Original Article
DOI: 10.7860/JCDR/2024/67239.19280

Dentistry Section

Evaluation of Failure Rate for Cortical Dental Implants Placed in the Mandibular Anterior Region: A Systematic Review

SRISHTY GOYAL[1], DHIRENDRA KUMAR SINGH[2], KUMARI LUCY BHOLA[3], JALALUDDIN MOHAMMAD[4]

ABSTRACT

Introduction: To enhance the success of dental implants, it is crucial to understand the factors contributing to implant failure. Practitioners should carefully evaluate the relevance and impact of critical risk factors associated with the mandibular anterior region to gauge the potential for implant failure.

Aim: To assess the rates of implant failure for implants placed in the mandibular anterior region.

Materials and Methods: For this systematic review, the eligibility criteria for present study included randomised and non randomised clinical trials, prospective cohort studies, and retrospective studies published in the English language between 2000 and 2022. These studies specifically documented dental implant failure rates in the anterior mandible, excluding reviews, in-vitro, cadaveric, and animal studies, as well as case series studies. The participants considered were systemically and mentally healthy individuals aged 18-90 years who had undergone oral restoration using dental implants in the anterior mandibular area. Exclusion criteria involved patients who did not undergo oral restoration with dental implants in the anterior mandibular region, those with systemic diseases affecting implant success, serious cardiac diseases, deficient homeostasis, blood dyscrasias, and psychological diseases. The intervention focused on patients rehabilitated with cortical dental implants in the mandibular anterior region, without a specific comparator or control. Based on the mentioned criteria, nine studies were included. The main outcome of interest was the dental implant failure rate.

Results: The review's included studies indicated the placement of 3,718 implants in the mandibular anterior region, with 86 failures, resulting in a 2.31% failure rate, suggesting an approximate 3% failure rate for implants in this area.

Conclusion: Given the multifactorial nature of implant failure, the available literature does not support the designation of the mandibular anterior region as a specific risk factor for such failures.

Keywords: Blood dyscrasias, Mandible, Osseointegration

INTRODUCTION

Dental implant failure, the situation where dental implants either need removal or are lost, presents an ongoing challenge in the field of implantology. Despite significant advancements in the effectiveness of dental implants, there remains a portion of cases where implant failure occurs, and the exact reasons behind these failures remain unidentified [1]. Understanding the factors contributing to implant failure is crucial for clinicians as it allows them to take necessary precautions and implement strategies to enhance the success of dental implant procedures [2,3]. As dental care utilisation rises globally, even in lower-middle-income countries like India where it's around 24%, procedures like dental implants are increasingly chosen for improved oral health and function. This growing popularity underscores the need to delve deeper into the multifactorial causes of implant failure, as documented in global scientific literature [4].

Local factors, such as poor bone quality, inadequate primary stability due to surgical trauma, and infections that disrupt primary bone healing, are known to contribute to implant failure [3]. These local factors can impair the osseointegration process, leading to an increased risk of implant failure. Additionally, systemic conditions like unregulated diabetes, osteoporosis, corticosteroid use, bisphosphonate therapy, and collagen-related disorders have the potential to affect bone healing and influence dental implant outcomes [3,5,6].

The placement site of dental implants is a biological factor that can impact the success of these procedures. Research has shown variations in implant failure rates based on the specific jaw region where implants are positioned [7-17]. Notably, there is a higher occurrence of implant failure in the upper jaw (maxilla) compared to the lower jaw (mandible) [10-13,17]. The reasons behind this discrepancy are not fully understood [14,15]. Several studies have indicated that reduced bone volume in the maxilla may contribute to the higher implant failure rates [14,18,19]. However, in recent research, comparable rates of implant failure were observed in both the maxilla and mandible, suggesting that the location of implant placement may not substantially influence implant failure [20]. Hence, the aim of present systematic review was to examine rigorous research and investigate the correlation between dental implant failure rate and the mandibular anterior region.

