

Peri-implantitis: All You Want (or not) To Know



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Conflict of Interest Disclosure Statement

- Dr. Levin reports no conflicts of interest associated with this course. He has no relevant financial relationships to disclose.

Short Description – Peri-implantitis

In recent years, the use of dental implants for tooth replacement is becoming a common practice and, subsequently, peri-implant diseases are more frequently evident. This course focuses on causes and risk factors for peri-implant diseases, ways to prevent its occurrence as well as the currently available treatment options for peri-implantitis.

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Overview

In recent years, the use of dental implants for tooth replacement is becoming a common practice and, subsequently, peri-implant diseases are more frequently evident. This course focuses on causes and risk factors for peri-implant diseases, ways to prevent its occurrence as well as the currently available treatment options for peri-implantitis.

Given the increasing prevalence of dental implant restorations and the current scientific literature, it is anticipated that an increasing number of peri-implant diseases will be seen. The reported prevalence in the literature suggests that almost 30 to 50% of implant patients are impacted by peri-implant disease. This would imply that one out of two or three of our implant patients might present with peri-implant disease at some point. This is also an important aspect of informed consent for our patients. Another troubling issue with regards to peri-implant diseases is the lack of appropriate, well-documented gold-standard treatment for peri-implantitis. There are many suggested treatment options described in case reports and case series in the literature; none of them seem to provide a predictable long-term resolution of the disease. In order to prevent and treat peri-implant diseases, there is a need to understand the nature of the disease and the risk factors.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Understand the risk factors for peri-implant diseases.
- Explore ways to prevent peri-implant diseases.
- Recognize the occurrence as well as the currently available treatment options for peri-implantitis.

Introduction

Dental implants have become a common, standard of care, treatment for replacement of missing teeth. Many patients are requesting dental implant treatment in order to improve their esthetics, function, and phonetic abilities. Overall, the survival rates of dental implants are considered to be high, however, the complication rates and the potential for disease around the implant are not uncommon. Many patients believe that implants require less cleaning and maintenance since they are not natural. The truth, nevertheless, is exactly the opposite. The most common and challenging complication of dental implants is peri-implantitis. Peri-implant diseases are common biological complications of dental implant therapy, which may result in the failure of dental implants. We, the clinicians, should understand the etiology and contributing factors of these common diseases.¹



Figure 1. Peri-implantitis lesion (intra-operative view).

Implant treatment can be very expensive, time consuming and challenging in some cases. Thus, it is of paramount importance, that we, and our patients will be very well aware of the possible complications and the ways to prevent them. The patients' current health status and risk factors should be identified during this

stage and be addressed or minimized before the patient receives dental implants.

Definitions

Peri-implant mucositis refers to an inflammation that is confined in soft tissue attachment around dental implant fixture. An implant with peri-implant mucositis often demonstrates erythema and edema around peri-implant marginal mucosa in addition to bleeding on gentle probing. In comparison, **peri-implantitis** refers to an inflammation in supporting alveolar bone as well as soft-tissue attachment, which results in irreversible destruction of alveolar bone.¹⁻⁴ In addition to the clinical signs of peri-implant mucositis, an implant with peri-implantitis may accompany suppuration, pain, and mobility. The loss of the supporting bone and attachment is irreversible. In the absence of treatment, peri-implantitis progresses in a “non-linear and accelerating pattern”, more rapid than the progression of periodontitis.^{2,3}

The American Academy of Periodontology and European Federation of Periodontology Classification of Periodontal and Peri-implant Diseases and Conditions proposed a new definition of these pathologies, aiming at introducing a uniform classification for peri-implant health, peri-implant mucositis, and peri-implantitis.^{2,3} Peri-implant tissue health status has been recently defined as an essential outcome domain that should be captured in all implant clinical trials, and the 2018 classification case definitions have been used in the European Federation of Periodontology (EFP) guidelines to drive prevention and treatment of peri-implant diseases.^{2,3} According to the 2018 classification, the distinction between peri-implant health and peri-implant mucositis is based on the

presence or absence of the following: (a) clinical signs of inflammation (e.g., gingival erythema, edema, and changes in soft tissue consistency); (b) bleeding and/or suppuration on gentle probing; and (c) increased probing pocket depth. Peri-implantitis—in addition to the previous clinical signs of inflammation of the mucosa—is characterized by radiographic evidence of progressive bone loss.^{2,3}

