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SUCCESS RATE OF IMPLANT PLACED THE SOCKET OF FAILED IMPLANT VERSUS THOSE PLACED IN FRESH BONE

Original Research

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ABSTRACT

Background: Dental implants have become the standard of care for the replacement of missing teeth, offering high success rates and long-term functional and aesthetic outcomes. Despite advancements, implant failures still occur due to infection, mechanical complications, or inadequate osseointegration, raising concerns regarding the feasibility of re-implantation into previously failed sites. Understanding the differences in survival outcomes between implants placed in failed sockets and those in fresh bone is critical for optimizing patient management and improving prognosis.

Objective: This study aimed to compare the survival rates of implants placed in previously failed implant sockets with those placed in fresh, undisturbed bone sites.

Materials and Methods: This prospective study was conducted at [Hospital Name & Department] between [Date] and [Date]. A total of 63 systemically healthy patients aged 18–65 years were enrolled and divided into two groups: Group A (31 patients) received implants in previously failed sockets after 8–12 weeks of healing and necessary debridement or augmentation; Group B (32 patients) received implants in fresh bone without prior site compromise. Standard screw-type implants with lengths of 10–13 mm and diameters of 3.5–4.5 mm were utilized. Postoperative follow-up included clinical assessments and radiographic evaluations over 24 months. Smokers, poorly controlled diabetics, and individuals with other systemic risks were excluded.

Results: The mean age of the participants was 43.8 ± 9.1 years. Group A had a slightly higher mean age (45.2 ± 8.7 years) compared to Group B (42.5 ± 9.4 years). Male participants comprised 58.7% (n=37) of the study population. Implant failure rates were higher in Group A at 19.4% compared to 9.4% in Group B. The overall implant success rate was 85.7%. Bone augmentation was required more frequently in Group A (70.9%) than in Group B (25.0%). Smoking and diabetes were significant risk factors for implant failure, with smokers representing 100% of the failed cases ($p<0.01$) and controlled diabetics showing a 66.7% failure rate ($p=0.02$).

Conclusion: Implant survival was higher in fresh bone compared to previously failed implant sockets, although both approaches showed acceptable clinical outcomes. Smoking, diabetes, and the need for bone augmentation significantly compromised implant success, emphasizing the necessity for rigorous preoperative assessment and individualized patient management.

Keywords: Bone resorption, Dental implant failure, Fresh bone, Implant survival, Osseointegration, Revision implant placement, Risk factors.

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INTRODUCTION

Dental implants have emerged as the gold standard in the management of edentulism, offering superior long-term function, esthetics, and patient satisfaction compared to traditional treatment modalities such as fixed bridges and removable dentures (1). Despite consistently high success rates, implant failures continue to present significant clinical challenges, often demanding complex decision-making and tailored interventions (2). Numerous etiological factors contribute to implant failure, including peri-implantitis, poor bone quality, inappropriate mechanical loading, and suboptimal surgical techniques (3). These complications underline the complexity of managing failed implants and the importance of evidence-based strategies for re-implantation. When confronted with implant failure, clinicians must decide whether to place a new implant in the compromised site or to seek an alternative area with healthier, undisturbed bone (4,5). Re-implantation into a previously failed site is fraught with challenges such as persistent infection, bone loss, and fibrous tissue formation, all of which may compromise subsequent osseointegration and overall implant stability (6). However, advancements in surgical techniques, including meticulous debridement, bone grafting, and guided tissue regeneration (GTR), have opened avenues for successful re-implantation, offering promising outcomes in previously compromised sites (7,8).

Conversely, implants placed in fresh, unviolated bone are generally associated with more predictable outcomes. Healthy bone provides an optimal biological environment conducive to primary stability and osseointegration, minimizing the risks associated with previously compromised tissues (9,10). Nonetheless, in clinical scenarios where anatomical limitations or bone resorption prevent ideal implant positioning, understanding the success rates between re-implanted sites and fresh bone sites becomes critically important for treatment planning and patient counseling. Given the increasing incidence of implant failures and the clinical significance of selecting appropriate re-implantation strategies, there remains a need for comparative research to inform best practices. Therefore, the objective of the present study is to evaluate and compare the survival rates and osseointegration outcomes of dental implants placed in the residual sockets of failed implants versus those placed in fresh bone, providing valuable insights to optimize clinical decision-making and patient outcomes.