MATERIALS AND METHODS

This systematic review was conducted in accordance with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) [21]. The review protocol was registered on the Open Science Framework (OSF), a software project that facilitates open collaboration in scientific research. The registration ID is https://doi.org/10.17605/OSF.IO/UWNPQ.

Inclusion criteria: Randomised and non randomised clinical trials, prospective cohort studies, and retrospective studies were included in present systematic review to record the dental implant failure rate for implants placed in the anterior mandible. The studies considered for inclusion were published in the English language from the year 2000 until 2022.

Exclusion criteria: Reviews, in-vitro studies, cadaveric and animal studies, case series, and case reports were excluded from present systematic review.

PICO for the Study

Participants/population

Included studies: Systemically and mentally healthy patients in the age range of 18-90 years who had undergone oral restoration utilising dental implants in the anterior mandibular area were included in present study.

Excluded studies:

- Those who have not undergone oral restoration utilising dental implants in the anterior mandibular area.
- Patients who have systemic diseases that lead to a higher susceptibility to infections and impaired healing around dental implants.
- Patients with serious cardiac diseases.
- Patients with deficient homeostasis and blood dyscrasias.
- Patients with psychological diseases.

Intervention(s), exposure(s): Patients rehabilitated with cortical dental implants in the mandibular anterior region were included in the study.

Comparator(s)/control: None.

Main outcome: Dental implant failure rate; A dental implant is considered to have failed if there is clinical mobility, the presence of peri-implant radiolucency, and a muted sound upon percussion. A failed implant is non functional, and its removal is necessary [22].

Strategy for Search

Information was sourced from Medline/PubMed, Web of Science, Scopus, LILACS (via Bireme), and The Cochrane. A comprehensive exploration was conducted in dental implant-related publications. Library database searches were performed to identify Randomised Controlled Trials (RCTs), observational studies, retrospective and prospective studies that met the eligibility criteria. The search terms used, such as (anterior mandible OR mandible OR risk factors) and (oral dental implant OR dental implant OR osseointegration OR peri-dental implantitis OR peri-dental implant), were adapted based on the specific requirements of each database, yielding 327 results from Medline/PubMed, Web of Science, Scopus, LILACS (via Bireme), and The Cochrane Library databases. Manual investigation of grey literature yielded 64 studies.

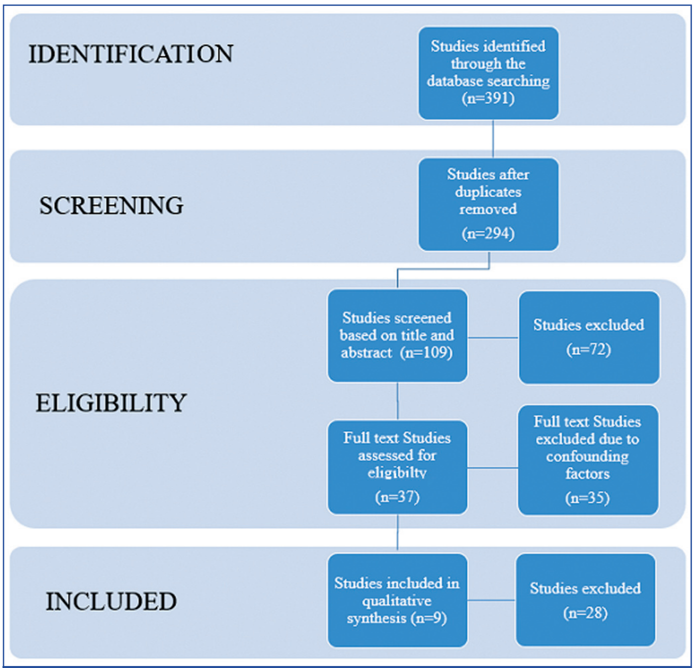
Selection Process

Two authors (SG and DKS) conducted the initial screening of the 391 records based on title and abstract. After eliminating duplicates, case reports, reviews, non human studies, studies exclusively centered on immediate/early loading, and those involving medically compromised patient groups (e.g., irradiated patients, individuals with systemic diseases), the total number of included records was reduced to 109 out of the initial 294. Disagreements between the authors were resolved in discussion sessions, and if not resolved, a third author (KLB) was consulted, who reviewed the manuscript independently. Subsequently, three authors from the same Institution (DKS, KLB, and JM) independently assessed these full-text papers using both exclusion and inclusion criteria, leading to the inclusion of 37 articles.

