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COMPARISON OF CERAMIC AND TITANIUM DENTAL IMPLANTS: EFFECTS ON QUALITY OF LIFE AND THE PREVALENCE OF PERI-IMPLANTITIS

COMPARAÇÃO DE IMPLANTES CERÂMICOS E DE TITÂNIO: EFEITOS NA QUALIDADE DE VIDA E NA PREVALÊNCIA DE PERI-IMPLANTITE

COMPARACIÓN DE IMPLANTES DE CERÁMICA Y DE TITANIO: EFECTOS SOBRE LA CALIDAD DE VIDA Y PREVALENCIA DE PERIIMPLANTITIS

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ABSTRACT

Oral rehabilitation using dental implants is an essential approach to restoring masticatory function, esthetics, and quality of life in patients with tooth loss. Titanium implants are widely used due to their mechanical strength, biocompatibility, and proven capacity for osseointegration, although they carry a risk of peri-implantitis, particularly in individuals with an unfavorable periodontal history or inadequate oral hygiene. Zirconia-based ceramic implants have emerged as a promising alternative, offering significant esthetic advantages, lower bacterial adhesion, and the potential to reduce peri-implant inflammation, thereby justifying a comparative evaluation of these biomaterials. In this context, the present study aimed to analyze the effects of ceramic and titanium implants on patients' quality of life and on the prevalence of peri-implantitis, providing support for evidence-based clinical decision-making. Study selection followed rigorous eligibility criteria, with independent screening of titles and abstracts and subsequent full-text assessment to extract data on implant type, follow-up duration, methods for evaluating peri-implantitis, and instruments for measuring quality of life, enabling qualitative analysis and comparison of the biomaterials. The results indicated that ceramic implants showed a lower incidence of peri-implantitis and greater esthetic satisfaction, whereas titanium implants demonstrated superior mechanical strength and predictable long-term performance. It is concluded that material choice should be individualized, considering clinical factors, esthetic demands, and patient expectations, to promote effective functional rehabilitation, reduce complications, and improve quality of life, thereby strengthening evidence-based dental practice.

Keywords: Dental Implants. Zirconia. Titanium. Peri-implantitis.

RESUMO

A reabilitação oral por meio de implantes dentários representa uma abordagem essencial para restaurar a função mastigatória, a estética e a qualidade de vida de pacientes com

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perda dentária. Para isso, os implantes de titânio são amplamente utilizados devido à sua resistência mecânica, biocompatibilidade e capacidade comprovada de osseointegração. Apesar das vantagens, indivíduos com histórico periodontal desfavorável ou higiene oral inadequada podem desenvolver a peri-implantite. Uma alternativa promissora para esses implantes de titânio são os implantes cerâmicos, à base de zircônia. Eles têm vantagens estéticas significativas, menor adesão bacteriana e potencial de redução da inflamação peri-implantar. Essa última característica, justifica a necessidade de avaliação comparativa entre esses dois tipos de implantes. Nesse contexto, o presente estudo teve como objetivo analisar os efeitos de implantes cerâmicos e de titânio na qualidade de vida dos pacientes e na prevalência de peri-implantite, por meio de uma revisão integrativa da literatura. A seleção dos estudos seguiu critérios de elegibilidade rigorosos, com análise independente de títulos e resumos e posterior leitura integral para extração de dados sobre tipo de implante, tempo de acompanhamento, métodos de avaliação de peri-implantite e instrumentos de mensuração da qualidade de vida, permitindo análise qualitativa e comparação dos biomateriais. Os resultados indicaram que os implantes cerâmicos apresentaram menor incidência de peri-implantite e maior satisfação estética, enquanto os implantes de titânio demonstraram resistência mecânica superior e desempenho previsível a longo prazo. Conclui-se que a escolha do material deve ser individualizada, considerando fatores clínicos, estéticos e expectativas do paciente, promovendo reabilitação funcional eficaz, redução de complicações e melhora da qualidade de vida, fortalecendo a prática odontológica baseada em evidências.

Palavras-chave: Implantes Dentários. Zircônia. Titânio. Peri-implantite.

