

Original Research Article

Descriptive retrospective study on dental implant failure by analyzing various factors: a 15-year study

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ABSTRACT

Background: Dental implant failure remains a significant clinical challenge despite advances in implantology. Understanding the underlying causes and contributing factors is crucial for improving implant success and patient outcomes.

Methods: This descriptive retrospective study was conducted over 15 years from January 2010 to December 2024 at two specialized dental centers in Dhaka, Bangladesh Banasree Dental and Implant Center and German Dental and Implant Center. Clinical records of 261 patients, aged 20-90 years, who received a total of 510 implants were reviewed. Data were collected from clinical files, radiographs and follow-up records to evaluate implant characteristics, duration of survival and causes of failure.

Results: Of the 261 patients, 158 (61%) were male and 103 (39%) were female, with a male-to-female ratio of 1.5:1. Most patients were middle-aged or older. A total of 285 implants (55.9%) were placed in the maxilla and 225 (44.1%) in the mandible. The majority (95.49%) received initial treatment at other clinics. Implant survival duration ranged from 6 months to 3 years. The primary causes of implant failure were infection (peri-implantitis) in 40.2%, improper placement in 25.3%, insufficient bone density in 17.2%, mechanical issues in 10.3%, systemic health issues in 5.7% and excessive stress in 1.1%. Failures were more frequent in the maxilla (58.2%) and occurred predominantly within the first year (41.4%).

Conclusions: Infection and improper implant placement were the leading causes of dental implant failure, with higher risk observed in maxillary implants and early post-implantation periods. Rigorous surgical planning and follow-up are essential for minimizing failures.

Keywords: Bone loss, Complication, Dental implant failure, Implant design, Inadequate planning, Peri-implantitis, Success, Surgical technique, Survival

INTRODUCTION

Dental implants have revolutionized restorative dentistry, offering a predictable solution for replacing missing teeth and restoring oral function, aesthetics and patient confidence.¹ Since their introduction, implants have become the standard of care for many edentulous patients

due to their high success rates and long-term stability.² The success of dental implants, however, depends on multiple biological, mechanical, procedural and patient-related factors that collectively influence osseointegration and functional longevity.³ Despite advances in surgical techniques, implant materials and prosthetic designs, implant failure remains a significant clinical challenge and a concern for both patients and dental professionals.

Dental implant failure can be broadly categorized into early failure, occurring before functional loading and late failure, occurring after the implant has been loaded. Early failures are often associated with poor bone quality, inadequate primary stability, infection, or surgical errors, whereas late failures may result from peri-implantitis, mechanical overloading, prosthetic complications, or systemic health issues.^{4,5} Peri-implantitis, a bacterial inflammatory condition affecting the soft and hard tissues surrounding an implant, is among the leading causes of late implant failure and has clinical manifestations such as bone loss, soft tissue inflammation and implant mobility.⁶ Other contributory factors include insufficient bone density, improper implant placement, occlusal overload, smoking and pre-existing systemic conditions such as diabetes or osteoporosis.

Over the last few decades, studies have reported varying rates of implant failure, with differences attributed to patient selection, implant systems, surgical protocols and follow-up duration.⁷ Long-term retrospective analyses are particularly valuable in identifying patterns, risk factors and outcomes that may not be apparent in short-term studies or controlled trials. Such studies can provide insights into the real-world performance of dental implants, especially in settings where patients may receive treatment from multiple sources or present with complications post-treatment.⁸

Bangladesh, with its increasing demand for implant-based rehabilitation, has witnessed a rise in the number of patients seeking implant treatment. Many patients initially receive implants in smaller clinics or by less experienced practitioners and are later referred to specialized centers after experiencing complications. Understanding the factors contributing to implant failure in this population is essential for improving clinical protocols, patient counseling and preventive strategies.^{9,10} Despite the growing prevalence of dental implants, there is limited long-term, multicenter data from Bangladesh analyzing implant failures and associated risk factors.