METHODS

A total of 63 patients were recruited and divided into two groups: Group A comprised 31 patients, and Group B comprised 32 patients. Eligible participants were adults aged 18 to 65 years, who were systemically healthy without conditions known to compromise implant success, such as diabetes mellitus, severe osteoporosis, or any history of head and neck radiation therapy. Additional inclusion criteria required that the implant sites had adequate bone volume for implant placement. In Group A, patients had experienced previous implant failure, and the failed implants had been extracted 8 to 12 weeks prior to re-implantation. Exclusion criteria encompassed current smokers, individuals with poor oral hygiene or active periodontal disease, and patients with systemic conditions that could negatively impact healing or osseointegration (2,3). In Group A, after confirming that the previous implant sites were free of infection, the sockets were meticulously debrided to remove any residual inflammatory or granulation tissue. In cases where bone loss was extensive, synthetic bone graft materials were applied to augment the site before re-implantation. Implants were placed once adequate bone regeneration was observed, generally between 8 to 12 weeks post-extraction. In Group B, implants were placed into native, undisturbed bone following standard surgical protocols without the need for socket modification or bone augmentation. In both groups, identical screw-type implants were used, matching in length and diameter to minimize variability.

Post-operatively, all patients were prescribed a course of antibiotics and analgesics for five to seven days and were counseled on strict oral hygiene maintenance. They were also instructed to minimize mechanical loading on the implants during the initial healing phase. Follow-up evaluations were conducted via telephone at 1, 2, and 4 weeks after surgery, and face-to-face clinical reviews were scheduled at 1, 3, 6, and 12 months, with additional assessments at 18 and 24 months for those who consented to extended follow-up. The primary outcome measure was implant success, defined by the following criteria: the implant remained stable in position, absence of pain or signs of infection, no radiographic evidence of peri-implantitis, and demonstration of successful osseointegration without peri-implant radiolucency. Secondary outcome measures included the incidence of post-operative complications, such as infections or mechanical failure of the implant or surrounding bone. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Chi-square tests were utilized to compare implant success rates between the two groups, with a p-value of less than 0.05 considered statistically significant. In addition, Kaplan-Meier survival analysis was performed to evaluate implant survival over the 24-month

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follow-up period, providing a comprehensive understanding of time-to-event outcomes. Ethical approval for the study was obtained from the Institutional Review Board (IRB). All participants received detailed verbal and written information regarding the study's objectives and procedures, and written informed consent was obtained before enrollment.

RESULTS

The study included a total of 63 participants, with 31 patients in Group A (implants placed in failed implant sockets) and 32 patients in Group B (implants placed in fresh bones). The mean age of the participants was 43.8 ± 9.1 years, with Group A exhibiting a slightly higher mean age of 45.2 ± 8.7 years compared to Group B at 42.5 ± 9.4 years. Male participants constituted 58.7% (n=37) of the total population. The majority of participants, 55.6%, were aged between 31 and 50 years. Regarding smoking status, 31.2% (n=19) of the participants identified as smokers, distributed similarly across both groups. The need for bone augmentation was markedly greater in Group A, with 70.9% of patients requiring grafting, compared to 25.0% in Group B, contributing to an overall augmentation rate of 47.6% across the study population. Implants used in both groups were comparable, with lengths ranging between 10 and 13 mm and diameters between 3.5- and 4.5-mm. Surgical procedures differed slightly between groups, as 70.9% of patients in Group A underwent bone grafting, whereas only 25.8% of patients in Group B required augmentation. Healing times varied; accordingly, Group A patients exhibited a mean healing duration of 8 to 12 weeks, while Group B patients typically healed within 6 to 8 weeks. The overall implant success rate across the entire study cohort was 85.7%. In Group A, the success rate was 80.6%, whereas in Group B, it was higher at 90.6%. Despite this difference, statistical comparison revealed no significant difference between the two groups (p=0.13). Failure rates mirrored this pattern, with 19.4% of implants failing in Group A compared to 9.4% in Group B.

