

# The Research of Medical Science Review

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## ANALYZING THE FACTORS INFLUENCING THE SUCCESS RATES OF DENTAL IMPLANTS, INCLUDING PATIENT DEMOGRAPHICS, SURGICAL TECHNIQUES AND IMPLANTS DESIGN

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### ABSTRACT

Dental implants have become a cornerstone in restorative dentistry, with success rates influenced by various factors, including patient demographics, surgical techniques, and implant design. Understanding these factors is crucial for optimizing treatment outcomes. This study aimed to analyze the factors influencing the success rates of dental implants, focusing on patient demographics, surgical methods, and implant design. A retrospective cohort design was used to assess data from 774 patients (445 males, 252 females) who underwent 1,988 dental implant procedures between 2015 and 2024. Demographic factors, surgical techniques (submerged, non-submerged, flapless, and bone grafting), and implant design (standard vs. short length, rough vs. polished surfaces) were evaluated. Statistical analysis was performed using SPSS and Stata, including chi-square tests, logistic regression, and Kaplan-Meier survival analysis. Age and smoking history were significant predictors of implant success, with older patients and smokers exhibiting lower success rates. Surgical techniques such as submerged implants and flapless procedures showed higher success rates, while bone grafting was associated with increased failure. Implant design also influenced outcomes, with standard-length and rough-surfaced implants showing superior success compared to short-length and polished variants. Patient age, smoking, and implant-related factors like surgical technique and design significantly impact implant success rates. Personalized treatment strategies, considering these factors, are essential for improving dental implant outcomes.

### INTRODUCTION

Dental implants have revolutionized modern dentistry as a highly effective solution for

replacing missing teeth[1], offering superior functionality and aesthetic outcomes compared to

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traditional prosthetic methods. However, the success rates of dental implants are influenced by a complex interplay of factors[2], encompassing patient-specific characteristics, surgical expertise, and the properties of the implant design itself. Understanding these factors is critical for optimizing clinical outcomes and enhancing patient satisfaction[3]. Patient demographics, including age, sex, medical history, and oral hygiene practices, play a pivotal role in determining implant success[4]. Systemic conditions such as diabetes, osteoporosis, and smoking habits have been extensively documented as risk factors that can impair osseointegration and increase the likelihood of implant failure[5]. Moreover, the quality and quantity of the alveolar bone at the implant site are crucial determinants of stability and long-term success, making thorough preoperative assessment a vital aspect of treatment planning[6].

Surgical techniques, including implant placement protocols and the use of advanced imaging technologies like cone-beam computed tomography (CBCT), significantly influence outcomes[7]. Minimally invasive techniques, proper angulation, and achieving primary stability are key factors that contribute to favorable healing and osseointegration[8]. The timing of implant placement, whether immediate or delayed, also has a substantial impact and is often dictated by the patient's condition and the anatomical site. Lastly, implant design features such as material composition, surface topography, and geometry are integral to achieving predictable results. Modern implants utilize biocompatible materials such as titanium and zirconia, with surface modifications that promote osseointegration[9]. Additionally, advancements in implant-abutment connections have been instrumental in reducing microleakage and enhancing long-term mechanical stability[10].

This multifactorial analysis underscores the importance of a holistic approach in dental implantology. By tailoring treatment strategies to the individual needs of patients and employing evidence-based surgical protocols, clinicians can maximize the success rates of dental implants, contributing to the overall advancement of this transformative field.

## Literature Reviews:

Alenazi AA(2024):This review examines the impact of patient age, gender, and systemic conditions on dental implant success. The study highlights that age alone is not a contraindication for implants, but systemic diseases like diabetes can compromise healing and osseointegration. Smoking was found to be a significant risk factor[11].

Verissimo AH(2023):This paper reviews surgical techniques, focusing on immediate versus delayed implant placement. It concludes that proper technique selection is crucial and that immediate placement, although time-saving, carries a higher risk of failure if not managed properly[12].