Prevalence

According to a meta-analysis, the prevalence of peri-implant mucositis is approximately 43% while that of peri-implantitis is 22%.^{2,3} Dental plaque (dysbiotic biofilm) is the most important etiologic factor for peri-implant diseases. Dental plaque accumulation at dental implants triggers the inflammatory response leading to peri-implant mucositis and peri-implantitis. Patients with poor oral hygiene were found to exhibit approximately 15 times higher chance of developing peri-implantitis. Considering that initiation of peri-implant diseases may be triggered by the presence of dental plaque similar to that of periodontal diseases, achieving and maintaining excellent plaque control is an important factor in prevention as well as treatment of peri-implant diseases. Based on the principles of cause related therapy, clinicians should educate their patients on how to effectively remove the potentially main etiologic factor, dental plaque around teeth and implants. According to the 2018 classification and consensus, the conversion from mucositis to peri-implantitis was evaluated in a retrospective observational study including 80 patients initially suffering from peri-implant mucositis.^{2,3} Over 5 years, the incidence of peri-implantitis was lower in subjects enrolled in a regular maintenance program (18%) than among

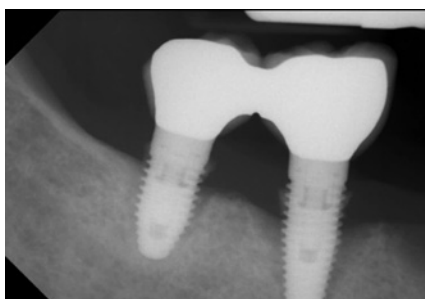


Figure 2. Peri-implantitis lesion (radiographic view).



Figure 3. Peri-implantitis lesion - probing.

patients without regular maintenance care (43%). The conversion to peri-implantitis was correlated with bleeding, deep pockets, lack of regular maintenance therapy and the presence of periodontitis.

Risk Factors

Patient Related Risk Factors

Risk factors for peri-implant diseases need to be addressed prior to treatment and even prior to the initial implant treatment planning. This is often referred to as “primordial prevention”. When risk factors are identified, the patient and the dental professional can either eliminate or manage them in order to ensure better implant success rates. Since bacteria is the main culprit of the disease, poor oral hygiene is accordingly a very important risk factor.^{2,3,5} Patients who incur difficulty maneuvering a toothbrush or an interdental cleaning aid may be unable to clean effectively also putting them at higher risk for implant failure. Poor oral hygiene was found to be associated with peri-implant disease with an odds ratio of 14.3.⁵⁻⁷ This emphasizes the importance oral hygiene has in maintaining dental implants and thus should be a central portion involved in implant consultations.

Dementia and other systemic diseases that decrease a patient’s ability to clean their mouth are at a higher risk for developing peri-implant diseases. Moreover, patients with uncontrolled diabetes and several other systemic conditions and medications are also at a higher risk. Smoking is another patient related risk factor that is associated with peri-implant diseases as it enables the colonization of bacteria and has been evidenced to double the marginal bone loss around implants.⁶



Figure 4. Extremely poor oral hygiene.

Periodontal disease also has an ability to influence the incidence of peri-implant disease and therefore also needs to be considered a risk factor. The pathogens in periodontal disease are hypothesized to move from the periodontal pocket to the susceptible implant and initiate inflammation leading to bone loss. Therefore, if an implant candidate has previous or current periodontal disease, the disease itself should be controlled first and in only after getting to a stable condition during the maintenance phase and the patient is able to demonstrate their ability to remain in this phase, an implant can be considered.⁷

Site Related Risk Factors

Local predisposing factors such as soft tissue characteristics, implant position and prosthetic design were found to be associated with the occurrence of peri-implant diseases. Bone quality, the nature of the bone (native vs. grafted) and other hard tissue characteristics might also be influential when the implant will be exposed to peri-implant inflammation and infection. Robust data points toward the strong link between residual sub-mucosal cement or other plaque retentive factors and peri-implant diseases.

Emerging data are confirming the influence of certain local factors might have upon the onset and development of disease, as they induce plaque accumulation. Conceptually, predisposing factors refer to conditions that places the given element (dental implant)/ individual (patient) at risk of developing a problem (peri-implantitis). If this factor is not controlled after diagnosing and arresting (or not) the problem (peri-implantitis), represents a perpetuating factor that maintains the problem.⁸⁻¹⁰ Other site-specific factors such as previous implant failure, previous chronic periapical infections etc., should also be considered.