RESUMEN

La rehabilitación oral mediante implantes dentales representa un enfoque esencial para restaurar la función masticatoria, la estética y la calidad de vida en pacientes con pérdida de dientes. Para conseguirlo, los implantes de titanio son muy utilizados por su resistencia mecánica, biocompatibilidad y capacidad de osteointegración demostrada. A pesar de las ventajas, las personas con antecedentes periodontales desfavorables o higiene bucal inadecuada pueden desarrollar periimplantitis. Una alternativa prometedora a estos implantes de titanio son los implantes cerámicos a base de circonio. Tienen importantes ventajas estéticas, menor adhesión bacteriana y potencial para reducir la inflamación periimplantaria. Esta última característica justifica la necesidad de una evaluación comparativa entre estos dos tipos de implantes. En este contexto, el presente estudio tuvo como objetivo analizar los efectos de los implantes de cerámica y titanio en la calidad de vida de los pacientes y la prevalencia de periimplantitis, a través de una revisión integradora de la literatura. La selección de los estudios siguió estrictos criterios de elegibilidad, con análisis independiente de títulos y resúmenes y posterior lectura completa para extraer datos sobre el tipo de implante, el tiempo de seguimiento, los métodos de evaluación de la periimplantitis y los instrumentos de medición de la calidad de vida, lo que permitió el análisis cualitativo y la comparación de biomateriales. Los resultados indicaron que los implantes cerámicos tenían una menor incidencia de periimplantitis y una mayor satisfacción estética, mientras que los implantes de titanio demostraron una resistencia mecánica superior y un rendimiento predecible a largo plazo. Se concluye que la elección del material debe ser individualizada, considerando factores clínicos, estéticos y expectativas del paciente, promoviendo una rehabilitación funcional efectiva, reduciendo las complicaciones y mejorando la calidad de vida, fortaleciendo la práctica odontológica basada en la evidencia.

Palabras clave: Implantes Dentales. Circonita. Titanio. Periimplantitis.

1 INTRODUCTION

The use of dental implants is one of the most consolidated and predictive strategies for the rehabilitation of patients with tooth loss, allowing the restoration of masticatory function, aesthetics and, significantly, psychosocial well-being. Tooth loss compromises not only functions such as chewing and speaking, but also impacts self-esteem, aesthetic self-perception, and quality of life related to oral health. Among the biomaterials available, titanium implants stand out for their biocompatibility, mechanical resistance, and proven osseointegration capacity, attributes that support long-term stability and clinical success. However, such systems are not exempt from limitations, among which the following can be highlighted: aesthetics when the implant is exposed or the tissue is translucent, due to the color of titanium, and peri-implant complications, especially peri-implantitis. This is because it can compromise bone integrity around the implant and culminate in its loss, when not diagnosed and treated properly (PEREIRA, 2023; QUEIROZ, 2025).

Peri-implantitis represents a relevant clinical challenge because it involves inflammatory processes that affect both soft tissues and peri-implant hard tissues. It is characterized by gingival inflammation and bleeding on probing, progressive loss of peri-implant bone, and may, in advanced stages, culminate in implant loss. Its incidence is widely variable and depends on multiple determinants, including systemic conditions, oral hygiene habits, periodontal history, and characteristics of the biomaterial used. Thus, the selection of the material and the design of the implant plays a central role not only in biomechanical performance, but also in the modulation of tissue response and the prevention of inflammatory complications, with direct impacts on the longevity of the treatment and patient satisfaction (DE OLIVEIRA RIBEIRO, 2022; COSTA, 2024).

Ceramic implants, especially zirconia-based ones, are emerging as an alternative to titanium to meet growing aesthetic and biological demands. Zirconia, with a white color similar to that of natural teeth, offers a relevant aesthetic advantage, particularly in cases with gingival retraction, slender gingival or bone phenotype, or in areas of high aesthetic demand. In addition to the aesthetic aspect, zirconia has shown promise from a biological point of view, since its surfaces tend to have less bacterial adhesion compared to those of titanium, potentially reducing peri-implant inflammation and the risk of peri-implantitis. The disadvantages of using this material are: higher costs and relatively recent clinical experience, with heterogeneous evidence of longevity and long-term performance, which

reinforces the need for evidence-based critical evaluations to support safe and informed clinical decisions (PEREIRA, 2023; PEREA, 2023).

In addition to the biological and clinical aspects, the impact of the type of implant on the quality of life related to oral health should be considered with equal relevance. This dimension encompasses functional, aesthetic, and psychosocial components: functions such as efficient chewing and speech clarity directly influence eating and socialization, while the aesthetics of the smile have repercussions on self-confidence, social perception, and self-esteem. Thus, the choice of implant should not be based exclusively on mechanical resistance or osseointegration, but should incorporate the subjective perception of comfort, aesthetic satisfaction, and the degree of patient adherence. In this sense, ceramic implants, due to their color and biocompatibility, can favor greater aesthetic acceptance and functional comfort, contributing to treatment adherence and maintenance of oral hygiene habits, determining factors for long-term success (RIBEIRO et al., 2022).