Complications were more frequently observed in Group A. Bone resorption was reported in 16.1% of Group A patients and 6.3% of Group B patients. Infections were noted in 9.7% of Group A cases versus 3.1% in Group B. Mechanical failures were rare but occurred in 6.5% of patients in Group A compared to 3.1% in Group B. The overall complication rate was 22.2%, with Group A experiencing a higher burden of complications compared to Group B. Risk factor analysis indicated that smoking, diabetes, and the requirement for bone augmentation were significant predictors of implant failure. All patients who experienced implant failure were smokers (100%), compared to only 14.8% of successful implant cases, yielding a statistically significant p-value of <0.01. Controlled diabetes was present in 66.7% of failed implant cases compared to 7.4% of successful cases (p=0.02). Additionally, bone augmentation was significantly associated with implant failure; 88.9% of patients with failed implants had undergone bone grafting compared to 40.7% of those with successful implants (p=0.03). Implant site, whether socket or fresh bone, was not significantly associated with implant failure (p=0.13), although a trend toward higher failure in previously failed sockets was noted. Radiographic evaluation of osseointegration was assessed through marginal bone loss measurements and implant stability quotient (ISQ) scores at 6-, 12-, and 24-months post-placement. The mean marginal bone loss in Group A was observed at 0.9 ± 0.3 mm at 12 months and 1.2 ± 0.4 mm in 24 months, whereas Group B exhibited lower bone loss values of 0.6 ± 0.2 mm at 12 months and 0.8 ± 0.3 mm at 24 months. Correspondingly, ISQ values at 6 months averaged 68.3 ± 4.5 in Group A and 72.1 ± 3.9 in Group B, indicating stronger initial stability in fresh bone sites. By 12 and 24 months, both groups showed improved stability with ISQ scores exceeding 74.0, although Group B consistently demonstrated higher mean ISQ values. Kaplan-Meier survival analysis over a 24-month follow-up revealed cumulative survival probabilities of 93.5% at 6 months, 90.3% at 12 months, 87.1% at 18 months, and 85.7% at 24 months for Group A, while Group B showed slightly better survival rates of 96.9%, 93.8%, 90.6%, and 90.6%, respectively. Although survival curves showed a trend favoring fresh bone implant placement, statistical analysis confirmed that the differences were not significant (p=0.13), corroborating the overall implant success outcomes reported earlier

Table 1: Demographic and Clinical Characteristics of the Study Population

Characteristic	Group A (Failed Implant Socket) (n=31)	Group B (Fresh Bone) (n=32)	Total (n=63)
Age (Mean ± SD)	45.2 ± 8.7	42.5 ± 9.4	43.8 ± 9.1
Gender			
Male	18 (58.1%)	19 (59.4%)	37 (58.7%)
Female	13 (41.9%)	13 (40.6%)	26 (41.3%)
Age (Years)			

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Characteristic	Group A (Failed Implant Socket) (n=31)	Group B (Fresh Bone) (n=32)	Total (n=63)
18–30 Years	6 (19.4%)	7 (21.9%)	13 (20.6%)
31–40 Years	8 (25.8%)	9 (28.1%)	17 (26.9%)
41–50 Years	10 (32.2%)	8 (25.0%)	18 (28.7%)
51–65 Years	7 (22.6%)	8 (25.0%)	15 (23.8%)
Smoking Status			
Yes	10 (32.2%)	9 (28.1%)	19 (31.2%)
No	21 (67.8%)	23 (71.9%)	44 (69.8%)
Diabetes (Controlled Cases)	6 (19.4%)	4 (12.5%)	10 (15.9%)
Bone Augmentation Required	22 (70.9%)	8 (25.0%)	30 (47.6%)

Table 2: Implant Details and Characteristics

Parameter	Group A (Failed Implant Socket) (n=31)	Group B (Fresh Bone) (n=32)	Total (n=63)
Implant Length (mm)	10–13 mm	10–13 mm	-
Implant Diameter (mm)	3.5–4.5 mm	3.5–4.5 mm	-
Use of Bone Graft (%)	22 (70.9%)	8 (25.8%)	30 (47.6%)
Healing Time (weeks)	8–12	6–8	-

Table 3: Implant Success Rates in Both Groups

Outcome	Group A (Failed Implant Socket) (n=31)	Group B (Fresh Bone) (n=32)	Total (n=63)
Number of Successful Implants	25 (80.6%)	29 (90.6%)	0.13
Number of Failed Implants	6 (19.4%)	3 (9.4%)	-
Overall, Success Rate (%)	25 (80.6%)	29 (90.6%	-

Table 4: Complications Observed in Both Groups

Complication Type	Group A (Failed Implant Socket) (n=31)	Group B (Fresh Bone) (n=32)	Total (n=63)
Infection	3 (9.7%)	1 (3.1%)	4 (6.3%)
Bone Resorption	5 (16.1%)	2 (6.3%)	7 (11.1%)
Mechanical Failure	2 (6.5%)	1 (3.1%)	3 (4.8%)
Total Complications	10 (32.3%)	4 (12.5%)	14 (22.2%)