Among the initially excluded 72 records:

- 21 were excluded due to inadequate methodology.
- 17 articles did not pertain to implant placement in the mandibular anterior region.
- 32 records lacked complete demographic patient data.
- 2 records lacked original research.

Among the 37 records, 12 were excluded because of confounding factors such as smoking and age. An additional 16 records were excluded since they did not pertain to implant placement in the mandibular anterior region. In the end, nine studies [2,23-30] were included in the final review, offering a comprehensive analysis of the association between implant placement location and dental implant failure [Table/Fig-1].



[Table/Fig-1]: PRISMA flowchart of the included studies.

Data Extraction

After the study selection was completed, authors SG and DKS compared search results to ensure completeness and remove duplicates. All the potentially qualified articles were checked for eligibility criteria using the following standards, such as the name of the first author and the year the study was published, the type of study (prospective, retrospective, cross-sectional studies, etc.,), by authors KLB and JM.

Quality Assessment

In 2013, the National Heart, Lung, and Blood Institute (NHLBI) [31] developed a set of tailored quality assessment tools to assist reviewers in evaluating fundamental concepts related to a study's internal validity. These tools were designed to be applicable to specific study designs, aiming to identify potential flaws in research methods or execution. In present systematic evidence review, these tools are employed as part of the process to update existing clinical guidelines. The quality assessment tool for observational cohort, cross-sectional studies, and the quality assessment of controlled intervention studies [31] were applied according to the study design.

Each study underwent evaluation in accordance with the guidelines, and scores were allocated accordingly. If a study met a criterion, it was labelled as "yes"; if it did not meet the criteria, it was marked as "no," and NA (Not Applicable) in cases where a certain criterion was not applicable to the study. The complete NIH assessment tool can be found on the nhlbi.nih.gov website [31]. Instances where criteria were not satisfied were documented and these were subsequently excluded from the final score calculation [2,23-30]. Each question that had a satisfactory answer and was relevant to the included study designs received a score of one; otherwise, zero. Questions that were not relevant to the studies were excluded and were not counted in the denominator for calculating an individual score. The calculation involved dividing by the total number of questions and then multiplying by 100 to obtain the percentage. Studies were scored with a percentage ≤50=poor, 50-75=fair, >75=good [32].

RESULTS

Study characteristics: Data on nine studies [2,23-30] in the review, outlining patient criteria and surgical interventions for the included studies, which consist of three prospective cohort studies and six retrospective studies has been provided in [Table/Fig-2] [2,23-30]. Date about study design, males, females, age range of the included studies, followed by the intervention, and implants placed in the mandibular anterior region have been presented in [Table/Fig-3] [2,23-30].

Alsaadi G et al., investigated dental implant malfunction, associating it with implant characteristics, smoking, and edentulism [23-25]. Kim JS et al., assessed Astra Tech implant predictability, finding no location-based differences in survival rates [26]. Olate S et al., examined acidification-based implant removal, focusing on prosthesis forces, with no site-specific correlations [2]. Ostmant PO et al., studied immediately loaded implants in partially edentulous lower jaws, concluding it's a viable technique [29]. Roos-Jansåker AM et al., investigated periodontitis's impact on implant loss [28]. Wang F et al., analysed implant replacements after early failures, finding no significant differences based on implant location [27].

In implant placement, torque readings showed no significant association with early loss, but Periotest Values (PTVs) did. High PTV values were linked to increased early failures, while bone defects at implant sites had no substantial impact.

