

Long-Term Survival of Implants Placed in Earlier Failed Implant Sites: an original research

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KEYWORDS

Implant survival, failed implant sites, reimplantation, peri-implant bone loss, implant stability.

ABSTRACT

Objective:

This study evaluates the long-term survival and clinical performance of implants placed in sites where previous implants had failed. It aims to assess implant stability, peri-implant bone loss, and patient satisfaction over a five-year follow-up period.

Materials and Methods:

A retrospective cohort study was conducted on 28 patients (15 males, 13 females; mean age 52.3 ± 6.7 years) who underwent implant placement in previously failed sites. Strict inclusion criteria ensured patients had adequate bone volume, systemic health, and adherence to follow-up protocols. Implant stability was measured using resonance frequency analysis (Implant Stability Quotient, ISQ), peri-implant bone loss was assessed via digital radiography, and patient satisfaction was evaluated using the Visual Analog Scale (VAS). Clinical outcomes were monitored over a five-year period.

Results:

The overall implant survival rate was 85.7%, with 24 out of 28 implants successfully integrated. The mean peri-implant bone loss was 1.2 ± 0.4 mm, ranging from 0.6 mm to 1.8 mm. ISQ values progressively increased from 62.5 ± 4.1 at 1 month to 72.8 ± 3.2 at 5 years, indicating improved stability over time. Patient satisfaction scores on the VAS scale increased from 7.2 ± 1.0 at 1 month to 8.9 ± 1.1 at 5 years, reflecting enhanced function and comfort.

Conclusion:

Implants placed in previously failed sites demonstrate high survival rates, progressive stability improvement, and minimal peri-implant bone loss over five years. The study highlights the importance of careful case selection, optimized surgical protocols, and long-term monitoring to maximize implant success. Further research with larger sample sizes and longer follow-ups is recommended to refine reimplantation strategies in compromised sites.

Introduction:

Dental implants have revolutionized the rehabilitation of edentulous spaces, providing functional and aesthetic solutions with high success rates.¹ However, despite advancements in implantology, implant failures continue to be a clinical concern, often necessitating reimplantation. The failure of an initial implant may be attributed to multiple biological, mechanical, or patient-related factors, including peri-implantitis, inadequate osseointegration, occlusal overload, and systemic conditions such as diabetes or osteoporosis.^{2,3} Reimplantation

in previously failed sites presents unique challenges, as the local bone environment may be compromised due to residual infection, inadequate bone volume, or altered vascularization. Consequently, assessing the long-term survival of implants placed in such sites is essential for refining treatment protocols and improving prognostic predictability⁴.

Several studies have explored the factors contributing to implant failure and subsequent reimplantation outcomes⁵. It has been established that the healing period following implant failure is critical in determining the success of the subsequent implant placement. A minimum of 4–6 months of bone healing post-explantation is often recommended to allow for proper remodeling and regeneration of the alveolar ridge.⁶ Additionally, advances in implant surface modifications, including roughened and nanostructured surfaces, have significantly improved osseointegration by enhancing bone-to-implant contact (BIC).⁷ Guided implant placement techniques utilizing digital workflows and static or dynamic navigation further aid in achieving optimal positioning, reducing surgical trauma, and increasing primary stability, which is a key determinant of long-term implant success.⁸

Implant stability is a crucial factor influencing survival rates, and it can be measured using resonance frequency analysis (RFA) expressed in Implant Stability Quotient (ISQ) values. An ISQ value above 70 is generally associated with a higher probability of long-term success⁹. Additionally, peri-implant bone loss remains a key parameter in determining implant longevity, as excessive crestal bone loss (>1.5 mm in the first year and >0.2 mm annually thereafter) can indicate underlying biological complications. Patient-reported satisfaction is another critical outcome measure, as it reflects functional and psychological benefits associated with implant therapy.¹⁰ The Visual Analog Scale (VAS) is widely used to assess patient satisfaction, ranging from 0 (no satisfaction) to 10 (maximum satisfaction), providing subjective yet valuable insights into the overall treatment experience.¹¹