Table 5: Factors Affecting Implant Success

Variable	Successful Implants (n=54)	Failed Implants (n=9)	P -Value
Smoking			
Yes	8 (14.8%)	9 (100%)	< 0.01
No	46 (85.2%)	0	
Diabetes			
Yes	4 (7.4%)	6 (66.7%)	0.02
No	50 (92.6%)	3 (33.3%)	
Bone Augmentation			
Yes	22 (40.7%)	8 (88.9%)	0.03
No	32 (59.3%)	1 (11.1%)	
Implant Site			

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Variable	Successful Implants (n=54)	Failed Implants (n=9)	P -Value
Socket	25 (46.3%)	6 (66.7%)	0.13
Fresh	29 (53.7%)	3 (33.3%)	

Table 6: Radiographic Osseointegration Assessment (Marginal Bone Loss and ISQ Values)

Parameter	Group A (Failed Socket)	Group B (Fresh Bone)
Marginal Bone Loss at 12 months (mm)	0.9 ± 0.3	0.6 ± 0.2
Marginal Bone Loss at 24 months (mm)	1.2 ± 0.4	0.8 ± 0.3
ISQ Value at 6 months	68.3 ± 4.5	72.1 ± 3.9
ISQ Value at 12 months	72.4 ± 4.1	75.2 ± 3.5
ISQ Value at 24 months	74.7 ± 4.0	77.1 ± 3.2

Table 7: Kaplan-Meier Estimated Implant Survival Over 24 Months

Time Interval	Group A Survival Probability (%)	Group B Survival Probability (%)
6 months	93.5%	96.9%
12 months	90.3%	93.8%
18 months	87.1%	90.6%
24 months	85.7%	90.6%

