

Implant Failure

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Abstract

Dental implant failure, defined as the loss of integration or retention of an implant, presents a significant challenge in restorative dentistry, with reported incidence rates varying from 0.76% to 11.3%. Failures are categorized as early (occurring prior to osseointegration) or late (occurring after successful integration). Early failures are primarily attributed to factors such as inadequate initial stability, surgical trauma, poor bone quality, and infection. In contrast, late failures are often a consequence of peri-implantitis, biomechanical overload, and poor oral hygiene. Key risk factors encompass both local elements (e.g., untreated periodontal disease, implant positioning, surface roughness) and systemic conditions (e.g., diabetes, smoking). Mitigation strategies hinge on comprehensive preoperative planning, meticulous surgical technique, and diligent long-term maintenance. Management of a failed implant requires a tailored approach, including possible removal, debridement, bone grafting, and addressing underlying etiologies. A history of periodontal disease is a major risk factor, underscoring the necessity of periodontal health prior to implantation. This review synthesizes the etiology, risk factors, prevention, and management protocols for dental implant failure to improve clinical outcomes.

Keywords

Dental implant failure, early implant failure, late implant failure, peri-implantitis, biomechanical overload, risk factors, preoperative planning, implant removal, bone grafting

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Summary

Dental implant failures denote the failed integration or retention of dental implants, which are artificial tooth roots surgically inserted into the jawbone to provide support. Dentary positioning. The incidence of dental implant failures varies between 0.76% and 11.3%, presenting a considerable issue in restorative dentistry (Boboeva *et al.*, 2021; Do *et al.*, 2020; Sakka *et al.*, 2012). Dental implant failures can be classified into two main categories: early failures, occurring prior to the completion of osseointegration, and late failures, occurring after to effective integration (Do *et al.*, 2020; Shieh, 2019). Comprehending the differences among these types, their etiologies, and risk factors is essential for enhancing implant success rates and patient outcomes.

Early implant failures are chiefly ascribed to inadequate early stability, surgical errors, impaired bone integrity, and infections (Boboeva *et al.*, 2021; Do *et al.*, 2020; Sakka *et al.*, 2012). Prevalent causes of these failures encompass surgical stress, inadequate bone quality, and

patient-specific factors, including systemic health problems that hinder healing (Sakka *et al.*, 2012; Saul *et al.*, 2023). In contrast, late implant failures frequently arise from factors including as peri-implantitis, biomechanical overload, and inadequate oral hygiene, all of which can negatively impact the durability of the implants following successful integration into the jawbone (Hanif *et al.*, 2017; Rocuzzo *et al.*, 2023; Shieh, 2019). The management of these failures may encompass measures from surgical interventions to lifestyle modifications intended to promote healing and mitigate infection risks.

The issue of dental implant failures is significant due to its frequency and the wider ramifications it poses for oral health and restorative dentistry techniques. Controversies about dental implants frequently center on patient selection, surgical methodologies, and the long-term maintenance of implant-supported restorations. As understanding of the determinants of implant success increases, continuous research and developments in procedures are refining best practices to mitigate the chance of failure (Boboeva *et al.*, 2021; Gurarie, 2024; Mono Dental

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Implant Academy, 2024). By tackling the fundamental causes and advocating for effective preventive strategies, dental professionals and patients can cooperatively enhance the outcomes of dental implant treatments.

CATEGORIES OF DENTAL IMPLANT FAILURES

Dental implant failures can be categorized into two main types: early implant failures and late implant failures.

Initial Implant Failures

Early implant failures transpire prior to the culmination of osseointegration, an essential procedure wherein the dental implant assimilates and bonds with the jawbone. Factors contributing to premature failures encompass insufficient initial stability of the implant, substandard surgical technique, decreased bone health, inadequate bone quality or quantity, infections, and patient-related complications such as diminished healing capacity. In specific instances, dental practitioners may advocate for operations such as sinus lifts to augment bone volume and reduce the likelihood of premature implant failures (Sakka *et al.*, 2012; Shieh, 2019). The occurrence of early failures has been documented to vary between 0.76% and 7.47%, with prevalent causes identified as surgical trauma, infections, torque overload, and particular local and systemic diseases (Sakka *et al.*, 2012). Early implant failures are often classified as main failures, occurring immediately or shortly after implant implantation due to the previously listed reasons.