Anitua E et al., conducted a retrospective analysis, revealing that implant failure was associated with two-stage implants and specific surgical techniques [30]. However, the study focused on implant

S. No.	Author and year	Inclusion criteria	Exclusion criteria	Type of surgery
1	Alsaadi G et al., 2007 [23]	All patients treated by means of endosseous implants.	NA	Classical two-staged surgical protocol
2	Alsaadi G et al., 2008 [24]	Implants that did not experience loss either before or during abutment surgery (referred to as early loss), and implants for which it was feasible to assess their condition two years following the abutment surgery.	Implants which failed before or at abutment surgery. Implants that although did not fail but in patients who could not be followed for upto two years after abutment surgery.	NA
3	Anitua E et al., 2008 [30]	Systemically healthy patients.	NA	Two-staged and single-staged protocol
4	Kim JS et al., 2011 [26]	Patients treated with Astra Tech Implants.	NA	Two-staged and single-staged protocol
5	Olate S et al., 2010 [2]	Patients who underwent dental implants placement.	Patients were ineligible for inclusion in the study due to the following criteria: • Incomplete or missing patient files. • Patients who were still undergoing treatment and had not yet received implant placement at the time of data collection. • Implants that had not progressed to the second surgical phase. • Patients who had implants placed but discontinued treatment, and their implants were inserted using a non submerged protocol.	Classical two-staged surgical protocol
6	Ostman PO et al., 2008 [29]	Indications for rehabilitation with an implant-Supported prosthesis in the partially dentate mandible include: • Sufficient residual bone to accommodate either two implants, each atleast 7 mm in length, or one 15 mm-long implant to be connected with a tooth. • The implant site must be free from infection. • If the implant is intended to replace an extracted tooth, a minimum healing period of 4 months is necessary.	General contraindications for oral surgery Age less than 18 years.	Two-staged and single-staged protocol
7	Alsaadi G et al., 2007 [25]	Patients who can benefit from implants for their oral rehabilitation.	NA	NA
8	Roos-Jansåker AM et al., 2006 [28]	Patients treated with titanium implants (Brånemark Systems, Nobelpharma, Göteborg, Sweden).	NA	Classical two-staged surgical protocol
9	Wang F et al., 2014 [27]	Inclusion criteria: (i) patients with one or more failed implants that were retrieved and were planned to be replaced; (ii) implant failure before prosthesis delivery; (iii) implant(s) inserted in the same site where the failed implant was previously anchored; (iv) surface-modified implants used in the initial and retreatment procedures; and (v) original and replaced fixtures placed by the same operator.	(i) Systemic status that was likely to affect bone metabolism (unbalanced hormonal condition, previous irradiation in the head and neck region); (ii) Non biological implant failure (i.e., implant fractured); (iii) Implant failure after prosthesis delivery; and (iv) Active smoker subjects (>10 cigarettes/day).	NA

[Table/Fig-2]: Inclusion and exclusion criteria of included studies [2,23-30].

S. No.	Characteristics of studies										
			Sample size				Implants placed			Implants placed in mandibular anterior region	
	Author and year	Methods	Males	Females	Mean age	Age range	Number of implants placed	Type of implants placed	Implants failed	Total	Failed
1	Alsaadi G et al., 2007 [23]	Prospective study, cross-sectional	96	187	56.2	18-86 years	720 implants	Mk III TiUnite implants	14	155	1 (0.64%)
2	Alsaadi G et al., 2008 [24]	Retrospective study	172	240	NA	NA	1514 implants	Brånemark systems implants (Nobel Biocare, Gothenburg, Sweden)	101	387	8 (2.06%)
3	Anitua E et al., 2008 [30]	Retrospective cohort study design	386	674	54	17-91 years	5787	BTI implants	28	460	1 (0.21%)
4	Kim JS et al., 2011 [26]	Retrospective analysis	49	49	50	40-60 years	195 implants	Astra Tech implants	0	12	0
5	Olate S et al., 2010 [2]	Retrospective study	221	429	43.2	13-84 years	1,649 implants	NA	50	270	10 (3.70%)
6	Ostman PO et al., 2008 [29]	Prospective clinical study	38	39	57.5	33-82 years	257 implants	Branemark systems implants	4	19	0 (0.0%)