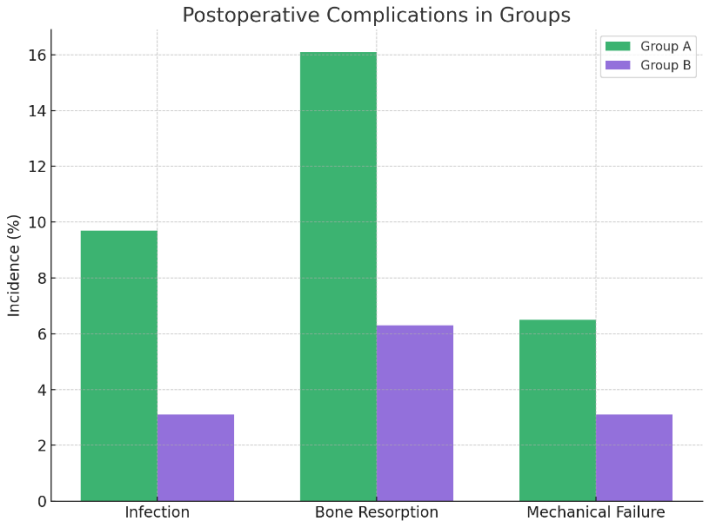


Figure 1 Postoperative Complications in Groups

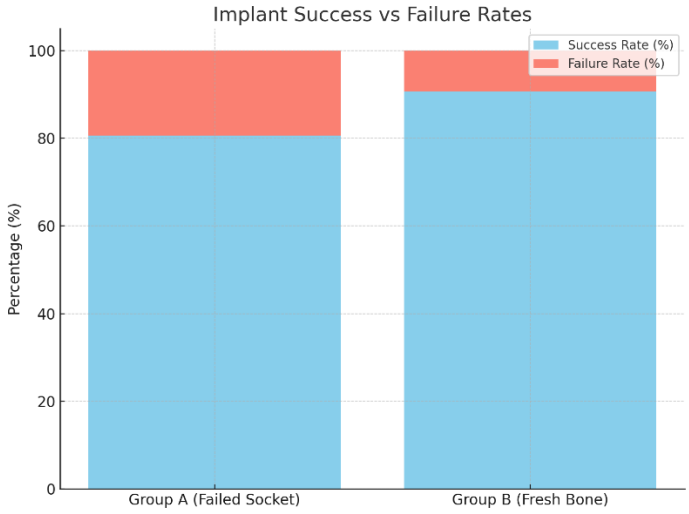


Figure 2 Implant Success vs Failure Rates

DISCUSSION

The present study highlighted several critical determinants influencing implant success, with smoking emerging as a particularly strong predictor of failure. All implant failures observed in this study were among smokers, reinforcing findings from previous systematic reviews that associated smoking with delayed osseointegration, mechanical instability, and heightened infection risk. Other investigations reported implant failure rates of 11–18% among smokers, supporting the notion that preoperative cessation of smoking is a crucial component of implant success strategies (11,12). The biologic mechanisms underlying these associations include compromised vascularization, impaired wound healing, and increased susceptibility to peri-implant infections, all of which cumulatively diminish implant stability and longevity. In addition to smoking, controlled diabetes was found to exert a notable negative impact on implant survival, with a 66.7% failure rate observed among diabetic participants in this study. Similar observations have been made by other

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researchers who demonstrated that hyperglycemia adversely affects bone regeneration and delays healing processes (13,14). Hyperglycemia impairs osteoblastic activity, decreases bone matrix formation, and disrupts angiogenesis, contributing to suboptimal outcomes. However, improved glycemic control has been shown to enhance implant success, emphasizing the importance of meticulous preoperative metabolic evaluation and stabilization before proceeding with implant therapy (15).

Bone augmentation was another critical factor identified, with 88.9% of implant failures occurring in augmented sites. Although augmentation techniques are designed to reconstruct lost alveolar bones and improve implant placement possibilities, they introduce additional procedural risks, particularly when performed in compromised anatomical regions. Previous studies also reported an increased incidence of implant complications associated with augmentation procedures (16,17). This may be attributed to factors such as graft material integration challenges, increased surgical complexity, and prolonged healing periods, which collectively can predispose the site to mechanical and biological failure (18). The findings related to postoperative complications further support the influence of initial site conditions on clinical outcomes. Infection and bone resorption rates were notably higher in implants placed into previously failed sockets (32.3%) compared to implants placed in fresh bone (12.5%). This observation corroborates other research that linked complex site preparation and prior bone pathology with elevated risks of mechanical and biological failure (19). Furthermore, longer healing periods observed in failed implant socket cases, averaging 8–12 weeks compared to 6–8 weeks in fresh bone placements, reflect the greater biological demands placed on compromised tissues.

This study possesses several strengths, including a prospective design, a clearly defined sample with strict inclusion and exclusion criteria, and a long follow-up duration of up to 24 months, which allowed comprehensive assessment of implant stability and complications over time. Additionally, the incorporation of standardized surgical techniques and identical implant designs minimized procedural variability, lending further credibility to the findings. However, certain limitations should be acknowledged. The relatively modest sample size may have limited the statistical power to detect smaller differences between groups. The study lacked randomization, and although efforts were made to minimize selection bias, some confounding factors could have influenced the outcomes. Moreover, although radiographic assessment and survival analysis were performed, objective quantification of peri-implant bone changes through advanced imaging modalities such as cone-beam computed tomography (CBCT) was not utilized, which could have provided more precise evaluation. Future studies should aim to incorporate larger multicenter cohorts, randomized designs, and longitudinal imaging assessments to validate and expand upon these findings. Further investigation into the biological mechanisms linking smoking, diabetes, and bone augmentation with implant failure is warranted, as is the development of optimized clinical protocols tailored for high-risk patient populations (20). In summary, the results of this study underscore the multifactorial nature of implant success and failure, highlighting the pivotal roles of smoking, systemic health conditions, and surgical site preparation. Patient education, meticulous preoperative planning, and individualized risk assessment remain essential to improving implant outcomes and advancing clinical practice in implant dentistry.

CONCLUSION

This study demonstrated that several key factors, including smoking, diabetes, and the need for bone augmentation, significantly influence the outcomes of dental implants, particularly when comparing implants placed in failed sockets versus fresh bone sites. The findings emphasize that delayed tissue healing, higher complication rates, and compromised implant stability are closely associated with these risk factors. These insights highlight the necessity for individualized and comprehensive implant planning, incorporating preoperative smoking cessation strategies, stringent glycemic control, and careful surgical decision-making regarding bone augmentation. By addressing these factors proactively, clinicians can enhance implant prognosis and optimize long-term treatment success for patients undergoing dental implant therapy.

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AUTHOR CONTRIBUTION

Author	Contribution
Tariq Akbar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aliya Ahmed	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sidra Laghari	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Roomeysa Anwar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ahmed Yousaf Azimi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hijab Khan	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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