

# Peri-Implantitis: An In-Depth Review

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**Abstract**—Peri-implantitis is an inflammatory disease related to biofilms affecting the tissues around dental implants. It leads to the gradual loss of the bone that supports the implant, putting the implant at risk of failure. This review gathers the latest information on what peri-implantitis is, how it is classified, its occurrence, how it develops, the factors that increase the risk, how it is diagnosed, and the approaches to treating it. Strategies backed by evidence are discussed, which include ways to prevent it, non-surgical and surgical treatments, additional technologies, and ongoing maintenance. The review also highlights existing global guidelines, particularly the European Federation of Periodontology S3-level recommendations. Lastly, it outlines areas where more research is needed and what this means for clinical practice, providing doctors with a clear guideline for making decisions.

## I. INTRODUCTION

Dental implants have transformed the field of prosthetic dentistry, allowing for successful long-term solutions for lost teeth. However, diseases related to implants, specifically peri-implant mucositis and peri-implantitis, can affect how well the implant works and the results for patients. Peri-implantitis is a long-lasting inflammation caused by biofilms that can lead to the breakdown of bone and potential loss of the implant if it is not treated. The frequency of this disease and how to manage it are still subjects of discussion due to differences in how it is diagnosed and treated (Berglundh et al., 2018).

## II. DEFINITIONS AND CLASSIFICATION

- Peri-implant mucositis: A type of inflammation in the soft tissues around an implant that can be

reversed and shows bleeding when checked, without significant bone loss seen in X-rays beyond normal changes (Berglundh et al., 2018).

- Peri-implantitis: An abnormal inflammatory process surrounding the implant that causes bleeding and pus when checked, deeper pockets around the implant, and increasing bone loss visible in X-rays (Schwarz et al., 2018).

The definitions provided by the 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions form the basis for current diagnosis and treatment methods.

## III. EPIDEMIOLOGY

The occurrence of peri-implant diseases differs based on how they are diagnosed, how long patients are monitored, and various risks in the population:

- Peri-implant mucositis affects about 43 to 58 percent of patients with implants.
- Peri-implantitis varies from 10 to 30 percent of patients and 9 to 15 percent of implants, depending on how it is diagnosed (Derks & Tomasi, 2015; Lee et al., 2017).

The differences in epidemiology highlight the need for standardized diagnostic methods.

## IV. ETIOLOGY AND PATHOGENESIS

Peri-implantitis is driven by biofilms, where bacteria colonize the surface of the implant, triggering an inflammatory response in the host. An imbalance in bacteria, leaning towards harmful types (like *Porphyromonas gingivalis* and *Tannerella forsythia*), leads to tissue damage (Schwarz et al., 2018). The

surface of the titanium implant can also affect how bacteria stick and how the body reacts.

Factors in the host, such as overall health issues, smoking, and a history of gum disease, can influence the start and progression of the disease. Bone loss usually occurs in an unpredictable way, speeding up once the disease has started.

## V. RISK FACTORS

### CHANGEABLE RISK FACTOR

- Ineffective control of plaque.
- Leftover cement.
- Design issues with prosthetics (excessive shaping, too much visible margin below the gum).
- Smoking.

### UNCHANGABLE/SYSTEMIC RISK FACTOR

- Previous gum disease history.
  - Genetic factors.
  - Overall health issues (like uncontrolled diabetes).
- Preventive measures aim to reduce the changeable risk factors, ensure proper placement of implants according to prosthetic needs, and establish customized care plans for support.

## VI. DIAGNOSIS AND MONITORING

To diagnose peri-implantitis, a combination of clinical findings and X-ray results is necessary:

Clinical signs: increased probing depth (greater than 6 mm), bleeding and/or pus when probed, and gum tissue retraction.

X-ray results: visible bone loss beyond normal initial changes, ideally analyzed with initial X-rays for comparison.

Additional tools: cone-beam CT scans for complex defects; although biomarkers show potential, they are not yet standardized.

Regular monitoring is essential, with recall intervals adjusted according to patient risk.

## VII. MICROBIOLOGY AND HOST RESPONSE

- Think of peri-implantitis as a version of gum disease that happens around a dental implant. While it is caused by bacteria similar to regular gum disease, the mix of germs is often more complex and can include bacteria that do not normally cause problems.

- When these bacteria build up, the body's immune system rushes to fight the infection. Unfortunately, this defense response can be a bit too aggressive. The body releases a flood of "alarm-bell" chemicals (like IL-1 $\beta$  and TNF- $\alpha$ ) that, in their effort to kill the germs, end up causing collateral damage to the healthy gum and bone that hold your implant in place.

