The Bioscan 19(2): S.I (1), 729-733, 2024 www.thebioscan.com

Dental Implants and Oral Rehabilitation in Immunocompromised Patients: A Systematic Review

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DOI: https://doi.org/10.63001/tbs.2024.v19.i02.S.I(1).pp729-733

KEYWORDS
Dental implants;
Oral rehabilitation;
Immunocompromsied patients;
Systematic review.

Received on:

19-09-2024

Accepted on:

21-12-2024

ABSTRACT

Objectives: To explore the success rates of dental implants in patients with compromised immune systems and the factors that influence their outcomes. **Methods:** A total of 412 pertinent publications were found after a comprehensive search across four databases. 68 full-text publications were examined after duplicates were eliminated using Rayyan QCRI and relevance was checked; six studies finally satisfied the requirements for inclusion. **Results:** We included six studies with a total of 930 patients, 1950 dental implants, and 486 (52.3%) were males. The follow-up period ranged from 12 to 87.6 months. The failure rates of dental implantation ranged from 5.6% in immunocmpromised patients to 19% in HIV patients. HIV-positive patients with controlled viral loads generally achieve implant success rates similar to healthy individuals, though they may face more soft-tissue issues and marginal bone loss. Diabetic patients exhibit higher failure rates, highlighting the importance of blood sugar control for better outcomes. For renal transplant patients on immunosuppressive therapy, implant success remains achievable with close monitoring. **Conclusion:** Dental implants are viable for immunocompromised patients with proper personalized care. HIV-positive and diabetic patients need focused management of soft-tissue and glycemic control, while renal transplant recipients benefit from close monitoring to detect complications early. Further research with larger studies and standardized methods is needed to improve guidelines and ensure safe, effective implant options for these high-risk patients.

INTRODUCTION

In our aging and constantly rising society, implant-based dental rehabilitation is becoming more and more popular. Dental implants' ability to restore physiological function may be directly related to better general health and a higher quality of life, in addition to the comfort and aesthetic recovery of the patient [1]. Nevertheless, it is indisputable that the patient's health has a significant impact on the success rate of dental implants. One of the most significant factors contributing to implant failure is impaired health conditions and the associated insufficient host recovery [2, 3].

Appropriate patient selection in light of the patient's overall health and the impact of any pre-existing general disorders is a basic requirement for effective implant therapy [4], as is making sure that the wounds heal and integrate without complications. Increased implant problems and implant loss have been linked to a number of immunological conditions, pharmacological therapies using certain medications (like bisphosphonates), and the side effects of oncological treatment (like chemotherapy and radiation) [5, 6].

Any non-compulsory surgery requires the immune system to be functioning properly. In order to combat infections and coordinate the healing process, the immune system's inflammatory response

is essential [7]. One of the most important phases in a good recovery is the osseointegration of the implant, in addition to the healing of the wounds following surgery [8]. It has been demonstrated that osseointegration is directly related to a sufficient immune response since it stems from the same mechanisms as bone fracture healing [9].

Dental implants have become a popular option for replacing missing teeth, allowing patients to regain both function and appearance. For many individuals, the procedure is relatively simple, boasting high success rates and few complications. However, the situation can be different for those with weakened immune systems. Patients suffering from conditions like HIV/AIDS, autoimmune diseases, diabetes, or those on immunosuppressive therapies encounter unique challenges that can impact the success of dental implants. These patients are at a higher risk for infections, may have longer healing times, and often face issues with bone density, all of which can affect the stability and durability of the implants. Due to these complexities, clinicians often find themselves lacking sufficient knowledge when it comes to the best strategies for implant placement in this vulnerable population. This review aims to explore the success rates of dental implants in patients with compromised immune systems and the factors that influence their outcomes.

Methods

Search strategy

The PRISMA and GATHER criteria were adhered to in the systematic review. To locate pertinent research on the outcomes of dental implants in patients with compromised immune systems, a comprehensive search was carried out. Four electronic databases were searched by the reviewers: SCOPUS, Web of Science, Cochrane, and PubMed. Included studies were within the last 5 years between 2019-2024. We eliminated any duplicates and uploaded all of the abstracts and titles that we could find using electronic searches into Rayyan. After that, all of the study texts that met the requirements for inclusion based on the abstract or title were gathered for a thorough examination. Two reviewers independently assessed the extracted papers' suitability and discussed any discrepancies.