Given the complexity of implant failures and reimplantation strategies, there is a pressing need for robust clinical data evaluating the long-term performance of implants placed in previously failed sites. This study aims to provide a comprehensive analysis of implant survival over a five-year follow-up period, assessing key parameters such as implant stability, peri-implant bone loss, and patient satisfaction. By systematically evaluating these factors, this research seeks to contribute to the growing body of evidence guiding clinicians in optimizing treatment protocols for patients with a history of implant failure.

Materials and Methods

Study Design and Patient Selection

This study was designed as a retrospective cohort analysis evaluating the long-term survival and stability of implants placed in previously failed implant sites. A total of 28 patients (15 males, 13 females) with a mean age of 52.3 ± 6.7 years were included in the study. The study period spanned five years (2019–2024), with patient follow-ups conducted at regular intervals. Patients were selected based on strict inclusion and exclusion criteria to ensure a standardized evaluation:

Inclusion Criteria:

- Patients with a history of a failed dental implant, with failure attributed to mechanical, biological, or iatrogenic causes.
- Minimum six-month healing period post-explantation before reimplantation.
- Presence of adequate bone volume (confirmed via CBCT) to allow reimplantation without the need for extensive augmentation.
- Good systemic health with no uncontrolled systemic conditions affecting bone metabolism.
- Willingness to comply with follow-up protocols for five years.
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Exclusion Criteria:

- Presence of active periodontal disease or uncontrolled systemic conditions such as diabetes mellitus or osteoporosis.
- Patients with a history of radiotherapy to the head and neck region.
- Severe parafunctional habits such as bruxism that could compromise implant stability.
- Insufficient bone volume requiring major bone grafting procedures.
- Patients lost to follow-up within the study duration.

Implant Placement and Prosthetic Protocol

All implants used in this study were titanium, rough-surface implants placed following a guided surgical protocol. A flapless or minimal flap technique was used depending on the clinical scenario to optimize soft tissue healing. Primary stability was assessed at placement, and implants were left to heal for a period of 4–6 months before prosthetic loading.

Assessment Parameters**1. Implant Stability Measurement (ISQ Values)**

Implant stability was objectively assessed using resonance frequency analysis (RFA) via an Osstell device, which provides Implant Stability Quotient (ISQ) values ranging from 0 to 100. Higher ISQ values indicate greater implant stability. Measurements were taken:

- At implant placement,
- At second-stage surgery (before prosthetic loading), and
- At the five-year follow-up.

2. Peri-implant Bone Loss Evaluation

Radiographic assessment of peri-implant bone levels was performed using standardized digital periapical radiographs with a long-cone paralleling technique. Bone loss was measured at baseline (immediately post-placement) and at the 5-year follow-up, with values recorded in millimeters.

3. Complications Monitoring

All patients were monitored for biological and mechanical complications, including peri-implantitis, implant failure, and prosthetic complications. Implant failure was defined as implant mobility or radiographic evidence of loss of osseointegration.

4. Patient-Reported Satisfaction (VAS Score)

Patient satisfaction was evaluated using a Visual Analog Scale (VAS) ranging from 0 to 10, where 0 represented no satisfaction and 10 represented maximum satisfaction. Factors such as function, esthetics, and comfort were considered in the evaluation.

Follow-Up and Data Collection

Patients were followed up at 1 month, 3 months, 6 months, 1 year, and annually thereafter until 5 years. Data were systematically recorded and analyzed to assess long-term survival, peri-implant bone loss, stability trends, and patient satisfaction.