7	Alsaadi G et al., 2007 [25]	Retrospective study	792	1212	NA	NA	6946 implants	Brånemark systems, Nobel Biocare, Gothenburg, Sweden	252	1966	46 (2.33%)
8	Roos-Jansaker AM et al., 2006 [28]	Prospective clinical study	108	110	65.6	29-92 years	1057 implants	Brånemark systems, Nobel Biocare, Gothenburg, Sweden	46	382	5 (1.30%)
9	Wang F et al., 2014 [27]	Retrospective analysis	38	28	44.5	21-68 years	10,234 implants	ITI implants (Straumann AG, Waldenburg, Switzerland)	100	67	15 (22.3%)

[Table/Fig-3]: Characteristics of included studies [2,23-30].

survival and did not comprehensively assess long-term success. Despite the limitations of retrospective studies, they offer valuable insights for clinicians to improve implant success and contribute to the field's knowledge.

Quality Assessment

The assessment of study quality followed the prescribed approach to evaluate potential bias in the included studies, as detailed in [Table/Fig-4]. Three studies conducted by Olate S et al., Wang F et al., and Anitua E et al., scored more than 75% [2,27,30]. Other studies received scores in the range of 75% to 50% [Table/Fig-4] [2,23-30]. Overall, the quality of the studies was found to be good. A traffic plot was generated based on the above information, as illustrated in [Table/Fig-5] [2,23-30].

DISCUSSION

The present review explored the intricate correlation between dental implant failure and the site of implant placement, with a specific focus on the mandibular anterior region. By examining various factors such as surgeon expertise, implant type, location, bone quality, and tissue healing processes, the review offered valuable insights into the multifaceted nature of implant failures. However, for a comprehensive understanding of this complex issue, it is crucial to supplement these findings with additional studies from the existing literature.

The collective data from the included studies disclosed the placement of a total of 3,718 implants in the mandibular anterior region. Among these, 86 implants encountered failure, resulting in a failure rate of 2.31%. This suggests that approximately three out

Questions	Kim JS et al., 2011 [26]	Alsaadi G et al., 2008 [24]	Alsaadi G et al., 2007 [23]	Olate S et al., 2010 [2]	Wang F et al., 2014 [27]	Roos-Jansaker AM et al., 2006 [28]	Anitua E et al., 2008 [30]	Ostman PO et al., 2008 [29]	Alsaadi G et al., 2007 [25]
1. Was the research question or objective in present paper clearly stated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Was the study population clearly specified and defined?	Yes	No	No	Yes	Yes	No	Yes	Yes	No
3. Was the participation rate of eligible persons at least 50%?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	Yes	No	No	Yes	Yes	No	Yes	Yes	No
5. Was a sample size justification, power description, or variance and effect estimates provided?	No	No	No	No	No	No	No	No	No
6. For the analyses in present paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	NA	NA	NA	NA	NA	NA	NA	NA	NA
9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. Was the exposure(s) assessed more than once over time?	No	No	No	No	No	No	No	No	No
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Were the outcome assessors blinded to the exposure status of participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA
13. Was loss to follow-up after baseline 20% or less?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total score	75%	66.66%	66.66%	83.33%	83.33%	66.66%	83.33%	75%	66.66%

[Table/Fig-4]: Quality assesment of the included studies (for observational cohort and cross-sectional studies) [2,23-30].

Authors name	Quality assessment scores	Traffic plot
Km 2011 [26]	75%	🔴
Alsaadi 2008 [24]	66.66%	🔴
Alsaadi 2007 [23]	66.66%	🔴
Olate 2010 [2]	83.33%	🟢
Wang 2014 [27]	83.33%	🟢
Roos-Jansaoker 2006 [28]	66.66%	🔴
Anitua 2008 [30]	83.33%	🟢
Ostman 2008 [29]	75%	🔴
Alsaadi 2007 [25]	66.66%	🔴

[Table/Fig-5]: Quality assessment scores in the traffic plot [2,23-30].

of every 100 implants positioned in the mandibular anterior region may face failure.