Based on the existing literature in the field of periodontology, peri-implant attached keratinized gingiva is beneficial in patients with neglected oral hygiene; whereas patients with adequate oral hygiene measures may not benefit from peri-implant attached keratinized gingiva.^{8,9}



Figure 5. Peri-implant keratinized gingiva deficiency.

Implant Related Risk Factors

While peri-implant diseases are attributable to bacterial colonization, the implant microroughness surface may serve as a viable niche to collect and promote putative microorganisms. It is nowadays understood that preventing/minimizing physiologic bone loss as consequence of surgical trauma or the establishment of the supra-crestal connective tissue attachment is key to maintain long-term stability. In general, if initial bone loss exceeds beyond ~0.5 mm, the odds to manifest peri-implant complications and implant failure down the road are significantly higher. It is speculated, thus, that the exposure of the implant surface to the peri-implant sulcus due to bone loss leads to inflammation mediated by the formation of bacterial colonies in the implant surface. Therefore, in the spirit of preventing biological complications, it is critical to

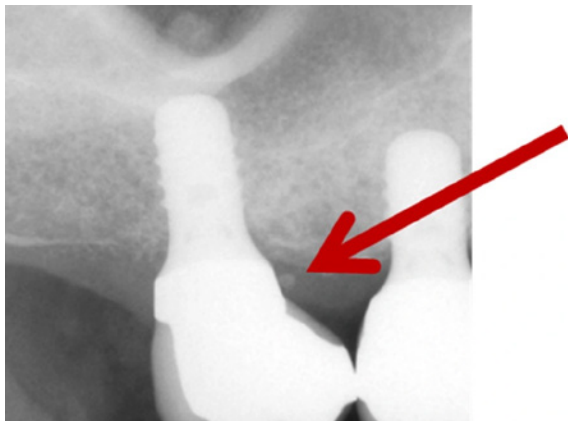


Figure 2. Peri-implantitis lesion (radiographic view).

identify and apply the surgical and prosthetic factors that may assist in limiting early bone remodeling.⁸

The type of implant can also effect the prevalence of peri-implant disease. Cemented implants can be a potential risk factor if cement is not completely removed. The remaining cement can foster the attachment of plaque bacteria leading to inflammation. As long as excess cement is removed properly, cement implants are not more likely to have peri-implant disease when compared to screw retained implants. Therefore, in order to maximize the prevention of peri-implant diseases, dental professionals need to thoroughly remove excess cement to prevent the possibility of inflammation. Other plaque retaining factors should be eliminated as well.^{8,10}

Primary Prevention

An integral part of dental implant related treatment plan should include meticulous home care and strict follow-up and maintenance protocols. This should be instilled in the patients prior to the implant placement to ensure that long term health conditions can be maintained around the implant. Prior to implant placement, oral hygiene instruction should be a big portion of the initial implant consultation. This includes demonstrating proper brushing and interdental cleaning techniques to the patient and ensuring they are understanding the oral hygiene instructions at follow up appointments. Patients should have to prove to the dental professional that they will be able to maintain the appropriate homecare protocols prior to implant placement. In regards to professional maintenance, patients are required to understand the increased recall regime that is required to maintain the dental implants. The recall regimen for patients is recommended to be approximately three to six months, however, patients who present with risk factors should have a significantly shorter recall. Having patients have frequent recalls increases the ability of the dental professional to diagnose complications at the earliest state possible and was shown to increase success rates of dental implants.^{11,12}

Appropriate tools need to be recommended and practiced together with the patient in a proper way to remove all plaque around the teeth and implants in the oral cavity. This should include proper brushing and inter-proximal cleaning as well.^{4,5,11,12} According to the American College of Prosthodontists' Clinical Practice Guidelines for recall and maintenance of patients with tooth-borne and implant-borne restorations, patients should be using an electric toothbrush to effectively remove biofilm as one of the specific oral hygiene aids for at-home maintenance.¹³