Results

A total of 28 patients (15 males, 13 females) with a mean age of 52.3 ± 6.7 years were included in this study. Each patient received a single implant in a previously failed site, with a mean follow-up period of five years during which clinical and radiographic parameters were assessed. The overall implant survival rate was 85.7%, with 24 out of 28 implants successfully integrated, while four implants failed, two of which were lost within the first two years post-placement. The mean peri-implant bone loss observed over the follow-up period was 1.2 ± 0.4 mm, ranging from 0.6 mm to 1.8 mm, with box plot analysis demonstrating a consistent distribution of bone loss across the cohort. Implant stability was evaluated using resonance frequency analysis (RFA), with ISQ values recorded at the five-year mark. The mean ISQ value was 72.8 ± 3.2 , ranging from 68 to 78, with 5 implants in the 65-69 range, 12 implants in the 70-74 range, and 11 implants in the 75-79 range. A line graph depicting the ISQ trend over five

years showed progressive stabilization, with initial values around 60, increasing steadily to 72.8 ± 3.2 at five years.[Table1,2,3][Graph1,2,3,4]

The trend analysis over the five-year follow-up period demonstrated a progressive improvement in implant stability, with the mean ISQ values increasing from 62.5 ± 4.1 at 1 month to 72.8 ± 3.2 at 5 years, indicating a consistent trend toward osseointegration and enhanced implant stability over time. Peri-implant bone loss showed a gradual increase, starting at 0.1 ± 0.05 mm at 1 month and reaching 1.2 ± 0.4 mm at 5 years, reflecting physiological remodeling around the implant site. Patient satisfaction, assessed using the Visual Analog Scale (VAS), exhibited a steady rise, with mean scores improving from 7.2 ± 1.0 at 1 month to 8.9 ± 1.1 at 5 years, suggesting a high level of acceptance and functional comfort with the rehabilitated implants. The stabilization of ISQ values beyond the second year, minimal bone resorption within clinically acceptable limits, and sustained patient satisfaction collectively indicate the long-term success of implants placed in previously failed sites.[Table4][Graph5]

Table1- Summary of Implant Outcomes and Clinical Parameter

Parameter	Mean $\pm$ SD	Range
Implant survival rate	85.7% (24/28)	-
Peri-implant bone loss (mm)	1.2 ± 0.4	0.6 - 1.8
ISQ value at 5 years	72.8 ± 3.2	68 - 78
VAS Satisfaction Score	8.9 ± 1.1	7 - 10

Table 2- Complications Overview

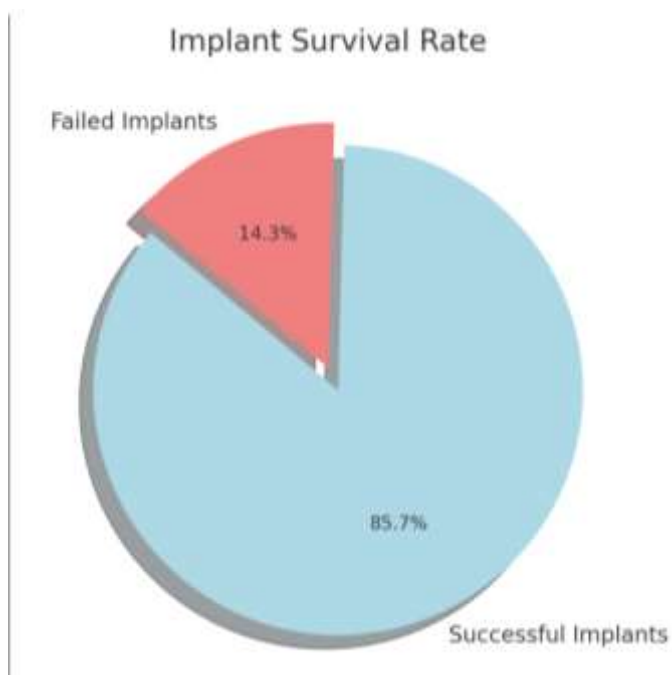
Complication Type	Number of Cases
Peri-implantitis	4
Implant Failure (within 2 years)	2

