ A soft toothbrush should be used – options include a manual brush, electric or sonic brush (e.g., Sonicare®, Oral-B® Sonic, or Pulsonic), end-tuft brush, or proxi-brush. The Oral-B® Pulsonic has a slim sonic brush that can fit under bar-retained implants or around ball implants used with overdentures. The interdental brushes that have coated wires are also recommended to clean around single implants or under a Hader bar. The end-tuft brushes clean around hard-to-reach implants and around bar-retained or ball-implant abutments.



Figure 5 Ultrasonic brushes



Figure 6a Flossing around over denture implants



Figure 6b Flossing single-tooth implants

(Floss mesial/distal and facial/lingual)

The use of a rubber tip stimulator once a day around implants or crowns has also been found to help keep the tissue healthy. Instruct the patient to place the tip such that it lays flat in between the teeth, not poking in the tissue, and to roll the tip toward one tooth and then return to the contact point and roll toward the other tooth using firm pressure. If done with correct pressure, the tissue blanches. Repeat this five to ten times on the mesial and distal of each implant crown to stimulate the tissue. Antimicrobial rinses may be recommended, especially if inflammation is present or the patient has dexterity problems with an area that is difficult to clean. If the patient is prone to inflammation, the use of Chlorhexidine Gluconate 0.2% or another antimicrobial rinse, in conjunction with a rubber tip stimulator, is recommended.¹⁹ Water irrigation units (e.g., Hydro Floss) can be beneficial if used twice daily (following proper instruction to ensure that the perimucosal seal is not damaged). The water must be directed only interproximally and horizon-tally on a low setting to avoid damaging the perimucosal seal.

Table 2. Oral care for single-tooth implants

Brush twice daily with a low-abrasive dentifrice.
 Floss once daily (mesial/distal and facial/lingual) or use interdental brushes.
 Use a rubber-tip stimulator once daily.
 Use an antimicrobial rinse if inflammation is present.
 If recommended, use of a water irrigation unit (not metal-tipped)

Oral care for overdentures

Oral care for overdentures starts by instructing the patient to remove the overdenture for care. The overdenture should be soaked in denture cleaner for the recommended time and a brush used to clean the underside, while being careful not to damage the Hader bar-and-clip system if present. The patient should then remove the overdenture from the cleaner and rinse with water and antimicrobial rinse, and should brush and floss the ball or bar-retained implant abutments as for single-tooth implants.



Figure 7 Overdenture

Implant Maintenance

After osseointegration has been confirmed and the final prosthesis or restoration is complete, the patient is largely responsible for the success of an implant and needs to understand the importance of proper in-office implant maintenance appointments every three months for the first year, to help prevent infection or failure of the implant.²⁰ After one year the bone surrounding the implant maintains a mature level of bone,²¹ and the interval between maintenance visits should be based on the patient's general health, assessment of the implant, and home care.

The Implant Maintenance Appointment

The implant maintenance appointment consists of:-

1. Review of the patient's medical history and general health
2. Assessment of the implant(s)
3. Proper instrumentation and polishing of the implant(s)
4. Reinforcement of home-care routine and specific recommendations.

Step 1: Review of the patient's medical history and general health

The patient's medical history should be updated and reviewed at every routine oral evaluation and implant maintenance appointment, to check if there has been any change in the patient's health status that could impact the implants or treatment. The patient's blood pressure should also be measured. If the patient has uncontrolled diabetes, increasing the risk of peri-implantitis and ultimately im-plant failure, it will be necessary to work in collaboration with the patient's

physician and the patient to gain control of the diabetes.^{5,15,22} Overall good general health is one of the keys to the success of implant(s) and may affect the length of time between implant maintenance visits.²³

Step 2: Assessment of implants

Implant assessment starts with a visual soft tissue examination of the perimucosal seal. Any signs of inflammation or bleeding upon probing, including peri-mucositis (a reversible inflammatory reaction with no bone loss) or peri-implantitis (an irreversible inflammation with bone loss) should be recorded,¹⁵ as well as any clinical symptoms present such as pain and mobility. These assessments must be performed at every maintenance appointment. Accurate radiographs are necessary to monitor the crestal bone level.