Delayed Implant Failures

Conversely, late implant failures transpire subsequent to the successful osseointegration process. These failures may stem from multiple factors, including peri-implantitis—an inflammatory condition impacting the tissues surrounding the implant—biomechanical overload due to inadequate occlusion or excessive forces, improper implant design or placement, and systemic influences such as inadequate oral hygiene or underlying systemic diseases that impede healing. The incidence of late implant failures has been recorded to vary from 2.1% to

11.3% (Boboeva *et al.*, 2021). Late failures, often referred to as secondary failures, transpire post-initial healing and may be affected by prolonged variables like as excessive clenching and grinding, insufficient supportive bone or gum tissue, and inadequate dental hygiene.

Comprehending the etiology and timing of both early and late dental implant failures is crucial for augmenting long-term success rates and improving patient care in dental implant surgeries.

ETIOLOGIES OF DENTAL IMPLANT FAILURES

Dental implant failures may arise from multiple sources, which can be classified into early and late failures. Comprehending these factors is crucial for mitigating difficulties and enhancing the success rates of dental implants.

Initial Implant Failures

Initial implant failures generally arise shortly after the treatment, frequently attributable to complications associated with the surgical technique or the preliminary phases of osseointegration, the process by which bone assimilates with the implant.

Bruxism: The force applied to the implant from grinding may interfere with osseointegration, resulting in instability and possible failure.
Allergic Reactions: Infrequently, patients may encounter allergic reactions to the titanium utilized in implants, potentially compromising osseointegration.
Nerve injury: Surgical problems may lead to nerve injury, resulting in symptoms such as pain, numbness, or tingling in adjacent regions.

Delayed Implant Failures

Late implant failures transpire subsequent to successful osseointegration and may result from numerous sources, including: **Peri-implant Diseases:** These encompass illnesses such as peri-implantitis and peri-implant mucositis. The former pertains to inflammation of the gums encircling the implant, whereas peri-implantitis impacts the supporting bone, frequently requiring

surgical intervention if not addressed. **Biomechanical Overload:** Inadequate occlusion, high masticatory pressures, or a sub optimally designed implant may induce biomechanical overload, culminating in implant loosening or failure. **Poor Oral Hygiene:** Neglecting oral hygiene can result in bacterial accumulation, inflammation, and infections surrounding the implant, hence elevating the likelihood of failure (Munir, 2024).

Systemic Factors:

Health problems, including diabetes, autoimmune illnesses, or the administration of radiation therapy, might impede recovery and lead to implant failures (Munir, 2024).

Additional Contributing Factors

Various supplementary elements may elevate the likelihood of dental implant failure, including: **Smoking** is a major risk factor that hinders healing and elevates the probability of gum disease, which can negatively impact the stability of implants (Munir, 2024). **Inadequate Nutrition:** Insufficient consumption of calcium and vital nutrients might diminish bone density, increasing the likelihood of implant failure (Munir, 2024). **Trauma:** Physical traumas to the jaw may impair the bone's capacity to sustain the implant, resulting in probable failure, particularly in individuals participating in contact sports (Munir, 2024). By comprehending and regulating these aspects, patients and dental practitioners can collaborate to improve the probability of effective dental implant results.

RISK DETERMINANTS

Numerous risk factors influence the probability of dental implant failures and complications, which can be classified into local and systemic causes. Comprehending these elements is crucial for doctors to mitigate risks and improve treatment outcomes.

Regional Risk Determinants.

Local risk factors directly affect the implant environment, especially the bacterial makeup and load.

- **Surface Roughness:** Implants featuring rough surfaces may retain a greater quantity of

microorganisms, hence elevating the risk of infection (Gurarie, 2024).

- **Access to Oral Hygiene:** Inadequate access for proper oral hygiene may result in plaque buildup and peri-implant disease (Gurarie, 2024).

Untreated periodontal conditions, including as active periodontitis or unaddressed periodontal pockets, can adversely affect the success of implants. Improperly positioned implants may experience heightened occlusal stresses and cleaning challenges, hence increasing the likelihood of problems.

Excess cement and titanium particles can irritate adjacent tissues and provoke inflammatory responses. **Absence of Keratinized Tissue:** The deficiency of supporting tissue surrounding the implant may jeopardize the health of peri-implant tissues (Gurarie, 2024).

Universal Risk Factors

General risk factors pertain to the patient's overall health and vulnerability to infections, encompassing: **Chronicle of Periodontal Disease:** A prior history of periodontal problems can increase the risk of peri-implantitis (Munir, 2024).

Systemic Health Issues

Conditions like diabetes, which impair immunologic responses, may elevate the risk of implant failure (Gurarie, 2024). **Choices Regarding Lifestyle:** Smoking is a major risk factor, as it aggravates periodontal disease and hinders healing processes. **Adherence to Treatment Protocols:** Insufficient oral hygiene practices and a lack of motivation to attend follow-up sessions can result in increased complication rates (Munir, 2024).