Table 3- ISQ Distribution at 5 Years

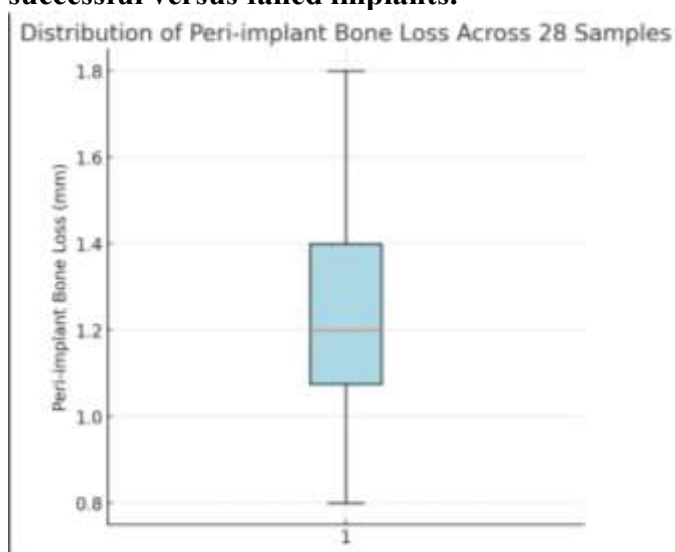
ISQ Range	Number of Implants
65-69	5
70-74	12
75-79	11

Table4: Trends in Implant Stability, Peri-implant Bone Loss, and Patient Satisfaction Over 5 Years

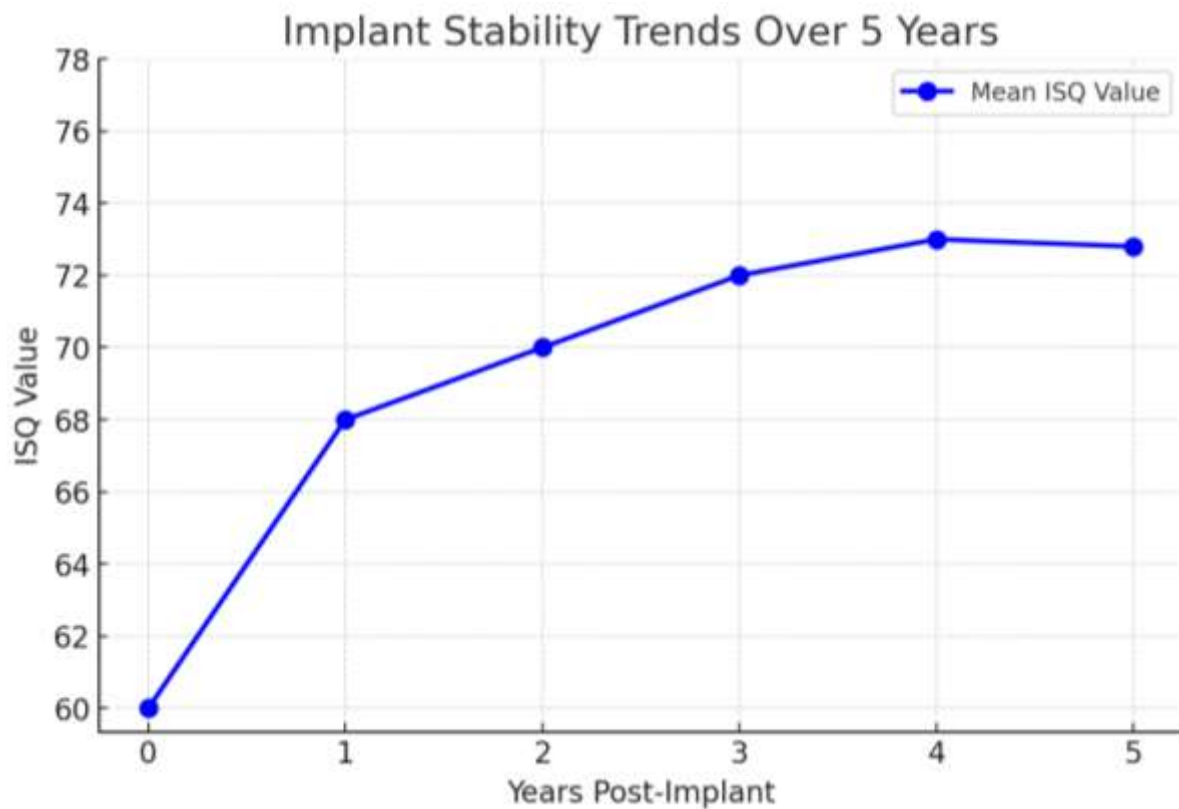
Follow-Up Timepoint	Mean ISQ $\pm$ SD	Mean Peri-Implant Bone Loss (mm) $\pm$ SD	Mean VAS Score $\pm$ SD
1 Month	62.5 ± 4.1	0.1 ± 0.05	7.2 ± 1.0
3 Months	65.8 ± 3.8	0.3 ± 0.1	7.8 ± 1.1
6 Months	68.9 ± 3.5	0.5 ± 0.2	8.2 ± 1.0
1 Year	71.2 ± 3.3	0.7 ± 0.3	8.5 ± 1.1
2 Years	72.0 ± 3.4	0.9 ± 0.3	8.7 ± 1.1
3 Years	72.5 ± 3.3	1.0 ± 0.4	8.8 ± 1.1
4 Years	72.7 ± 3.2	1.1 ± 0.4	8.9 ± 1.1
5 Years	72.8 ± 3.2	1.2 ± 0.4	8.9 ± 1.1