Evidence showed that oscillating-rotating (O-R) powered toothbrushes demonstrate more plaque removal and reduce the number of bleeding sites better than other powered toothbrushes.¹⁴ A meta-analysis showing 50% greater reduction in bleeding sites compared to manual brushes and 28% greater reduction in bleeding sites versus sonic (side-to-side motion) brushes.¹⁵ Subjects with localized or generalized gingivitis had 7.4 times better odds of transitioning from gingivitis to a healthy state after using an electric O-R brush versus a manual brush. Moreover, electric toothbrush users showed significantly lower progression for mean probing depth (22.0%), clinical attachment loss (21.0%), tooth loss (20%), and decayed/missing/filled surfaces (17.7%) compared to manual toothbrush users. When evaluated on dental implant patients, powered toothbrushes were found to be effective, safe and comfortable for patients rehabilitated by means of oral implant-supported prostheses. At the end of a 12-month study of 80 peri-

implant patients replacing their manual brush with an oscillation-rotation brush, the mean overall pocket depth decreased by 0.3mm, mean recession decreased by 0.1mm, no gingival or mucosal ulcerations/desquamations were observed, and high scores were given to convenience and comfort of the powered toothbrush with 95% indicating they would continue to use the powered brush. Therefore, it might be reasonable to recommend on oscillating-rotating (OR) powered toothbrushes for long-term dental implant maintenance and home care.

In many cases, the traditional inter-proximal cleaning methods such as string flossing are not user friendly for patients and do not provide the proper inter-proximal plaque removal. Thus, other inter-proximal cleaning aids should be introduced.¹⁶

Treatment

Non-surgical Treatment

Initial treatment of peri-implant disease includes localized non-surgical mechanical debridement in combination with home care therapy. The concept of cause related therapy should be applied, targeting the etiologic factor, dental plaque around dental implants. Clinicians should educate their patients about the main etiologic factor, dental plaque, and guide them to remove dental plaque effectively at home. Clinicians should carefully review and update patients' medical and dental history to reveal any potential risk indicators such as smoking habit and diabetic conditions.^{7,17}



Figure 7. Inter-proximal plaque removal tools. Inter-dental brush (left) and triangular wooden toothpick (right)

Table 1. Oral Hygiene Recommended Devices and the Suggested Techniques.

Devices	Instructions	Notes and Examples
Oscillating Electric Toothbrush	Place or park the brush head around the buccal surface of each tooth, leave it for 4 seconds, and move it to another tooth. Place the lower half of the brush head on the gingiva and the upper half of the cervical third of the tooth. When the buccal surfaces are completed, repeat the same process for the lingual surface of each tooth in the same manner. Lastly, place or park the brush head on the biting/occlusal surface of each tooth, apply apical pressure, leave the brush head for 4 seconds, move to another tooth, and repeat the same technique until completion of all occlusal surfaces.	Perform twice a day. Three times daily for severe periodontal patients or high caries risk patients. 
Floss	Once passing the interproximal contact, hug/wrap around the distal side of the anterior tooth, slide the floss apically until the floss disappears 2-3mm subgingivally. Move the floss coronally and apically 2-3 times. Repeat the same on the mesial side of the posterior tooth. When completed, slide the floss out by pulling it buccally. Repeat the same technique for all interproximal contacts.	Perform twice a day. Suitable for patients with healthy periodontium or low caries risk as well as for patients with periodontitis, who have very high dexterity skills and motivation. 
Rubber Tip Stimulator	Place the pointy tip interproximally from the buccal side. Press lingually until the tip is fully engaging. Then, draw 5 circles especially with the apical pressure until the gingiva blanches. Repeat the same technique for all interproximal surfaces. Once completed, repeat the same from the lingual side.	For patients with healthy periodontium or gingivitis, perform once a day. Excessive use may induce interproximal recession. For patients with periodontitis, perform 2-3 times a day. 
Interdental Brush/ Triangular-Shaped Wooden Toothpick	Place the brush/toothpick between the two teeth from the buccal aspect. Gently push and pull five times from the buccal to the lingual aspect. Ensure the brush/toothpick completely passes through the buccal embrasure to the lingual embrasure. For the toothpick, the apex or the tip of the triangle should be pointing occlusally while the base of the triangle should be in contact with interproximal papilla.	Perform twice a day. Suitable for patients with periodontitis, who have difficulty with effective flossing. Help patients identify the size that fits their embrasures.  