## VIII. MANAGEMENT STRATEGIES

How we treat peri-implantitis depends on how far it has progressed. We always start with the simplest, least invasive options first.

### 8.1 NON-SURGICAL THERAPY

This is our first line of attack and is best for early-stage problems. The goal is to do a deep, thorough cleaning without surgery. This includes:

- **Specialized Cleaning:** Using unique tools designed to clean the implant surface without scratching it.
- **Gentle Power Washing:** Using a device that sprays a fine, gentle powder to remove the sticky bacterial film.
- **Antiseptic Rinses:** We may recommend something like chlorhexidine to help control the bacteria.
- While other things like targeted antibiotics, probiotics, or laser therapy can help in the short term, we do not have strong proof yet that they make a significant difference in the long run.

### 8.2 SURGICAL THERAPY

If the infection does not clear up or if there has already been significant bone loss, we may need to consider surgery. The options include:

- **Access Flap Surgery:** We gently lift the gum tissue to get a direct look at the implant. This allows us to give it a much deeper and more effective cleaning.
- **Reshaping Surgery:** Sometimes we need to reshape the gum and bone around the implant. This removes the deep pockets where bacteria hide, making it easier for you to keep the area clean at home.
- **Regenerative Surgery:** If you have lost bone, we can sometimes try to rebuild it. This involves using bone graft material and a special membrane

to encourage your body to grow new, healthy bone around the implant.

- The success of any surgery depends on the shape of the bone loss, the type of implant surface, and how well we can disinfect it.

### 8.3 ADJUNCTIVE TECHNOLOGIES

- Lasers and Photodynamic Therapy: These can be helpful tools for disinfecting the implant surface, but studies have not yet proven them to be superior to traditional methods.
- Systemic Antibiotics: We rarely prescribe antibiotic pills for this condition. They are saved for very severe, fast-moving infections because we want to avoid contributing to antibiotic resistance.
- Host Modulation and Probiotics: These are exciting new areas of research that aim to help balance your body's immune response or the bacteria in your mouth, but we need more evidence before they become a standard treatment.

### IX. PROGNOSIS AND LONG-TERM OUTCOMES

- The long-term health of your implant is truly a team effort. Success depends on catching the problem early, your commitment to excellent home care, and sticking to a regular professional cleaning schedule.
- Even after we get things under control, peri-implantitis can come back. This is why lifelong supportive care with your dental hygienist is not just a suggestion it is essential for keeping your implant healthy. If the bone loss becomes too severe and the implant is failing, the best and only option might be to remove it.

### X. CLINICAL PRACTICE GUIDELINES (EFP S3, 2023)

- Leading experts in Europe have created a clear, evidence-based "playbook" for dentists to follow. The core message is simple and follows a logical order:
- Prevention is everything. The best approach is to avoid the problem in the first place.
- Start with non-surgical cleaning first.
- Move to surgery only if the disease does not

respond or gets worse.

- Consider additional therapies on a case-by-case basis.
- Lifelong, personalized care is the key to long-term success.

### XI. DISCUSSION

Peri-implantitis is tough to manage. The tissues around an implant are biologically different from those around a natural tooth, so we cannot just treat them the same way. A major challenge is that different studies use different definitions for the disease, which makes it hard to compare results and figure out which treatments are truly the best. While surgery can help, the results can be unpredictable. Patient health, the design of the implant crown, and commitment to follow-up care all play huge roles in the outcome.

- To improve how we care for patients, future research is focused on.
- Finding biomarkers (like in saliva) to spot the disease earlier and identify who is at higher risk.
- Creating a standardized "ruler" to measure treatment success so we can properly compare different studies.
- Running more long-term studies on bone regeneration techniques.
- Figuring out which treatments are the most cost-effective.
- Developing personalized medicine so we can tailor treatment

### XII. CONCLUSION

- Peri-implantitis is a serious challenge, but it is one we can manage. The keys to success are prevention, catching it early, and using proven treatments. While we have excellent guidelines, every patient is unique. The best way to protect your investment and keep your implant for a lifetime is through a partnership between you and your dental team, focusing on careful design from the start and consistent, lifelong maintenance.
- Clinical and radiographic features of peri-implantitis.
- Microbial and host immune interactions at the peri-implant interface.
- Treatment algorithm for peri-implant diseases (adapted from EFP S3 guideline).

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