Nevertheless, a systematic review conducted by Fouda AAH highlights a higher incidence of failure in the maxilla compared to the mandible [33]. Specifically, there is a 1% increase in failure rates observed in the maxilla when compared to the mandible. One study by Smith DC delved into the influence of implant design on failure rates [34]. Their findings suggested that implants with specific macro-design and surface characteristics exhibited higher success rates, particularly in regions with lower bone density. This aligns with the recommendation from the present review to consider implant designs tailored to the unique characteristics of specific locations.

Cochran DL's investigation on tissue healing and osseointegration processes in various anatomical regions emphasised the critical importance of considering local tissue characteristics and the microenvironment in assessing implant failure risks [35]. These factors were found to significantly influence the ultimate success of the implant. In exploring the role of bacterial infiltration in implant failure, Covani U et al., uncovered that certain bacteria at the implant site increased the risk of failure [36]. This underscores the importance of infection control and thorough site preparation, as previously noted in the review.

Another aspect addressed in the review was the relationship between bone quality and implant stability, corroborated by Yoon HG et al., study [37]. Their findings indicated that variations in bone quality exert a substantial impact on implant success, reinforcing the need to carefully consider bone density when planning implant placement. The systematic review also acknowledged the work of Chrcanovic BR et al., which concluded that sites with poorer bone quality and insufficient bone volume may statistically affect implant failure rates [19]. The role of implant surfaces in different bone qualities was recognised in the review.

Limitation(s)

Regarding limitations at the study and outcome levels, as well as at the review level, numerous challenges have emerged. Many studies presented incomplete data, and some studies failed to clearly specify and define the study population. Studies focusing on long-term outcomes, retrospectively analysed implant failure over a 7-year period, did not clarify whether the outcome was assessed multiple times over the specified duration, presenting a significant obstacle to reaching definitive conclusions. Furthermore, the variability in the definitions of implant failure across studies introduced heterogeneity, complicating the comparison of findings. The potential presence of publication bias, where studies with positive results are more likely to be published, may have skewed success rates or led to underestimated implant failure rates. Additionally, confounding variables, such as patient habits and systemic health, proved challenging to control for in research.

Moreover, an inherent bias may exist toward studies reporting significant findings or correlations, potentially overlooking those that did not find a strong link between implant site and failure.

CONCLUSION(S)

The present study on mandibular anterior implant placement reveals a failure rate of 2.31%. The lack of consensus on monitoring parameters hampers thorough evaluations across studies. Addressing this gap is crucial, necessitating standardised clinical trial designs for oral implants to enable meaningful comparisons and enhance research reliability. Universally accepted success criteria aligned with treatment goals are essential for consistent assessment, while independent evaluation and accurate reporting of implant failure rates foster transparency. The study highlights the need for further exploration of prognostic factors and innovative non invasive techniques, emphasising the importance of collecting and examining failed implants for a comprehensive understanding of implant failure mechanisms. The key takeaway for clinicians and researchers is to prioritise well-defined criteria for reporting implant failure rates, explore prognostic factors, and employ innovative assessment techniques for more reliable outcomes in oral implantology.