Visual soft tissue assessment

The soft tissue should be visually examined for color, texture, form, bleeding, and inflammation. The assessment and any tissue changes should be recorded in the patient's charts as well as with a regular intra-oral or digital camera. This photograph or digital image can be used to help educate the patient on the appearance of healthy tissue and, if present, the patient can be shown the inflamed tissue. Images can also be an excellent visual tool to reinforce the importance of good home care.

Table 3. Visual soft tissue assessment

- Color: pink, red, purple, cyanotic
- Surface texture: stippled, glossy, fibrotic
- Size and shape: tight, enlarged, cratered
- Bleeding: spontaneous, none
- Inflammation
- Exudate: peri-implantitis

Keratinized or non-keratinized tissue.

Protocol for proper probing around the implant

There are a number of considerations and guidelines that should be followed when probing the tissue surrounding an implant. A plastic-coated probe (e.g., PDT EasyView; Hu-Friedy Colorvue®) should be used to reduce the risk of scratching the implant's surface; plastic probes are also more flexible enabling them to follow the anatomy for a more accurate clinical reading.

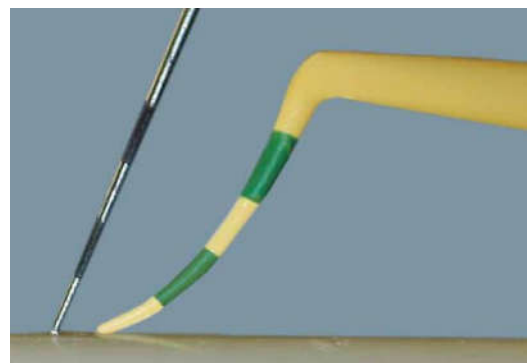


Figure 8 Plastic and metal probe

Flexible plastic probe reduces the potential for trauma during probing

The perimucosal seal is fragile and more susceptible to trauma and penetration during probing than the periodontal ligament

around teeth, which could introduce pathogens and jeopardize the success of the implant.²⁴ Probing in the perimucosal seal may not be recommended by some clinicians in the first three months following abutment attachment to avoid disrupting the biologic seal. Guidelines for proper implant probing are described below.

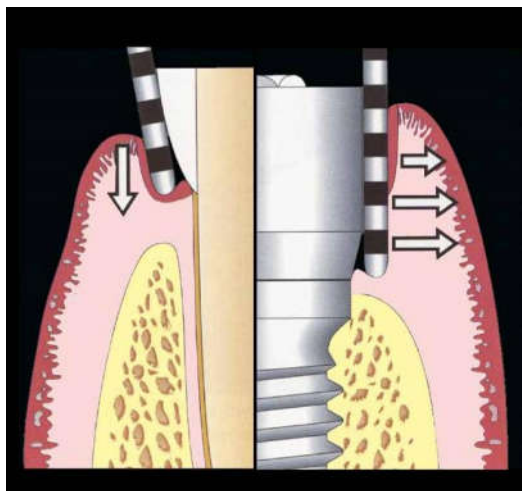


Figure 9 How to probe

Table 4. Guidelines for proper probing around implants

- Place the probe parallel to the long axis of the implant, identify a location on the restoration as a monitor marker, and gently use a plastic probe to check the clinical parameters (see below).
- Record the baseline after the initial three months. For new patients, record an existing probe reading, placement date, or any other details the patient can supply for you.
- Record inflammation or bleeding upon probing or any visual changes in the patient's chart.
- Report findings to the implantologist for evaluation.

A probe baseline measurement at a specific location should be recorded, to establish a clinical parameter for the patient's record. This baseline should be recorded in the patient notes at the first maintenance appointment after three months.²⁵ The measurement should ideally read 2.5 mm to 5.0 mm or less, depending on soft tissue depth, and there should be no signs of inflammation.²⁶ Measurements at appointments should be compared to baseline, and if the probe depths change, this must be noted in the patient's chart.

Visual examination upon probing

Bleeding upon probing should not occur with healthy peri-implant tissue. If redness, inflammation, or bleeding upon probing is present, check for the presence of deposits around the implant. The peri-implant tissues can cascade from peri-mucositis to peri-implantitis similarly to the progression of gingivitis to periodontitis around natural teeth.²⁷ Peri-implant infections can progress more rapidly than infection around natural teeth - a key consideration in the recommended three-month re-care visit, especially in the first year following placement of an implant. If an infection is present, evaluate for pain and mobility, and develop a plan or refer the patient to the periodontist. The plan may include shortening the interval between implant maintenance visits, possible antibiotics, a radiograph, and/or the dentist may refer the patient for specialist evaluation.