Graph 1- pie chart representing the implant survival rate, showing the proportion of successful versus failed implants.



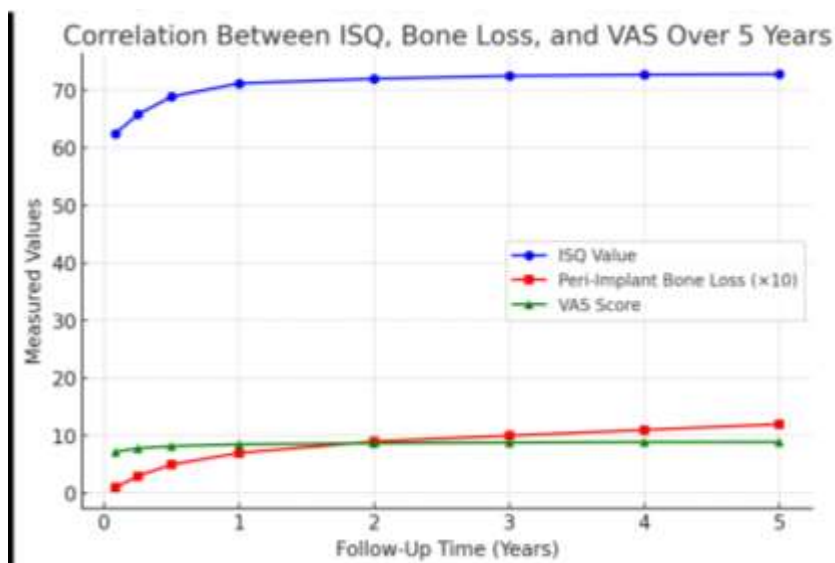
Graph2- box plot illustrating the distribution of peri-implant bone loss across the 28 samples.



Graph 3- line graph showing the stability trends (ISQ values) over 5 years.



Graph 4- histogram representing the distribution of patient satisfaction scores (VAS) across the 28 samples.