Adapted from Kwon TH, Salem DM, Levin L. The role of home care therapy in periodontal disease treatment and management. Quintessence Int. 2023 Apr 11;54(4):288-295

After eliminating and correcting the aforementioned contributing factors, non-surgical mechanical debridement should be initiated. For peri-implant mucositis with inflammation confined in soft-tissue without apparent alveolar bone loss surrounding the fixture, conventional non-surgical mechanical therapy in combination with home care therapy is the standard treatment for peri-implant mucositis, resulting in 0.5–1 mm pocket depth reduction and 15–40% reduction in bleeding on probing. For peri-implantitis with alveolar bone loss around the fixture, clinicians should assume that implant fixture surface is heavily contaminated and should use both conventional automated and hand scalers to ensure effective removal of dental plaque or biofilm around the contaminated implant fixture.^{1,4,16,17}

Non-surgical treatment should, usually, not be considered predictable for the resolution of peri-implantitis in the long-term, avoiding implant loss. Nevertheless, non-surgical treatment was associated with the reduction of peri-implant pocket depth and inflammation. Studies had reported pocket reduction after implant debridement (alone) that varied from 0.2 mm to 1.8 mm. This heterogeneity in the outcomes may be explained by some elements including different conditions at baseline and diverse ability of operators.

Both peri-implant mucositis and peri-implantitis are characterized by tissue inflammation. Even though it is difficult to define the role of

tissue inflammation on the progression from mucositis to peri-implantitis, the transition was commonly noted. It could be speculated that prolonged tissue inflammation is a main risk factor for progression. Non-surgical treatment was effective in reducing bleeding values between 5.3 to 57.1%. However, the results were heterogeneous and residual inflammation was present at majority of the treated implants. Thus, further treatments might be warranted.¹⁷



Figure 8. Non-surgical treatment.

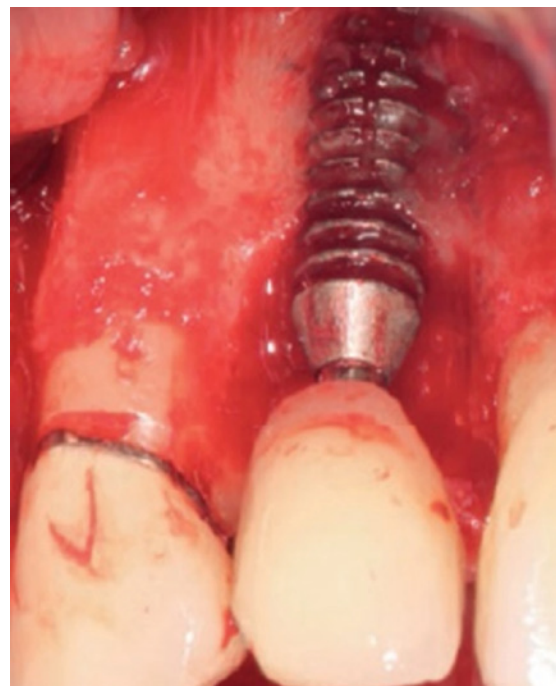


Figure 9. Resective surgery



Figure 10. Guided bone regeneration.

Surgical Treatment

Following the completion of non-surgical peri-implant therapy, peri-implant re-evaluation should be performed in 4–6 weeks to determine the magnitude of improvement. For non-responsive sites especially in advanced peri-implantitis, surgical interventions may be necessary to further eradicate the residual disease. The surgical interventions include, but not limited to, traditional open flap debridement with or without resective surgery, contemporary peri-implant guided bone regenerative therapy or combination of both modalities.^{4,7,18}

Surgical interventions including resective surgery and guided bone regeneration-supported reconstructive therapy for peri-implantitis-related bone defects implementing bone substitutes may lead to good clinical outcomes in terms of resolution of bleeding scores, probing pocket reduction, improved radiographic bone levels, and soft tissue height maintenance.^{4,7,18}

Peri-Implant Re-Evaluation and Maintenance

Following the successful resolution of peri-implant diseases or even the initial

completion of implant therapy (i.e., delivery of implant restoration), patients should receive regular implant maintenance therapy. The maintenance interval should be at least every 5–6 months; however it should be continuously updated or modified based on each patient's risk for peri-implant diseases. During the maintenance therapy, clinicians should continuously monitor their patients for any recurrence or initiation of the disease. Regular implant maintenance therapy significantly lowers one's risk for peri-implant diseases.¹

Conclusion

As more dental implants are used to restore a patient's dentition, there is an increased chance of patients presenting with peri-implant diseases. If we, as dental professionals, fully understand the etiology of peri-implant diseases and the associated risk factors we will be better able to prevent the disease. This involves thoroughly educating patients and ensuring they understand the homecare regime and maintenance recalls that are necessary to prevent peri-implant diseases. By using these strategies before and after dental implants are placed, we will be able to ensure implant success and the prevention of peri-implantitis.