Pain: Pain or discomfort around an implant may be the first

sign of a failing implant, before it is evident on a radio-graph. If pain is present, the dentist will need to evaluate whether this is due to occlusal trauma or infection.

Mobility: Mobility following osseointegration can be present due to a loose fixed restoration, an infection, a loose or fractured abutment thread, an implant fracture or trauma. If the mobility is due to a loose crown, it may be possible to recement it or rescrew it (depending on the type of abutment). An occlusal adjustment may also be necessary. If there is mobility of the implant itself or a broken screw, this is a greater cause for concern. A radiographic assessment can help determine the source of the mobility.

Protocol for radiographic monitoring

Bone level: This final step is a critical one. A radiograph is taken to accurately monitor crestal bone level around the implant(s) using a measurable device and to verify that the restoration is seated properly on the implant following placement of the restoration. Subsequent radiographs are used to determine if any crestal bone loss around the implant has occurred and, if so, to measure this. Periapical or vertical bitewings for one to four implants and a panoramic or full mouth series for five or more implants is recommended,²⁸ to enable accurate determination of the crestal bone level. Radiographs should show indentations in the implant or the screw clearly in focus to help visual confirmation that the X-ray is the correct way round.

Table 5. Radiographic guidelines to assess bone level.

Make a periapical or vertical bitewing radiograph of each implant for one to four implant(s) at prosthesis placement, at six months following delivery, and at one-year intervals.

For five or more implants, a panoramic or full mouth radiographic series is recommended at prosthesis placement, at six months following delivery, and at one-year intervals.

A measurement of 0.5 mm to 1 mm horizontal bone loss is acceptable in the first year, with an anticipated 0.1 mm of bone loss each subsequent year.²⁹ If more than 1 mm of horizontal or vertical bone loss is detected in the first year, a referral to the periodontist may be given. Any signs of peri-mucositis, mobility, peri-implantitis, or bone loss need to be recorded at each appointment and appropriately treated. After carefully assessing the implant and recording the findings, evaluate if calculus is present on the implant or abutments. Minimal or no instrumentation is necessary for an implant with a healthy gingival attachment. If an implant does fail with loss of osseointegration it is generally due to bacterial infection, occlusal overload or a poorly- designed prosthesis.³⁰

The cause of a failing implant and a treatment plan must be determined by the dentist.

Table 6. Signs of a failing implant

- Clinical tissue characteristics similar to periodontal disease in the natural dentition.
- Presence of mobility, pain or exudate.
- Radiographic evidence of unacceptable bone loss.

Proper Instrumentation

Selecting instruments that will effectively remove all plaque and calculus deposits without scratching the surface of the implants is essential. Calculus deposits on implants are generally softer than on teeth and are more often found supragingivally

than subgingivally. Generally, proper hand instrumentation is all that is needed.³¹ Excessive pressure or trauma to the perimucosal seal during instrumentation is contraindicated to avoid damaging it, the surface of the implant, or any exposed abutment surface. Stainless steel-tipped instruments, as well as metallic sonic and ultrasonic scalers, have been found to gouge titanium^{32,33,34} and are contraindicated for implant instrumentation as scratching or roughening the implant surface can cause bacteria to adhere more easily, with an increased risk of inflammation.³⁵ Clinicians also need to avoid damaging the surfaces of ball, bar-retained or locator abutments as this can result in increased plaque formation and retention.³⁶ Metal-tipped sub-gingival irrigators are also contraindicated.

The appropriate instruments for implant maintenance are plastic, graphite, or solid titanium scalers and curettes. These have been proven to be safe and effective for the removal of plaque and other deposits on titanium implants.^{37,38} If ultrasonic or sonic scalers need to be used, caution is required to avoid damaging the perimucosal seal and they must have a nonmetal tip or plastic sleeve to prevent scratching of the implant surface during use.³⁹ Several manufacturers have developed implant power scaler tips and silicone covers to place on ultrasonic scaler tips to prevent possible scratching of the implant surface (Cavitron® SofTip™; GentleCLEAN™; EMS Piezon® Implant cleaning tip; PerioSoft™ carbon composite mini-tip; SensiTips®). Plastic sleeve tips may become loose in the patient's mouth and should be used with caution to avoid the risk of aspiration.

