Characteristics of Early Versus Late Implant Failure: A Retrospective Study

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Purpose: Implant failures can be divided into early and late according to the timing of failure. The purpose of this study was to characterize and compare both types.

Patients and Methods: A retrospective cohort study was conducted in 194 patients (98 men and 96 women) who presented after dental implant failures during a 6-year period (2000 to 2006). The patient served as the unit of analysis. A history of at least 1 failed and removed dental implant served as the inclusion criterion. Patients were excluded from this study whenever their files had missing data. The collected data included a patient's characteristics, failure characteristics, and the anatomic status of the alveolar ridge after failure.

Results: Late failures were associated with moderate to severe bone loss, a larger number of failed implants per patient, a higher incidence in men, and mostly in posterior areas. Early failures were associated with minimal bone loss, occurred more in women, at a younger age, and in most cases the implants were intended to support single crowns.

Conclusions: Meticulous follow-up is needed to reveal and treat failing or ailing implants. Once established as hopeless, they should be removed as soon as possible to prevent further bone loss.

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The high predictability of implant dentistry has popularized its use during the past 25 years. The reported overall mean survival rate for 2- to 16-year follow-up was 94.4%,[1] whereas others have reported a global failure rate of 1.9% to 3.6%.[2-4] Primary predictors of implant failure are poor bone quality, chronic periodontitis, systemic diseases, smoking, advanced age, implant location, parafunctional habits, loss of implant integration, and inappropriate prosthesis.[2-4]

Implant failure timing is used for classification. Early failure occurs before or at abutment connection. It is suggested to occur because of failure to establish osseointegration, due to interference with the healing process. Late failure occurs after occlusal loading. It is suggested to occur because of failure to maintain the established osseointegration, due to a process involving its breakdown.[4,5] To minimize the occurrence of early and late failures, it is mandatory to understand the pathogenesis and risk factors, describe the signs and symptoms, and clarify future clinical implications. Nevertheless, the number of publications is small.[1-4]

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The purpose of the present study was to compare early with late implant failure with regard to risk factors, signs and symptoms, and future clinical implications.

Patients and Methods

A retrospective cohort study was conducted in 194 patients (98 men and 96 women) who presented after dental implant failures during a 6-year period (2000 to 2006). The patient served as the unit of analysis. A history of at least 1 failed and removed dental implant served as the inclusion criterion. Patients were excluded from this study whenever their files had missing data. The study was conducted at Tel Aviv University and was approved by the ethics committee of the Faculty of Medicine.

The collected data included:

1. Patient's characteristics
   a. Demographic data (gender, age)
   b. General health status according to the American Society of Anesthesiology system[6]
   c. Habits
2. Failure characteristics
   a. Implant manufacturer
   b. Implant site
   c. Number of removed implants per patient
   d. Interval from diagnosis of failing implant to removal
   e. Reasons for failure
3. Anatomic status of the alveolar ridge after failure was classified by the aid of computerized tomography
   a. Minor bone loss: reimplantation can be performed without bone augmentation
   b. Moderate bone loss: reimplantation can be performed simultaneously with guided bone regeneration
   c. Severe bone loss: reimplantation can be performed only after a waiting period after bone grafting

The study population was divided according to early and late failures.[2,3] The collected data were analyzed using SPSS 10.0 (SPSS Inc, Chicago, IL) for mean values and standard deviations. Statistical analysis was performed using Pearson χ^2 test, Fisher exact test, and Levene test for equality of variances. A 1% significance level was used to determine meaningful differences.

Results

One hundred ninety-four patients (294 implants) were included in the present study. Half of the patients had early failures (97 patients) and the other half had late failures (97 patients). Implant distributions per patient (patients/implants) were 138/1, 35/2, 13/3, 4/4, 1/5, 2/7, and 1/10.

PATIENT CHARACTERISTICS

Gender

Ninety-eight men and 96 women were included. Early failures occurred more in women (56 of 97, 57.7%), whereas late failures occurred more in men (57 of 97, 58.8%, $P = .031$).

Age

The average age was 51 ± 13 years (range, 20 to 83 yrs). Mean age was lower in the early failure group (48.93 ± 13 vs 53.84 ± 12.63, $P = .009$).

General Health Status

The number of patients with medical problems (American Society of Anesthesiology score >1) was significantly ($P = .001$) larger in the late failure group (26 of 97, 27.1%, vs 8 of 97, 8.4%). No specific systemic disease had any statistical significance.

Habits

Although the number of patients with bruxism was higher in the late failure group, it was statistically insignificant.

FAILURE CHARACTERISTICS

Implant Manufacturer

Implants were from 5 different manufacturers. There were no differences between the studied groups (3I–Implant Innovation Inc, Palm Beach Gardens, FL; MIS, Shlomi, Israel; Zimmer Dental, Carlsbad, CA; Steri-Oss, Yorba Linda, CA).

Implant Site

In the late failure group, the number of patients with failures in the posterior (premolar, molar) area was significantly higher (64 of 97 66%, $P = .029$).

Number of Removed Implants per Patient

The average number was larger in the late failure group (1.79 vs 1.22, $P < .001$).