Figure 11. Plaque removal

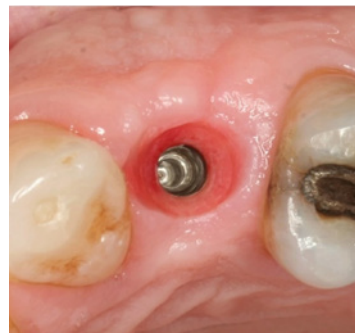
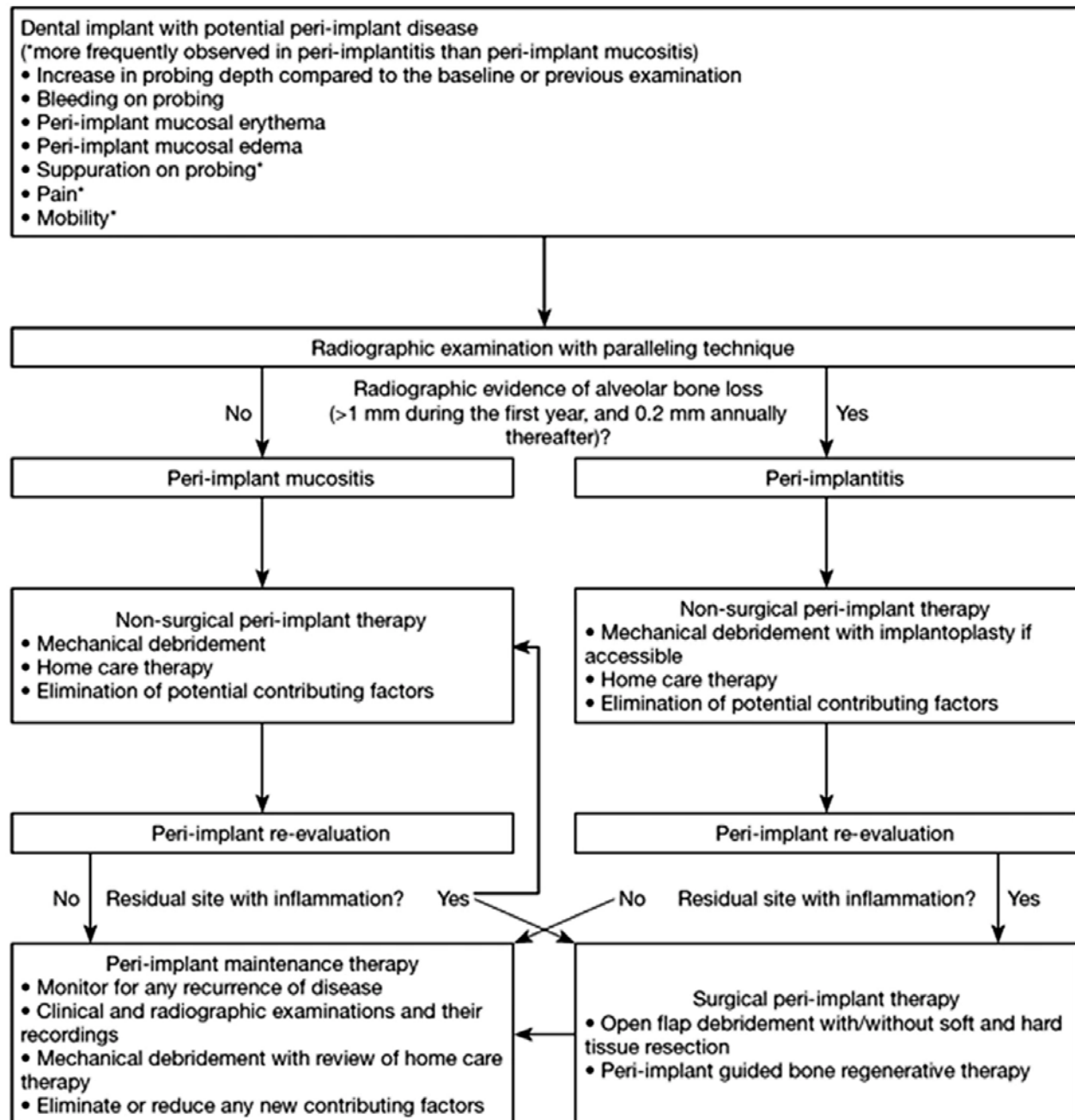