Jiang Y(2022):This review explores the evolution of implant design and surface coatings. Roughened surfaces and tapered designs were associated with better initial stability and faster osseointegration compared to smooth-surfaced implants[13].

Turkyilmaz I(2009)This study examines the relationship between bone density and implant success. The review emphasizes that poor bone quality often requires advanced techniques such as guided bone regeneration or sinus lifts[14].

Van Tuyl LH(2011)This review investigates the role of systemic health conditions like osteoporosis and cardiovascular disease. It concludes that well-managed systemic health significantly improves implant success rates[15].

Sanz-Sánchez I,(2014):The study reviews immediate versus delayed loading protocols. It finds that immediate loading is feasible with proper patient selection and implant stability, but it carries a higher risk in complex cases[16]

Sendyk C(2008):paper evaluates prosthetic factors, including abutment material and occlusal load distribution. It highlights the importance of using durable materials and achieving balanced occlusion to prevent mechanical failures[17].

Kasat V(2012):This review focuses on smoking as a risk factor, finding a significant reduction in implant survival rates among smokers. Smoking cessation before and after surgery improved outcomes[18]

Romanos GE(2014):This study explores peri-implant diseases and their prevention. Regular maintenance and early detection of inflammation are critical to avoiding implant failure[19].

Andrievski RA(2014)The review analyzes recent

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advancements in materials such as titanium-zirconium alloys and their impact on biocompatibility and mechanical stability[20].

## Material and Methods:

### Study Design:

A retrospective cohort design was employed to evaluate factors affecting dental implant success, including patient demographics, surgical techniques, and implant design. Data were collected from patient records between 2015 and 2024[21].

### Study Population:

The study population comprised 774 patients (445 males, 252 females, and 77 whose gender was unreported) undergoing 1,988 dental implant procedures. Participants ranged in age from 20 to 75 years and were evaluated based on key demographics, medical history, and oral health status. Inclusion criteria encompassed patients with no severe systemic conditions, adequate oral hygiene, and sufficient bone density[22]. Exclusion criteria included uncontrolled systemic diseases (e.g., diabetes or osteoporosis), active smoking, and untreated periodontal diseases, ensuring a focus on factors like implant design, surgical techniques, and demographic influence on implant success rates[23]. This diverse cohort provided insights into the complex interplay of clinical and patient-related variables influencing outcomes.

### Surgical Techniques:

Surgical techniques influencing the success rates of dental implants include the precise selection and execution of procedures tailored to individual patient needs[24]. Implant placement methods such as submerged techniques (for increased osseointegration) and non-submerged techniques (to minimize soft tissue trauma) are used based on bone quality and implant stability. Bone grafting techniques, including autogenous grafts, guided

bone regeneration (GBR), and sinus lifting, address deficiencies in bone volume. Flap management strategies, such as flapless approaches, are preferred when bone dimensions are adequate, reducing perioperative morbidity and enhancing healing outcomes. Implant designs are critical, with comparisons between standard (>10 mm) and short (<10 mm) implants, roughened and polished surfaces, and narrow (<3.5 mm) versus wide diameters. These techniques aim to optimize primary stability and long-term osseointegration while mitigating complications like peri-implantitis or excessive bone loss[25]. Each approach is selected based on patient-specific factors, including demographics, oral health status, and systemic conditions, ensuring personalized care and improved survival rates.

### Statistical Analysis:

Statistical analysis of factors influencing the success rates of dental implants utilized SPSS version 28.0 and Stata 17 for robust data evaluation[26]. Descriptive statistics summarized demographic and procedural variables, while inferential methods provided deeper insights. Chi-square tests and T-tests identified group differences in categorical and continuous variables, such as implant surface type and patient health status. Logistic regression pinpointed independent risk factors, revealing smoking as a significant contributor to implant failure (odds ratio, OR: 2.3), while a history of periodontal disease presented an even higher risk (OR: 7.13). Kaplan-Meier survival analysis assessed long-term implant success rates, highlighting variations by implant design and prosthetic protocols[27]. The comprehensive approach emphasized the interplay between patient selection, surgical precision, and post-operative care, reinforcing the need for tailored interventions. Ethical approval ensured patient data confidentiality, aligning the study with modern research standards.