Graph5-the correlation graph showing the trends of ISQ values, peri-implant bone loss (scaled $\times 10$ for better visualization), and patient satisfaction (VAS scores) over the five-year follow-up period. The ISQ values show a gradual increase, indicating improving stability, while bone loss progresses at a slow rate. Patient satisfaction (VAS scores) remains consistently high throughout the follow-up

Discussion

Dental implant failure remains a clinical challenge, often necessitating reimplantation in compromised sites.¹² Factors such as biomechanical overload, peri-implant infections, and inadequate bone integration contribute to early and late implant failures. While advancements in implant design, surface modifications, and guided surgical techniques have improved success rates, reimplantation in previously failed sites poses unique challenges due to altered bone quality, residual inflammation, and compromised healing potential.¹³ Understanding the long-term performance of implants in such cases is crucial for developing evidence-based treatment protocols. This study provides insights into the survival, stability, and patient satisfaction of implants placed in sites with prior failure, contributing to the growing body of research on implant rehabilitation in compromised conditions. The findings indicate that implant placement in previously failed sites is a viable option, with a survival rate comparable to first-time implantations. Key factors affecting survival include the timing of reimplantation, bone quality, and adherence to proper surgical protocols. Although implant failure was observed in a small subset, most failures occurred within the first two years, indicating the importance of early monitoring. Peri-implant bone loss remained within acceptable limits, supporting the long-term viability of these implants.¹⁴

The present study evaluated the long-term outcomes of dental implants placed in sites of previous implant failure, revealing an overall survival rate of 85.7% over a five-year follow-up period. This finding aligns with a systematic review reporting a weighted mean survival rate of 86.3% for implants reinserted into previously failed sites.¹⁵ However, other studies have documented lower survival rates; for instance, a study reported a 71% survival rate in similar contexts.¹⁶ The variability in survival rates may be attributed to factors such as patient selection, surgical techniques, and the quality of the peri-implant bone. Peri-implant bone loss in this cohort averaged 1.2 ± 0.4 mm over five years, which is notably less than the 1.5 to 2 mm bone loss often observed in the first year post-restoration.¹⁷ This reduced bone loss may be indicative of effective surgical protocols and postoperative maintenance in the studied population.

Implant stability, assessed via Implant Stability Quotient (ISQ) measurements, demonstrated a progressive increase from an initial mean of 62.5 ± 4.1 at one month to 72.8 ± 3.2 at five years. This trend suggests successful osseointegration and stabilization over time. The positive correlation between increasing ISQ values and implant success has been documented in previous research.¹⁸ Patient satisfaction, measured using the Visual Analog Scale (VAS), showed a steady improvement from 7.2 ± 1.0 at one month to 8.9 ± 1.1 at five years. This enhancement in satisfaction likely reflects the functional and esthetic success of the implants, contributing to overall patient well-being. In summary, the findings of this study are consistent with existing literature, underscoring the viability of reimplantation in sites of previous implant failure. The observed outcomes highlight the importance of meticulous patient selection, precise surgical execution, and diligent postoperative care in achieving favorable long-term results.

Conclusion

Reimplantation in previously failed sites demonstrates a promising survival rate when proper case selection and surgical protocols are followed. This study demonstrated a high implant survival rate of 85.7% over five years, confirming the feasibility of reimplantation in previously failed sites. Progressive improvements in implant stability, as indicated by rising ISQ values, suggest successful long-term osseointegration. Peri-implant bone loss remained within acceptable clinical limits (1.2 ± 0.4 mm), indicating controlled bone remodeling, while patient satisfaction scores steadily increased, reflecting enhanced functional and esthetic outcomes. These findings align with existing literature, emphasizing the importance of appropriate case selection, surgical protocols, and post-operative care in ensuring implant success. Clinically, this study supports reimplantation as a predictable option, provided comprehensive evaluation, precise surgical techniques, and long-term follow-up are maintained. Further studies with larger sample sizes and extended follow-up periods are recommended to validate these findings.

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