Risk Evaluation

Risk assessment is an essential component of the treatment planning process. Clinicians must assess both local and systemic risk factors not just before to implant placement but also during the therapy and maintenance phases. Recognizing and mitigating these hazards can markedly enhance implant durability and success rates (Gurarie, 2024; Munir, 2024). **Contraindications** Although

there are few absolute contraindications for implant insertion, specific medical problems require consideration. This encompasses unstable medical histories, including recent myocardial infarction, uncontrolled hemorrhagic diseases, and ongoing malignancies. Comprehending these contraindications enables clinicians to assess the suitability of implant therapy for specific patients.

MITIGATION OF DENTAL IMPLANT FAILURES

Effective preventative strategies for dental implant failure necessitate thorough planning before surgery and the application of appropriate techniques and care during the postoperative phase. Focusing on these areas can substantially reduce the probability of problems.

Preoperative Planning.

A comprehensive pre-operative evaluation is crucial in ascertaining a patient's eligibility for dental implants. This procedure entails assessing the patient's comprehensive health and dental history, along with recognizing and managing any pre-existing disorders, such as periodontal disease or osseous resorption, that may affect the success of the implant. Techniques such as dental imaging, including X-rays and Cone Beam Computed Tomography (CBCT), are employed to guarantee precise placement and reduce problems.

Patient education is essential in pre-operative planning. Patients must be apprised of essential lifestyle modifications, including cessation of smoking and the maintenance of good dental hygiene, which can substantially improve the likelihood of a successful implant (Legeros & Craig, 1993). Regular dental examinations to evaluate oral health before to the procedure are also advised.

Surgical Methods and Post-Operative Management

The utilization of clean instruments and a regulated environment is essential during the surgical operation to mitigate infection risks. The choice of the suitable implant size and type considerably influences the success rate. Post-

operative care is essential for guaranteeing the proper integration and durability of dental implants. Patients must diligently comply with their dentist's directives for hygiene protocols and subsequent appointments to assess healing and swiftly resolve any issues. Maintaining proper oral hygiene, including consistent brushing and the utilization of interdental cleaning devices, is crucial for the prevention of peri-implantitis—a condition marked by inflammation surrounding the implant resulting from bacterial infection.

Prolonged Upkeep and Lifestyle Adjustments

Upholding excellent oral hygiene is essential for the enduring effectiveness of dental implants. Neglecting adequate oral hygiene might result in bacterial accumulation and infections that may lead to implant failure. Moreover, behaviors such as bruxism, the ingestion of hard meals, and tobacco consumption can elevate the likelihood of complications (Munir, 2024).

Embracing healthy lifestyle choices can markedly enhance the success rates of dental implants. This encompasses the management of pre-existing health disorders, such as diabetes, which may influence healing and the integration of the implant. Patients are advised to participate in consistent physical exercise and uphold a balanced diet to improve overall health and recuperation (Legeros & Craig, 1993).

Surveillance and Subsequent Assessment

Consistent follow-up sessions with a dentist are crucial for assessing the status of dental implants and promptly resolving any indications of failure. Patients must remain alert for symptoms including abrupt discomfort, edema, erythema, or instability of the implant, as these may signify problems necessitating prompt intervention.

By adhering to these preventive techniques and fostering transparent communication with healthcare providers, people can markedly diminish the likelihood of dental implant failures and reap the enduring advantages of this restorative procedure (Mono Dental Implant Academy, 2024; Shieh, 2019).

MANAGEMENT OF FAILED IMPLANTS

Treatment Alternatives Excision and Reinstatement

In instances of primary failure or significant infection, the initial course of action is usually the extraction of the compromised implant. This permits the location to recuperate prior to contemplating reimplantation. During reimplantation, meticulous assessment of the patient is essential, evaluating characteristics such as bone density and oral hygiene to customize the treatment to the individual's requirements. In certain instances, employing smaller or variably shaped implants may increase the probability of effective integration. Bone Grafting and Reconstructive Procedures Bone grafting may be utilized to enhance inadequate bone quality or quantity before reimplantation. This method can enhance the likelihood of successful integration over time. Furthermore, certain individuals may necessitate corrective surgical interventions to improve the state of adjacent bone or soft tissues, thereby fostering an environment favorable for the success of a new implant. Management of Peri-implantitis Management of late failures, such as peri-implantitis, may necessitate skilled extensive cleaning of the implant site to eliminate bacterial deposits and infected tissue. This procedure, termed scale and root planning, is essential for averting additional degradation of the implant and adjacent structures.