REFERENCES

[1] Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JYK. Clinical complications with implants and implant prostheses. J Prosthet Dent. 2003;90(2):121-32.
[2] Olate S, Lyrio MCN, de Moraes M, Mazzonetto R, Moreira RWF. Influence of diameter and length of implant on early dental implant failure. J Oral Maxillofac Surg. 2010;68(2):414-19.
[3] Sakka S, Baroudi K, Nassani MZ. Factors associated with early and late failure of dental implants. J Investig Clin Dent. 2012;3(4):258-61.
[4] Talukdar R, Barman D, Thakkar V, Kanungo S. Utilization of dental care services among adult Indian population: A meta-analysis of evidence from 2011-2022. Health Promot Perspect. 2022;(4):325-35.
[5] Baqain ZH, Moqbel WY, Sawair FA. Early dental implant failure: Risk factors. Br J Oral Maxillofac Surg. 2012;50(3):239-43.
[6] Olmedo-Gaya MV, Manzano-Moreno FJ, Cañaveral-Cavero E, De Dios Luna-Del Castillo J, Vallecillo-Capilla M. Risk factors associated with early implant failure: A 5-year retrospective clinical study. J Prosthet Dent. 2016;115(2):150-55.
[7] Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants, (I). Success criteria and epidemiology. Eur J Oral Sci. 1998;106(1):527-51.
[8] Khan S. Biological factors responsible for failure of osseointegration in oral implants. Biology and Medicine. 2011;3(2):164-70.
[9] Moheng P, Feryn JM. Clinical and biologic factors related to oral implant failure: A 2-year follow-up study. Implant Dent. 2005;14(3):281-88.
[10] Oztel M, Bilski WM, Bilski A. Risk factors associated with dental implant failure: A study of 302 implants placed in a regional center. J Contemp Dent Pract. 2017;18(8):705-09.
[11] Moy PK, Medina D, Shetty V, Aghaloo TL. Dental implant failure rates and associated risk factors. Int J Oral Maxillofac Implants. 2005;20(4)569-77. PMID 16161741.
[12] Levin L, Sadet P, Grossmann Y. Case series: A retrospective evaluation of 1,387 single-tooth implants: A 6-year follow-up. J Periodontol. 2006;77(12):2080-83.
[13] Bahat O. Brånemark system implants in the posterior maxilla: Clinical study of 660 implants followed for 5 to 12 years. Int J Oral Maxillofac Implants. 2000;15(5):646-53. PMID: 11055131.
[14] Lang LA, Hansen SE, Olvera N, Teich S. A comparison of implant complications and failures between the maxilla and the mandible. J Prosthet Dent. 2019;121(4):611-17.
[15] Onur G, Hakan B, Esma G, Altug C, Emre M, Canan B. Evaluation of possible prognostic factors for the success, survival, and failure of dental implants. Implant Dentistry. 2014;23(1):44-50.
[16] Hinode D, Tanabe SI, Yokoyama M, Fujisawa K, Yamauchi E, Miyamoto Y, et al. Influence of smoking on osseointegrated implant failure: A meta-analysis. Clin Oral Implants Res. 2006;17(4):473-78.
[17] Becker W, Becker BE, Alsuwyed A, Al-Mubarak S. Long-term evaluation of 282 implants in maxillary and mandibular molar positions: A prospective study. J Periodontol. 1999;70(8):896-901. Doi: 10.1902/jop.1999.70.8.896. PMID: 10476898.
[18] Pabst AM, Walter C, Ehbauer S, Zwiener I, Ziebart T, Al-Nawas B, et al. Analysis of implant-failure predictors in the posterior maxilla: A retrospective study of 1395 implants. J Craniomaxillofac Surg. 2015;43(3):414-20.
[19] Chrcanovic BR, Albrektsson T, Wennerberg A. Reasons for failures of oral implants. J Oral Rehabil. 2014;41(6):443-76.
[20] Kang DY, Kim M, Lee SJ, Cho IW, Shin HS, Caballe-Serrano J, et al. Early implant failure: A retrospective analysis of contributing factors. J Periodontal Implant Sci. 2019;49(5):287-98.
[21] Moher D, Liberati A, Tetzlaff J, Altman DG, Antes G, Atkins D, et al. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Med. 2009;6(7):e1000097.