Figure 12. Proper gingival healing around an implant

Table 2. A simplified flow-chart outlining each phase of managing implants with peri-implant disease



adopted from1

Course Test Preview

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1. What is the definition of peri-implant mucositis?

- A. Infection of the titanium surface of a dental implant.
- B. Inflammation that is confined in soft tissue attachment around dental implant fixture.
- C. Inflammation in supporting alveolar bone as well as soft-tissue attachment, which results in irreversible destruction of alveolar bone.
- D. Inflammatory tissue inside the abutment of the implant.

2. What is the definition of peri-implantitis?

- A. Infection of the titanium surface of a dental implant.
- B. Inflammation that is confined in soft tissue attachment around dental implant fixture.
- C. Inflammation in supporting alveolar bone as well as soft-tissue attachment, which results in irreversible destruction of alveolar bone.
- D. Inflammatory tissue inside the abutment of the implant.

3. What is the estimated prevalence of peri-implant mucositis?

- A. 22%.
- B. 43%.
- C. 66%.
- D. 90%.

4. What is the estimated prevalence of Peri-implantitis?

- A. 22%.
- B. 43%.
- C. 66%.
- D. 90%.

5. How much higher are the chances of developing peri-implant disease among patients with poor oral hygiene?

- A. 3 times higher.
- B. 5 times higher.
- C. 10 times higher.
- D. 15 times higher.

6. What is the most important patient related risk factor for Peri-implantitis?

- A. Smoking.
- B. Nutrition.
- C. Poor oral hygiene.
- D. Implant neck.

7. Which of these factors is critical in initiating peri-implant disease?

- A. Implant diameter.
- B. Implant length.
- C. Abutment type/color.
- D. Residual cement.

8. Which powered toothbrushes demonstrated more plaque removal and reduce the number of bleedings sites better?

- A. Large-headed toothbrushes.
- B. Oscillating-rotating (OR) powered toothbrushes.
- C. Sonic powered toothbrushes.
- D. Long-bristled toothbrushes.

9. What does the initial treatment of peri-implant disease include?

- A. Non-surgical mechanical debridement in combination with home care therapy.
- B. Resective surgery to eliminate the pockets as the first step.
- C. Bone grafting from the ramus of the mandible.
- D. Immediate removal of the implant to prevent further damage.

10. Which describes the best maintenance interval for a patient with an implant?

- A. 12-18 months since implants are less susceptible than teeth to disease.
- B. Once a year to prevent damage to the implant surface.
- C. 5-6 months but should be modified based on each patient's risk for peri-implant diseases.
- D. As requested by the patient.