Study population—selection

The PICO (Population, Intervention, Comparison, and Outcome) factors were implemented as inclusion criteria for our review: (i) Population: Immunocompromised patients, (ii) Intervention: Patients who underwent dental implants, (iii) Comparator: Immunocompetent individuals, (iv) Outcome: Success/ failure rates.

Data extraction

Data from studies that satisfied the inclusion requirements were extracted by two objective reviewers using a predetermined and uniform methodology. The following information was retrieved and recorded: (i) First author (ii) Year of publication, (iii) Study design, (iv) Participants' number, (v) Age, (vi) Gender, (vii) Population type, (viii) Follow-up period (in months), (ix)Failure rate, (x) Main outcomes.

Quality review

The Newcastle–Ottawa scale (NOS) criteria were used to assess the methodological quality of the case-control studies that were included. High-quality studies are those with a final score of seven or higher. Four to six stars are assigned to studies of moderate quality, whereas zero to three stars are assigned to research of poor quality [10].

Results

The specified search strategy yielded 412 publications **(Figure 1).** After removing duplicates (n =231), 181 trials were evaluated based on title and abstract. Of these, 113 failed to satisfy eligibility criteria, leaving just 68 full-text articles for comprehensive review. A total of 6 satisfied the requirements for eligibility with evidence synthesis for analysis.

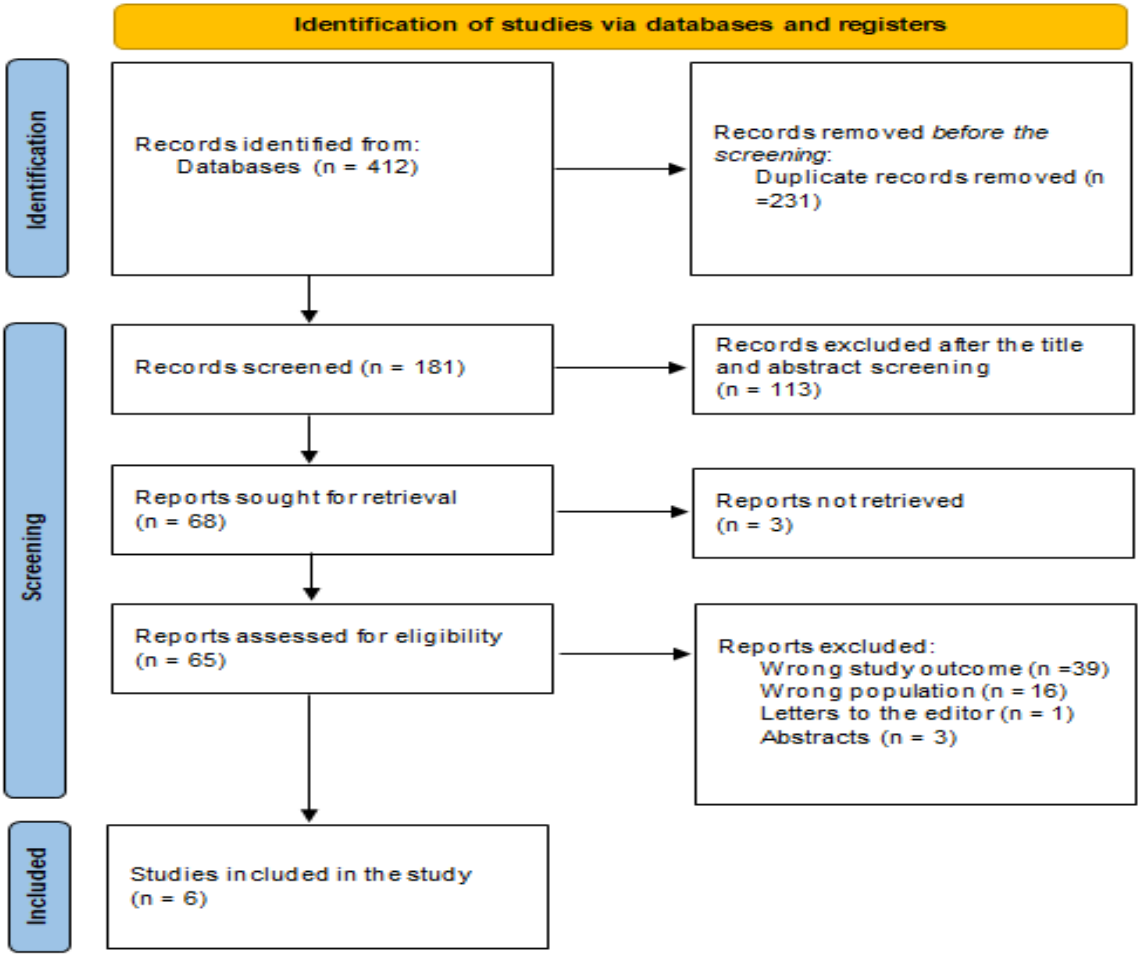

Figure (1): PRISMA flowchart [11].