This study, therefore, aimed to conduct a descriptive retrospective analysis over 15 years at two specialized dental centers in Dhaka, Bangladesh, to evaluate the prevalence, causes and patterns of dental implant failure. By analyzing a cohort of 261 patients with 510 implants, the study sought to identify key biological, mechanical, procedural and patient-related factors contributing to failure, thereby providing valuable insights to guide clinical decision-making, improve success rates and optimize long-term outcomes in implant dentistry.

METHODS

This descriptive retrospective study was conducted at two specialized dental centers, Banasree Dental and Implant Center and German Dental and Implant Center, Dhaka, Bangladesh over a 15-year period from January 2010 to December 2024. The study evaluated dental implant

failures by analyzing clinical records of 261 patients who collectively received 510 implants. The patients were healthy individuals aged between 20 and 90 years. Data were collected from clinical files, radiographs and follow-up records to identify the causes and contributing factors associated with implant failure. The duration of implant survival ranged from 6 months to 3 years.

Inclusion criteria

The inclusion criteria were patients who had undergone dental implant placement and subsequently reported with implant-related complications such as infection, loosening, mechanical issues, or failure of osseointegration. Only those with complete clinical and radiographic data were included in the analysis.

Exclusion criteria

The exclusion criteria were patients with incomplete records, missing follow-up data, or implants that were still under active evaluation during the study period. Patients who received implant-supported prostheses without evidence of complications were also excluded.

Each patient's data was analyzed to determine demographic characteristics, implant site, duration of survival and specific causes of failure. Failure of implants was defined as loss of stability, persistent pain, peri-implant infection, or radiographic evidence of bone loss around the implant. The most common causes of implant failure identified included infection (peri-implantitis), improper placement, insufficient bone density, mechanical complications, systemic health issues and excessive stress on the implant.

Statistical analysis

All collected data were coded and entered into a computer for statistical analysis. Descriptive statistics including frequency and percentage distributions were calculated to present the pattern of implant failures and associated factors. Statistical analysis was performed using IBM SPSS Statistics version 25 (SPSS Inc., Chicago, IL, USA). The results were presented in tabular form for better visualization and interpretation. All patient data were handled confidentially.

RESULTS

Figure 1 illustrates the sex distribution of the 261 patients included in this 15-year retrospective study on dental implant failure. Out of the total study population, 158 patients (61%) were male and 103 patients (39%) were female, reflecting a male-to-female ratio of approximately 1.5:1.

Figure 2 presents the age distribution of the 261 patients included in this study. The majority of patients were between 40 and 79 years of age, with 93 patients (35.6%)

in the 40-59 years group and 96 patients (36.8%) in the 60-79 years group. The younger age group of 20-39 years accounted for 42 patients (16.1%), while 30 patients (11.5%) were aged 80 years or older.

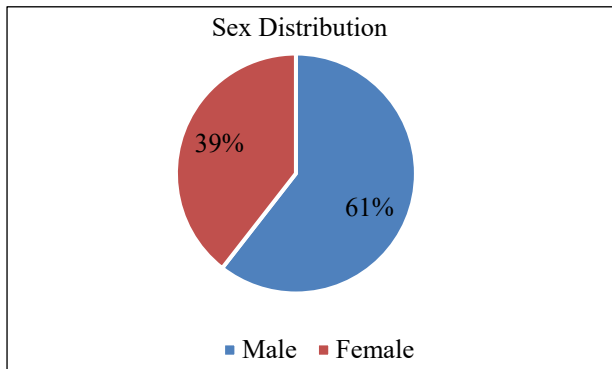


Figure 1: Sex distribution of study population (n=261).