Interval From Diagnosis of Failing Implant to Removal

In the early failure group, the interval was significantly shorter (0.59 ± 1.35 vs 4.8 ± 8.2 months, $P = .003$).

Reasons for Failure

In the early failure group, the main reason for failure was lack of osseointegration (73.2%). In the late failure group, the main reasons were peri-implantitis (32%), overloading (46.4%), and implant fracture (6.2%; Table 1).

Table 1. FAILURE CAUSES RELATED TO THE STUDY GROUPS

	Unknown	Peri-implantitis	Overload	Lack of Osseointegration	Implant Brake	Lack of Augmentation
Early failure	17 (17.5%)	6 (6.2%)	3 (3.1%)	71 (73.2%)	0	2 (2.1%)
Late failure	10 (10.3%)	31 (32%)	45 (46.4%)	3 (3.1%)	6 (6.2%)	0
Total	27 (13.9%)	37 (19.1%)	48 (24.7%)	74 (38.1%)	6 (3.1%)	2 (1%)

Manor et al. Early Versus Late Implant Failure. J Oral Maxillofac Surg 2009.

Anatomic Status of Alveolar Ridge After Failure

The early failure group was characterized by minor bone loss (59.5%), whereas the late failure group by moderate (59.4%) and severe (37.5%) bone loss. This was statistically significant ($P < .001$; Table 2).

Discussion

Early versus late implant failures were characterized by female gender, younger age, better health, 1 implant failure per patient, early implant removal, and minor bone loss. Late failures were characterized by male gender, older age, more medical problems, an average of 2 failing implants per patient, late implant removal, and moderate to severe bone resorption. The failure rate in the posterior area was significantly higher. The main reasons for late implant failure were peri-implantitis, overloading, and implant fracture.

In this study, men were more likely to have late failure. In contrast, Sverzut et al[7] found that men have a 1.255 times greater risk of early dental implant failure than women. This can be explained by the fact that their study dealt only with early implant failure.

The research of failures focuses on the reasons for failure to prevent their occurrence; the means that should be undertaken to minimize failure damages; and the means that should be undertaken to allow the most cost-effective treatment with minimum postoperative morbidity. In the present study, all the outcome parameters were clinical. Such a methodology can allow insight only for affecting parameters that can be evaluated clinically. The reason for early implant failure is lack of osseointegration. The measured parameters do not affect osseointegration; therefore, no relevant conclusion could be drawn. Late implant failures, however, are a result of osseointegration breakdown after everyday use of the implant-supported prosthesis. The data demonstrate that the main reason for late failure is improper functional balance. This is supported by a higher prevalence in the posterior area and by the reasons for failure. It can be suggested that preventing late failure functional balance is mandatory. Moreover, once peri-implantitis occurs, functional balance can enhance it, rendering functional balance as a major reason for late implant failure. Paquette et al[1] in dealing with risk factors included peri-implantitis as a leading factor for late failure. Montes et al[8] also mentioned that iatrogenic conditions such as contamination and occlusal trauma are reasons for failure. Kozlovsky et al[9] concluded that overloading aggravated the plaque-induced bone resorption when peri-implant inflammation was present. The results regarding overloading should be evaluated with extreme caution because they are subjective factors and very difficult to determine.

Table 2. BONE LOSS RELATED TO THE STUDY GROUPS

	Minor Bone Loss	Moderate Bone Loss	Severe Bone Loss
Early failure	58 (59.8%)	37 (38.1%)	2 (2.1%)
Late failure	3 (3.1%)	57 (59.4%)	36 (37.5%)
Total	61 (31.6%)	94 (48.7%)	38 (19.7%)

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The next question would be how to minimize the failure damage. The interval before implant removal was minimal in early failures. This was easier for the clinician because the efforts and costs up to this stage were minimal. There was only 1 failing implant per case. In addition, the patients were younger and healthier with a higher tendency to reimplantation. As a result it is more cost effective for patients and clinicians to accept the failure and advocate faster treatment to resolve the case before further damage occurs.

Late failures are more difficult to treat. The interval before implant removal is significantly longer compared with early failures. It postulates that it is more difficult for patients and clinicians to accept the failure and advocate fast treatment to resolve the case before further damage occurs. In those cases the efforts and costs up to this stage were maximal. There were 2 failing implants per case. In addition, the patients were older with more medical problems and a lower tendency to reimplantation.[10] As a result, patients and clinicians tried to "save" the case but unfortunately ended up without solving the case and with more severe damage. It can be clearly suggested that, although it is tempting to try to save the case, a decision as to whether the problem is treatable or

hopeless should be reached as soon as possible to minimize additional damage.

The severe bone loss occurring after late implant failure requires extensive bone grafting. The postoperative morbidity and costs are high, and often the patient does not agree to undergo this process one more time.[10] Therefore, at this stage it is too late for treatment modifications.

It can be concluded that most efforts should be dedicated to early treatment of late failure and that failed implants should be removed as soon as possible.

In conclusion, bone loss is minimal in early failures and severe in late failures. Close follow-up and early removal of ailing, failing implants in those cases are recommended to prevent massive bone loss, which might render reimplantation extremely challenging or impossible.

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