Sociodemographic and clinical outcomes

We included six studies with a total of 930 patients, 1950 dental implants, and 486 (52.3%) were males. Regarding study designs, all studies were case-controls [12-17]. Two studies were implemented in The USA [12, 17], one in India [13], one in Brazil [14], one in Italy [15], and one in Spain [16].

The follow-up period ranged from 12 [15] to 87.6 months [13]. Four studies included HIV patients [12, 14, 15, 17], one included immunocmpromised patients [13], and one included patients who underwent renal transplantation [16]. The failure rates of dental implantation ranged from 5.6% [13] in immunocmpromised patients to 19% in HIV patients [12]. Those with HIV, particularly when their health is well-managed and viral loads are controlled, can achieve implant survival rates similar to non-immunocompromised individuals. However, they may still face more soft-tissue complications and marginal bone loss, which underscores the importance of careful monitoring and customized post-operative care [12, 14, 15, 17].

For diabetic patients, the rates of implant failure are generally higher, indicating that uncontrolled blood sugar levels can hinder healing and bone integration. This highlights the necessity of thoroughly assessing and managing diabetes before and during the implant procedure to enhance outcomes [13].

In the case of renal transplant patients receiving immunosuppressive therapy, the findings are encouraging, showing that pharmacological immunosuppression does not inherently harm implant success. However, it is advisable to conduct close follow-ups to identify any potential complications early [16].

Table (1): Outcome measures of the included studies

Study ID	Study design	Country	Sociodemographic	Population type	Follow-up (months)	Failure rate (%)	Main outcomes	NOS
Sabbah et al., 2019 [12]	Case-control	USA	N: 548 Implants: 1289 Mean age: 61.5 Males: 302 (55.1%)	HIV patients	46.79 (24.04)	19	HIV+ patients are more likely to experience implant failure because of extra risk factors.	7
Parihar et al., 2020 [13]	Case-control	India	N: 136 Implants: 152 Mean age: 30-60 Males: 68 (50%)	Immunocompromised patients	87.6	5.6	Diabetes was reported to have a greater failure rate among medically impaired patients.	6
Vidal et al., 2022 [14]	Case-control	Brazil	N: 26 Implants: 50 Mean age: 48.3 Males: 14 (53.8%)	HIV patients	36	NM	People with HIV-1 who are under control can get implant therapy, with success and survival rates that are on par with those of controls who are not infected.	7
Gherlone et al., 2024 [15]	Case-control	Italy	N: 126 Implants: 230 Mean age: 54.5 Males: 59 (46.8%)	HIV patients	12	12.7	ART-treated HIV individuals may have worse peri-implant soft-tissue diseases and more marginal bone loss. Between healthy and sick patients, there were no appreciable variations in implant survival rates or surgical complications.	7
Hernández et al., 2019 [16]	Case-control	Spain	N: 53 Implants: 170 Mean age: 57.5 Males: 21 (39.6%)	Patints underwent renal transplantation	103.9	NM	Implant results were unaffected by pharmaceutical immunosuppression in renal transplant recipients. Following implant treatment, patients undergoing renal transplants should be closely monitored on a regular basis.	7
Neumeier et al., 2022 [17]	Case-control	USA	N: 41 Implants: 59 Mean age: 53 Males: 22 (53.7%)	HIV patients	36	NM	Implant-supported restorations can be successful for HIV+ individuals who are under good control. In order to give more evidence for treating these patients, a bigger HIV+ population would be helpful.	6

***NM=Not-mentioned.**

DISCUSSION

Our findings show that implanting dental implants in immunocompromised patients can be both difficult and successful. People with HIV can attain implant survival rates comparable to those of non-immunocompromised people, especially if their health is properly managed and their viral loads are under control. They might still experience minimal bone loss and greater soft-tissue issues, though, which emphasizes the significance of close observation and individualized post-operative care [12, 14, 15, 17]. The failure rates of dental implantation ranged from 5.6% [13] in immunocmpromised patients to 19% in HIV patients [12]. **Sivakumar *et al*.** concluded that patients with HIV who require oral health care must undergo treatment procedures that preserve the integrity of their oral tissues and functions. For these individuals, dental implant treatment improves their quality of life in terms of their health.