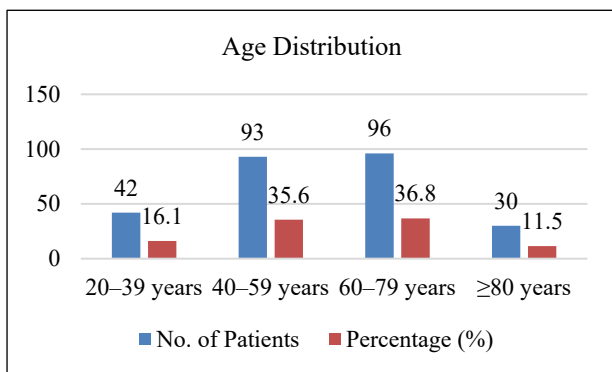


Figure 2: Age Distribution of study population (n=261).

Table 1: Implant characteristics (n=510).

Variables	Category	No. of implants	Percentage (%)
Implant site	Maxilla	285	55.9
	Mandible	225	44.1
Duration of survival	6-12 months	120	23.5
	1-2 years	228	44.7
	2-3 years	162	31.8
Origin of treatment	Received in other clinics	487	95.49
	Implanted at study centers	23	4.51
Total		510	100

Table 1 summarizes the characteristics of the 510 dental implants included in this study. Regarding the implant site, 285 implants (55.9%) were placed in the maxilla, while 225 implants (44.1%) were placed in the mandible, indicating a slightly higher prevalence of maxillary implants. The duration of implant survival varied, with 120 implants (23.5%) surviving 6-12 months, 228 implants

(44.7%) surviving 1-2 years and 162 implants (31.8%) surviving 2-3 years. This shows that most implants survived between 1 and 2 years before presenting with complications. In terms of the origin of treatment, the majority of implants, 487 (95.49%), were initially placed in other clinics and later referred to the study centers due to complications, whereas 23 implants (4.51%) were placed directly at the Banasree and German Dental and Implant Centers.

Table 2: Distribution of implant failures according to primary causes (n=261).

Cause of implant failure	No. of patients	Percentage (%)
Infection (peri-implantitis)	105	40.2
Improper placement	66	25.3
Insufficient bone density	45	17.2
Mechanical issues	27	10.3
Systemic health issues	15	5.7
Excessive stress on implant	3	1.1
Total	261	100

Table 2 presents the distribution of dental implant failures among the 261 patients in this study. Infection (peri-implantitis) was the most common cause, affecting 105 patients (40.2%), followed by improper implant placement in 66 patients (25.3%). Insufficient bone density contributed to 45 failures (17.2%), while mechanical issues were responsible for 27 cases (10.3%). Systemic health issues, such as diabetes or osteoporosis, accounted for 15 failures (5.7%) and excessive stress on the implant was the least common cause, observed in only 3 patients (1.1%).

Table 3: Implant failure related to implant site and duration of survival (n=261).

Parameter	Category	No. of failure cases	Percentage (%)
Implant site	Maxilla	152	58.2
	Mandible	109	41.8
Duration of survival	6-12 months	108	41.4
	1-2 years	93	35.6
	2-3 years	60	23
Total failed implants		261	100

Table 3 illustrates the relationship between implant failure, implant site and duration of survival among the 261 cases evaluated in this study. Regarding the implant site, 152 failed cases (58.2%) were located in the maxilla, whereas 109 failed cases (41.8%) were in the mandible, indicating a slightly higher failure rate in the upper jaw. When considering the duration of survival, 108 cases (41.4%) failed within 6-12 months, 93 cases (35.6%) failed between 1-2 years and 60 cases (23.0%) failed after 2-3 years of placement. These findings suggest that most case

failures occurred within the first two years, emphasizing the critical importance of early monitoring and follow-up. Overall, 261 cases (100%) failed, highlighting the cumulative impact of biological, mechanical, procedural and patient-related factors on long-term implant success.

DISCUSSION

The present 15-year descriptive retrospective study evaluated 261 patients with 510 dental implants treated at two specialized implant centers in Dhaka, Bangladesh, aiming to identify and analyze the factors associated with dental implant failure. The overall findings demonstrated that infection (peri-implantitis) was the predominant cause of failure (40.2%), followed by improper placement (25.3%), insufficient bone density (17.2%) and mechanical complications (10.3%). Furthermore, maxillary implants (58.2%) showed a higher failure rate than mandibular implants (41.8%) and most failures occurred within the first year after placement (41.4%), suggesting that early failures remain a major clinical challenge.