References

1. Kwon T, Yen HH, Levin L. Peri-implant disease: early diagnosis and non-surgical treatment—a narrative literature review. *Frontiers of Oral and Maxillofacial Medicine* 2022
2. Schwarz F, Derks J, Monje A, Wang HL. Peri-implantitis. *J Periodontol.* 2018;89(Suppl 1):S267-S290.
3. Heitz-Mayfield LJA, Salvi GE. Peri-implant mucositis. *J Clin Periodontol.* 2018;45(Suppl 20):S237-S245.
4. Kwon T, Wang CW, Salem DM, Levin L. Nonsurgical and surgical management of biologic complications around dental implants: peri-implant mucositis and peri-implantitis. *Quintessence Int.* 2020;51(10):810-820.
5. Clark D, Levin L. Dental implant management and maintenance: How to improve long-term implant success? *Quintessence Int.* 2016;47(5):417-23.
6. Levin L, Hertzberg R, Har-Nes S, Schwartz-Arad D. Long-term marginal bone loss around single dental implants affected by current and past smoking habits. *Implant Dent.* 2008;17(4):422-9.
7. Herrera D, Berglundh T, Schwarz F, Chapple I, Jepsen S, Sculean A, Kebschull M, Papapanou PN, Tonetti MS, Sanz M; EFP workshop participants and methodological consultant. Prevention and treatment of peri-implant diseases—The EFP S3 level clinical practice guideline. *J Clin Periodontol.* 2023 Jun;50 Suppl 26:4-76.
8. Monje A, Kan JY, Borgnakke W. Impact of local predisposing/precipitating factors and systemic drivers on peri-implant diseases. *Clin Implant Dent Relat Res.* 2023 Aug;25(4):640-660.
9. Kumar PS, Dabdoub SM, Hegde R, Ranganathan N, Mariotti A. Site-level risk predictors of peri-implantitis: A retrospective analysis. *J Clin Periodontol.* 2018 May;45(5):597-604.
10. Salem D, Alshihri A, Levin L. Peri-implantitis induced by a retained retraction cord. *Quintessence Int.* 2014 Feb;45(2):141-3.
11. Jepsen S, Berglundh T, Genco R, et al. Primary prevention of peri-implantitis: managing peri-implant mucositis. *J Clin Periodontol* 2015;42 Suppl 16:S152-7.
12. Vandekerckhove B, Quirynen M, Warren PR, Strate J, van Steenberghe D. The safety and efficacy of a powered toothbrush on soft tissues in patients with implant-supported fixed prostheses. *Clin Oral Investig.* 2004 Dec;8(4):206-10.
13. Bidra AS, Daubert DM, Garcia LT, et al. Clinical practice guidelines for recall and maintenance of patients with toothborne and implant-borne dental restorations. *J Prosthodont.* 2016;25(suppl 1):S32-S40.
14. Clark-Perry D, Levin L. Systematic review and meta-analysis of randomized controlled studies comparing oscillating-rotating and other powered toothbrushes. *J Am Dent Assoc.* 2020 Apr;151(4):265-275.
15. Grender J, Adam R, Zou Y. The effects of oscillating-rotating electric toothbrushes on plaque and gingival health: a metaanalysis. *Am J Dent.* 2020;33(1):3-11.
16. Kwon TH, Salem DM, Levin L. The role of home care therapy in periodontal disease treatment and management. *Quintessence Int.* 2023 Apr 11;54(4):288-295.
17. Barbato L, Cavalcanti R, Rupe C, Scartabelli D, Serni L, Chambrone L, Cairo F. Clinical efficacy of adjunctive methods for the non-surgical treatment of peri-implantitis: a systematic review and meta-analysis. *BMC Oral Health.* 2023 Jun 9;23(1):375.
18. Ramanauskaite A, Becker K, Cafferata EA, Schwarz F. Clinical efficacy of guided bone regeneration in peri-implantitis defects. A network meta-analysis. *Periodontol 2000.* 2023 Jul 25.

Additional Resources:

- Fu JH, Wang HL. Breaking the wave of peri-implantitis. *Periodontol 2000.* 2020 Oct;84(1):145-160.
- Kotsakis GA, Lan C, Barbosa J, Lill K, Chen R, Rudney J, Aparicio C. Antimicrobial Agents Used in the Treatment of Peri-Implantitis Alter the Physicochemistry and Cytocompatibility of Titanium Surfaces. *J Periodontol.* 2016 Jul;87(7):809-19.
- Kotsakis GA, Olmedo DG. Peri-implantitis is not periodontitis: Scientific discoveries shed light on microbiome-biomaterial interactions that may determine disease phenotype. *Periodontol 2000.* 2021 Jun;86(1):231-240.
- Prevention and treatment of peri-implant diseases—The EFP S3 level clinical practice guidelines

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Prof. Liran Levin is a professor of periodontology at the Faculty of Medicine and Dentistry, University of Alberta, Canada. He is also a visiting professor at the Harvard School of Dental Medicine, Boston, MA.

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Prof. Liran Levin has published more than 300 articles and book chapters in the international professional literature and is involved in research mainly in periodontology, dental implants and dental trauma. His papers received more than 13,000 scientific citations. He has been lecturing extensively both nationally and internationally in the fields of dental implants and periodontal diseases.

Prof. Levin serves as the Editor-in Chief of Dental Traumatology, an Associate Editor for the International Dental Journal, Scientific Associate Editor for the Quintessence International and as an Editorial Board Member and a manuscript reviewer for some of the leading international professional Journals in the fields of periodontology, dental implants, dental trauma and general dentistry.

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