[22] Truhlar RS. Peri-implantitis: Causes and treatment. Oral Maxillofac Surg Clin North Am. 1998;10(2):299-308.
[23] Alsaadi G, Quirynen M, Komárek A, Van Steenberghe D. Impact of local and systemic factors on the incidence of oral implant failures, upto abutment connection. J Clin Periodontol. 2007;34(7):610-17.
[24] Alsaadi G, Quirynen M, Komárek A, Van Steenberghe D. Impact of local and systemic factors on the incidence of late oral implant loss. Clin Oral Implants Res. 2008;19(7):670-76.
[25] Alsaadi G, Quirynen M, Michiles K, Teughels W, Komárek A, Van Steenberghe D. Impact of local and systemic factors on the incidence of failures upto abutment connection with modified surface oral implants. J Clin Periodontol. 2008;35(1):51-57.
[26] Kim JS, Sohn JY, Park JC, Jung UW, Kim CS, Lee JH, et al. Cumulative survival rate of Astra Tech implants: A retrospective analysis. J Periodontal Implant Sci. 2011;41(2):86-91.
[27] Wang F, Zhang Z, Monje A, Huang W, Wu Y, Wang G. Intermediate long-term clinical performance of dental implants placed in sites with a previous early implant failure: A retrospective analysis. Clin Oral Implants Res. 2015;26(12):1443-49.
[28] Roos-Jansåker AM, Lindahl C, Renvert H, Renvert S. Nine- to fourteen-year follow-up of implant treatment. Part I: Implant loss and associations to various factors. J Clin Periodontol. 2006;33(4):283-89.
[29] Ostman PO, Hellman M, Sennerby L. Immediate occlusal loading of implants in the partially edentate mandible: A prospective 1-year radiographic and 4-year clinical study. Int J Oral Maxillofac Implants. 2008;23(2):315-22. PMID: 18548929.
[30] Anitua E, Orive G, Aguirre JJ, Ardanza B, Andía I. 5-Year clinical experience with BTI® dental implants: Risk factors for implant failure. J Clin Periodontol. 2008;35(8):724-32.
[31] Study Quality Assessment Tools | NHLBI, NIH. Available from: https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools.
[32] Pahari S, Barman D, Talukdar R. Tobacco usage in India: A meta-analysis of evidence drawn from regional studies between 2010 and 2022. Trop Med Int Health. 2023;28(9):699-709.
[33] Fouda AAH. The impact of the alveolar bone sites on early implant failure: A systematic review with meta-analysis. J Korean Assoc Oral Maxillofac Surg. 2020;46(3):162-73.
[34] Smith DC. Dental implants: Materials and design considerations. International Journal of Prosthodontics. 1993;6(2):106-17.
[35] Cochran DL, Jones A, Sugita R, Brown MC, Guda T, Prasad H, et al. Immediate dental implant stabilization in a canine model using a novel mineral-organic adhesive: 4-month results. Int J Oral Maxillofac Implants. 2020;35(1):39-51.
[36] Covani U, Marconcini S, Crespi R, Barone A. Bacterial plaque colonization around dental implant surfaces. Implant Dent. 2006;15(3):298-304.
[37] Yoon HG, Heo SJ, Koak JY, Kim SK, Lee SY. Effect of bone quality and implant surgical technique on implant stability quotient (ISQ) value. J Adv Prosthodont. 2011 Mar;3(1):10-5. doi: 10.4047/jap.2011.3.1.10. Epub 2011 Mar 31. PMID: 21503187; PMCID: PMC3076567.

PARTICULARS OF CONTRIBUTORS:

1. Postgraduate Trainee, Department of Periodontology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India.
2. Professor, Department of Periodontology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India.
3. Postgraduate Trainee, Department of Periodontology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India.
4. Professor and Head, Department of Periodontology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dhirendra Kumar Singh,
9R27+59P, Campus 15 Road, Chandaka Industrial Estate, KIIT University, Patia,
Bhubaneshwar-751024, Odisha, India.
E-mail: dhirendra.singh@kids.ac.in

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Sep 04, 2023
- Manual Googling: Nov 06, 2023
- iThenticate Software: Feb 14, 2024 (12%)

ETYMOLOGY: Author Origin

EMENDATIONS: 10

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? No
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Sep 02, 2023**
Date of Peer Review: **Nov 02, 2023**
Date of Acceptance: **Feb 16, 2024**
Date of Publishing: **Apr 01, 2024**