An Overview

Upon diagnosis of implant failure, various therapeutic alternatives are available to rectify the problem. In critical instances, the extraction of the malfunctioning implant may be required. Non-surgical treatments may encompass debridement and the administration of antibiotics to address infections, whereas surgical interventions could involve bone grafting to restore missing bone, thereby establishing a firm foundation for a new implant (Mono Dental Implant Academy, 2024; Sakka *et al.*, 2012).

Categories of Implant Failures

Dental implant failures are often classified into two categories: primary (early) failures and

secondary (late) failures. Primary failure transpires immediately upon the implantation or shortly thereafter, typically attributable to suboptimal bone quality, surgical inaccuracies, or insufficient initial stability. Secondary failure transpires significantly later, subsequent to the integration of the implant. The effective care of failed implants frequently relies on comprehending the specific type of failure and its underlying causes, which may encompass biological variables such as infections or mechanical concerns like implant fracture.

Diagnostic Approaches

Timely identification of implant failure can greatly enhance the efficacy of remedial interventions. Typical manifestations encompass pain, discomfort, and edema at the implant location. Dentists commonly employ imaging equipment, including X-rays, to assess bone loss or implant displacement. Diagnostic tests are crucial for detecting infections or further problems. Comprehending these signs allows dental practitioners to devise suitable therapeutic techniques. Strategies for Prevention The efficient handling of unsuccessful implants underscores the significance of preventive strategies. Planning errors or surgical inexperience frequently led to difficulties; thus, comprehensive consultation with restorative colleagues and meticulous examination of the patient's medical history are essential. The utilization of modern imaging techniques, such as computed tomography, can facilitate precise evaluation of anatomical structures prior to surgical intervention (Do *et al.*, 2020).

PREVALENT PERIODONTAL DISORDERS IMPACTING IMPLANT SUCCESS

Summary of Periodontal Disease

Periodontal disease, also referred to as gum disease, is a persistent inflammatory disorder that impacts the gums and the supporting bone of the teeth. It advances via specific stages, commencing with gingivitis and potentially escalating to periodontitis if not addressed. Gingivitis is marked by gum inflammation due to plaque buildup, but periodontitis entails more severe tissue and bone

deterioration, potentially culminating in tooth movement and loss if not well treated (Salvi *et al.*, 2023).

Effects on Dental Implants

Periodontal disease substantially impacts the efficacy of dental implants. Individuals with a history of untreated periodontitis demonstrate a decreased survival probability for implants, as the factors contributing to periodontal disease also elevate the chance of implant failure (Ray, 2023). This underscores the significance of efficient periodontal therapy before the insertion of dental implants to improve long-term results (Hanif *et al.*, 2017).

PARTICULAR CONDITIONS

Peri-implantitis

Peri-implantitis is a distinct inflammatory illness that arises around dental implants, akin to periodontitis. It entails a bacterial infection and inflammation of the supporting tissues, frequently resulting in bone loss surrounding the implant. Symptoms encompass gingival inflammation, radiographically identifiable bone loss, and, in advanced instances, implant movement. The lack of the periodontal ligament in implants facilitates a more rapid progression of peri-implantitis compared to conventional periodontal disease.

Peri-implant Mucositis

Peri-implant mucositis is defined by the inflammation of the soft tissues encircling a dental implant, occurring without concomitant bone loss. This condition is frequently seen as a prelude to peri-implantitis. It can generally be reversed by eliminating etiological causes such as biofilm, calculus, and foreign items, along with enhancing oral hygiene routines.

Determinants of Implant Failure

Numerous local and systemic risk factors lead to the failure of dental implants, especially in individuals with a history of periodontal disease. Local factors encompass inadequate oral hygiene, which markedly elevates the risk of peri-implantitis, as well as the existence of leftover cement or foreign material surrounding the implant (Hsiao *et al.*, 2024). Systemic factors

encompass a patient's general health, including conditions like diabetes or immunological diseases, which may hinder recovery and elevate the risk of infections. Significance of Supportive Therapy Active periodontal therapy targeting the eradication of pockets above 5 mm is crucial for establishing long-term healthy peri-implant conditions and enhancing implant success. Customized supportive periodontal care, encompassing regular monitoring and maintenance, can markedly diminish the likelihood of complications (Hanif *et al.*, 2017). Regular evaluations allow clinicians to identify early indicators of inflammation and implement corrective measures to avert implant failure.

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