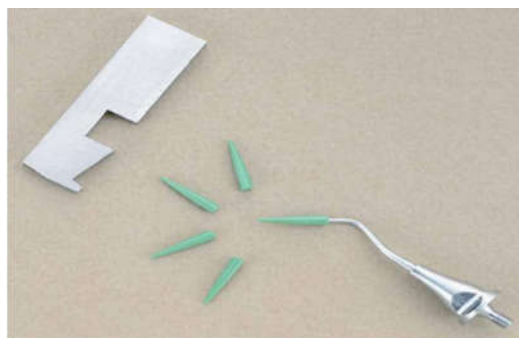


Figure 10a Implant scaler tips for an ultrasonic scaler



Figure 10b Blade length modification on implant scaler (orange)

Hand implant scalers and curettes are available in polycarbonate plastic (e.g., Prophy+™, Advanced Implant Technologies) and graphite (e.g., Premier Dental), can be sharpened and are autoclavable. Implant scalers are also available with a sturdy handle and plastic disposable tips (Implacare™, Hu-Friedy) - these are single-use and must be disposable after one use. Solid titanium scalers and curettes are also now available that can be used to scale on “like metal” titanium implants, are thinner than plastic or graphite instruments and provide more

strength to dislodge calculus.^{37,38} (Nordent Im-plaMate™). Titanium instruments have been adapted with a shorter radius blade length and rounded tips specifically for peri-implant therapy (Paradise Dental Technologies), as well as with replaceable titanium tips (ImplantPro™, Brasseler).



Figure 11 Implant scalers with disposable plastic tips



Figure 12 Graphite implant scalers



Figure 13 Titanium implant scalers

Implant maintenance instruments must be able to effectively remove calculus from narrow- and wide-based implants, high water bridges and full-arch cement- or screw-retained prostheses, as well as from Hader clip bars, “O” ring balls or locator abutments. It is recommended to replace the O-rings or plastic retention inserts if they show signs of wear or once per year.⁴⁰ Anterior implant scalers should be small enough to adapt under a Hader clip bar, around a ball or Locator abutment, and to scale calculus on exposed implant threads. The Nebraska 128/L5 mini, L1-2, H6-7, G11-12, and Facial implant scaler all adapt well to anterior implants and abutments. To remove calculus from any exposed threads of an implant, the side of a shorter radius blade tip should be used to carefully scale in a side-to-side motion, one thread at a time. A side-to-side motion should also be used to scale under a Hader clip bar and a short vertical stroke around any anterior ball or locator abutments. For narrow-base implants or an implant that replaces two teeth, the Langer (L) 3-4, Columbia (C) 4L-4R, and Gracey (G) 5-6 curettes work well; the instrument blades can stretch under the more bulbous-shaped crowns and under the framework of a high-water bridge or full-arch implant-retained prosthesis. Short scaling strokes should be used to dislodge calculus present on these implants, crowns, or frameworks. For wide-base implants, short vertical strokes should be used to remove calculus with a Barnhart (B) 5-6, 204S, Columbia (C)13-14, or C4L-4R.



Figure 14a Plastic scaler in use around implant-ball abutment



Figure 14b Titanium scaler in use around a locator abutment



Figure 14c Graphite scaler in use under a Hader bar

Polishing

Basic steps for proper coronal polishing around implants include using a soft rubber tip, not brush, with appropriate nonabrasive paste. Aluminum oxide, tin oxide, APF-free prophylaxis paste, and low-abrasive dentifrice are all considered acceptable polishing abrasives for implants.⁴¹ Coarse abrasive polishing pastes are contraindicated, as is airpolishing.⁴² It should be noted that acidulated phosphate fluoride (APF) products are also contraindicated, as they may etch the surface of implants.⁴³ It may be helpful to polish first around implants to remove any plaque or debris present and to then determine if deposits need instrumentation.

Summary

Implant maintenance requires evaluation of the patient's general health, assessment of the implants, safe instrumentation, and patient instruction for home-care. Proper maintenance and monitoring of implants, together with home care, will help ensure the long-term success of implants.

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