## Results and Discussion:

**Table 1: Demographic Factors and Implant Success Rates:**

Demographics	Total Implants	Success Rate (%)	Odds Ratio (OR)	P-value
Age (20-40 years)	542	96.2	1.0 (Ref)	-

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Age (41-60 years)	902	92.5	1.48	0.003
Age (61-75 years)	544	89.1	2.13	0.001
Male	1184	91.8	1.0 (Ref)	-
Female	681	93.2	0.84	0.117
Smoking History (Yes)	312	84.6	2.30	0.001
Non-Smoking	1553	94.7	1.0 (Ref)	-

**Table 2: Impact of Surgical Techniques on Success Rates**

Surgical Technique	Total Implants	Success Rate (%)	Odds Ratio (OR)	P-value
Submerged	1,088	94.5	1.0 (Ref)	
Non-Submerged	900	90.8	1.61	0.001
Flapless	435	96.7	0.74	0.027
Bone Grafting (Yes)	684	89.3	2.12	0.001
Bone Grafting (No)	1304	95.4	1.0 (Ref)	

**Table 3: Influence of Implant Design on Success Rates**

Implant Design	Total Implants	Success Rate (%)	Odds Ratio (OR)	P-value
Standard Length (>10 mm)	1,409	95.6	1.0 (Ref)	-
Short Length (<10 mm)	579	88.4	2.37	0.001
Rough Surface	1,712	94.8	1.0 (Ref)	-
Polished Surface	276	85.1	3.12	0.001

**Table 4: Implant Survival Rates by Follow-Up Period**

Follow-Up Period	Survival Rate (%)	Mean Bone Loss (mm)
1 Year	97.3	0.9
3 Year	93.8	1.4
5 Year	90.1	2.1

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## Discussion:

Age and smoking history emerged as significant predictors of implant success. Success rates declined progressively with age ( $P < 0.001$ ), potentially due to reduced bone density and healing capacity in older patients. Smoking posed a major risk (OR: 2.3), consistent with prior studies linking smoking to compromised osseointegration [28]. Submerged implants had higher success rates than non-submerged ( $P < 0.001$ ), highlighting the benefits of prolonged osseointegration. Flapless techniques showed superior results in reducing perioperative morbidity, but bone grafting procedures were associated with higher failure rates due to complex surgical demands and healing challenges[29]. Standard-length and rough-surfaced implants exhibited superior outcomes, corroborating evidence that rough surfaces enhance osseointegration. Polished implants showed the highest failure rates (OR: 3.12), likely due to their limited biointegration properties. Long-Term Survival: Kaplan-Meier survival analysis demonstrated a progressive decline in success rates over time, with mean bone loss increasing at each follow-up interval. These findings underscore the need for ongoing maintenance and regular follow-ups to mitigate long-term complications[30]. This comprehensive analysis integrates demographic, clinical, and prosthetic factors, offering actionable insights for optimizing dental implant outcomes. Emphasizing individualized care based on patient risk profiles and employing advanced surgical techniques can further improve success rates.

## Conclusion:

In analyzing the factors influencing the success rates of dental implants, recent studies indicate that patient demographics, surgical techniques, and implant design play significant roles. A study found that implant success rates in younger patients (under 50 years) were approximately 94%, compared to 85% in older patients, highlighting the importance of age in the outcomes. Surgical techniques also significantly influence success, with a 95% success rate observed in patients who underwent guided bone regeneration compared to a 90% rate in those receiving conventional techniques. Implant design has also been found to affect longevity, with tapered implants showing a

5% higher success rate compared to cylindrical designs, especially in challenging bone conditions. Thus, a combination of these factors significantly determines the overall success of dental implants, with patient-specific factors and advanced techniques enhancing outcomes.

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