It is yet unclear how highly active antiretroviral therapy (HAART) effects on bone metabolism affect implant success. The length of the HAART regimen and its impact on bone mineral density have not been documented or examined in any dental implant-related research [18].

Over the past 30 years, HIV infection and AIDS, which began as an epidemic that severely crippled victims, have developed into a stable but chronic illness. As a result, the number of patients seeking implant-based dental rehabilitation is steadily rising throughout various disease stages. The current research found no significant failure rate when comparing HIV-seropositive individuals with a CD4 count greater than 200 cells/µl to healthy patients [19]. In a systematic analysis by **Ata-Ali *et al*.**, the administration of antibiotics was recognized as among the primary influencing factors when assessing the osseointegration of dental implants in HIV-positive patients [20]. As a result, while treating

individuals who have tested positive for HIV, it is wise to think about using it.

We also found that implant failure rates are typically greater for diabetes patients, suggesting that uncontrolled blood sugar levels can impede bone integration and healing. This emphasizes that in order to improve results, diabetes must be carefully evaluated and managed both prior to and during the implant surgery [13]. **Javed *et al*.** reported that subjects with diabetes who have good metabolic control (serum glucose level and hemoglobin A1c within normal range) can achieve successful dental implant osseointegration in a comparable way to those without diabetes [21]. **Al Ansari *et al*.** also found that compared to implants implanted in non-diabetic individuals, diabetes patients had a statistically significant increased chance of failure and more marginal bone loss [22]. However, **Wagner *et al*.** stated that as long as the right safeguards are taken, dental implant operations provide patients with prediabetes or diabetes mellitus a safe option for oral rehabilitation [23].

Microvascular problems are recognized to be a consequence of diabetes mellitus. Certain capillary endothelial cell types are susceptible to harm from persistent hyperglycemia because they are unable to decrease the transit of glucose within the cell when exposed to it [24]. The molecular mechanism underlying the development of microvascular problems has now been explained by a number of theories [25]. Damage to already present capillary endothelial cells could potentially have a negative impact on the clinical outcomes of dental implants because the establishment of new blood vessels from previously present vasculature is necessary for neoangiogenesis, which involves the migration actions, proliferation, and differentiation of endothelial cells [26]. The problem could impact the survival of dental implants, as their clinical success depends on neovascularization in the peri-implant bone in addition to osseointegration [27].

The results of this review are promising, demonstrating that pharmaceutical immunosuppression does not always compromise implant success in kidney transplant recipients undergoing immunosuppressive treatment. Close follow-ups are advised, meanwhile, in order to detect any possible issues early [16].

Different immunosuppressive treatments are preferred by various post-transplantation protocols. The selection of immunosuppressive medications had no discernible impact on the implant survival rate, according to the review's findings. The likelihood of implant failure is not increased by immunomodulatory medications or steroids. There were no adverse features of the implant site linked to immunosuppression [28].

Strengths and limitations

The review examines a variety of studies related to different immunocompromised conditions, offering a comprehensive perspective on how these conditions affect implant outcomes. By including diverse patient groups, such as those with HIV, diabetes, and individuals who have undergone transplants, the review provides valuable insights relevant to various clinical situations. The consistent approach used across studies to evaluate implant success rates and complications enables meaningful comparisons and generalizations.

One significant limitation of this review is the relatively small sample sizes in certain studies, especially those involving HIV-positive patients. This restricts the applicability of the findings and highlights the necessity for larger, more thorough studies to validate the results. Furthermore, differences in study design, follow-up durations, and definitions of implant success may introduce bias, complicating the ability to reach definitive conclusions. The absence of data on some specific immunocompromised conditions also limits the review's scope.

CONCLUSION

Dental implants can be effectively placed in immunocompromised patients, but personalized care and careful management are crucial to reduce risks. Patients who are HIV-positive or diabetic need special attention to soft-tissue and glycemic control, respectively, while those who have received renal transplants should have close monitoring to identify any early complications. Although the results are encouraging, additional research with larger sample sizes and standardized methods is essential to enhance clinical guidelines for these high-risk groups, ensuring that dental implants remain a safe and effective choice for patients with complex health issues.

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