Our findings are consistent with previous studies emphasizing biological and procedural factors as leading contributors to implant failure. Olmedo-Gaya et al, reported infection and surgical inaccuracies as key determinants of early implant loss, aligning closely with our observation that peri-implantitis and improper placement accounted for nearly two-thirds of the failures.¹¹ Similarly, Thiebot et al and Mayta-Tovalino et al, highlighted the significant impact of microbial contamination and inadequate bone support on implant stability, reinforcing that effective infection control and preoperative bone assessment are essential for implant success.^{12,13}

The higher failure rate in the maxilla (58.2%) observed in our study corresponds with the results of Wittneben et al and De Angelis et al, who noted reduced bone density in the maxilla as a primary reason for lower implant survival compared to the mandible.^{14,15} Moreover, Anitua et al, demonstrated that short implants in the posterior maxilla are particularly vulnerable to early biomechanical overload, which may explain our relatively high early failure rate (41.4% within 12 months).¹⁶

Mechanical issues accounted for 10.3% of failures in our sample, which supports the findings of Chrcanovic et al, who identified overloading and implant fracture as major mechanical causes of failure, particularly when occlusal forces exceed physiological limits.¹⁷ Our study also observed that systemic conditions, including diabetes and autoimmune diseases, contributed to 5.7% of failures, aligning with the results of Cheng et al and Chappuis et al, who reported that metabolic and medication-related alterations can compromise osseointegration and healing capacity.^{18,19}

Interestingly, most failures occurred within the first two years of implantation, consistent with Lin et al and Malm et al, who demonstrated that early implant failures are more frequent than late ones and are commonly associated with inadequate osseointegration, surgical trauma and infection.^{20,21} These findings reinforce the importance of close monitoring during the initial post-placement period, which is critical for early detection and intervention.

Our data further revealed that 79.3% of failed implants were originally placed in other clinics before referral to our centers, indicating that surgical experience, case planning and postoperative maintenance play a decisive role in implant outcomes. French et al, similarly reported that operator expertise, adherence to maintenance protocols and regular follow-ups significantly affect long-term implant success and bone stability.²²

Furthermore, the association between insufficient bone density (17.2%) and implant loss in our study echoes findings by Pommer et al, who emphasized that inadequate bone quality increases early failure risk, especially when combined with improper angulation or insufficient implant length.²³ Our results suggest that comprehensive preoperative imaging and bone grafting techniques may help mitigate this risk.

In line with Shahapur et al, our study underscores the predictive role of multifactorial interactions biological, mechanical and systemic in implant prognosis.²⁴ The incorporation of machine learning and predictive models, as suggested by Lyakhov et al, may enhance risk stratification and individualized treatment planning in future implantology research.²⁵

Overall, this study contributes to the understanding that infection control, precise surgical technique, adequate bone preparation and strict postoperative maintenance are pivotal in preventing implant failure. While early failures remain more prevalent, continuous advancements in surgical training, digital planning and patient education can substantially reduce these complications.

This study has few limitations. This study was retrospective in nature, relying on existing clinical records, which may have introduced documentation bias and limited the availability of detailed clinical variables. The sample was drawn from only two dental centers in Dhaka, which may reduce generalizability to the broader population. Additionally, variations in surgical technique, operator skill and follow-up duration could not be fully controlled, potentially influencing the observed implant failure rates.

CONCLUSION

In conclusion, the present study confirms that peri-implantitis, improper placement and poor bone quality are the predominant causes of implant failure in the Bangladeshi population, consistent with global evidence.

These findings emphasize the need for improved preventive protocols, clinician expertise and long-term maintenance to ensure better outcomes in dental implant therapy.

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