From the mechanical-structural point of view, titanium implants have proven resistance to high masticatory loads, adequate elastic deformation capacity and predictable support for complex prostheses. Ceramics, in turn, although more rigid, are intrinsically more susceptible to fracture failures under lateral loads, especially in regions of high functional demand. The decision between titanium and ceramic must therefore simultaneously consider aesthetics, biocompatibility, and specific mechanical requirements of each case, including implant positioning, type of prosthetic rehabilitation, and magnitude/direction of the expected functional load. In addition, surface characteristics, such as roughness, porosity, and surface treatments, directly influence osseointegration and bacterial colonization, playing a central role in preventing peri-implantitis and maintaining the integrity of peri-implant tissues (PEREIRA, 2023; MATOS, 2024).

In light of this scenario, the comparison between ceramic implants (zirconia-based) and titanium implants, simultaneously considering the prevalence of peri-implantitis and the impacts on quality of life related to oral health, is a topic of high relevance in contemporary dentistry. A critical and integrated synthesis of the available evidence allows mapping benefits, limitations, and knowledge gaps, guiding clinical decisions aligned with patient safety, effectiveness, and values. Thus, this review aimed to analyze the findings of the literature in the clinical, biological, mechanical, and psychosocial domains, with the purpose of sustaining evidence-based dental practice and optimizing long-term outcomes in oral rehabilitation with implants.

2 METHODOLOGY

2.1 METHODOLOGY

The present integrative literature review aimed to compare ceramic and titanium implants regarding the effects on patients' quality of life and the prevalence of peri-implantitis. For the selection of studies, a systematic search was carried out in the PubMed/MEDLINE, Scopus, Web of Science and LILACS databases, in Portuguese, English or Spanish, including publications from the last 20 years. The descriptors and keywords were used: dental implants, titanium, zirconia/ceramic, peri-implantitis and quality of life, combined by Boolean operators to ensure comprehensiveness and specificity. Randomized controlled trials, controlled clinical trials, systematic reviews, and observational studies that presented data on clinical outcomes, incidence/prevalence of peri-implantitis, and quality of life assessments in patients rehabilitated with dental implants were considered eligible.

Exclusion criteria included animal or in vitro studies, isolated case reports, publications without clear assessment of clinical or subjective outcomes, and articles without full text available in Portuguese, English, or Spanish. The screening of titles and abstracts was carried out independently by two reviewers; disagreements were resolved by consensus or by a third reviewer. Potentially eligible studies were read in full for confirmation of criteria and data extraction, including type of implant and material, number of participants, follow-up time, methods of diagnosis/evaluation of peri-implantitis, and instruments used to measure oral health-related quality of life.

To standardize data extraction, a specific spreadsheet was developed with all the variables of interest. The collected information was analyzed qualitatively, allowing the comparison of the different implant materials in terms of peri-implantitis incidence, bone integration, and the patient's perception of comfort, aesthetics, and functionality. The analysis also included the identification of risk factors associated with implant failure and the occurrence of peri-implantitis, as well as the influence of individual characteristics (age, periodontal history, and oral hygiene habits). In addition, aspects of the design and surface of the implant were considered, recognizing its relevance for bacterial colonization, inflammatory response, and long-term biomechanical stability.

The data were organized in order to enable a critical synthesis, highlighting trends, divergences and gaps in the literature. A qualitative approach was chosen due to the methodological heterogeneity among the included studies, notably differences in the instruments for assessing quality of life, in the diagnostic criteria for peri-implantitis and in the

surgical protocols adopted. Methodological quality was assessed based on standardized parameters, including clarity of design, detailed description of participants and interventions, adequacy of statistical analyses, and consistency in the presentation of results.

Finally, the integrated analysis correlated the characteristics of the implant biomaterial with objective and subjective clinical outcomes, contemplating the relationship between bone integrity, peri-implant tissue health, and patient perception. This approach provided a comprehensive overview of the benefits and limitations of ceramic and titanium implants, allowing for informed clinical recommendations and the identification of priorities for future research.

The entire process was conducted with scientific rigor, transparency, and reproducibility, in line with the principles of evidence-based reviews and with the critical analysis of the impacts of implant materials on dental practice.

3 RESULTS

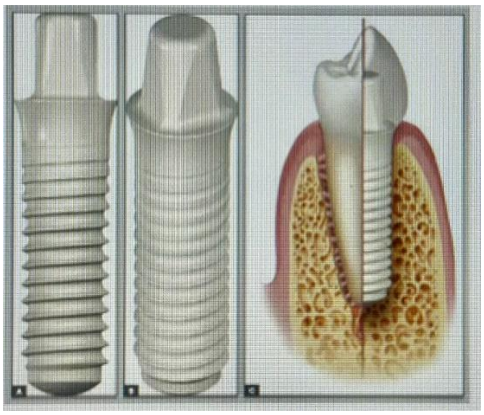
The analysis of the selected studies showed significant differences between ceramic and titanium implants in clinical, biological, and subjective outcomes, including perceived quality of life and occurrence of peri-implantitis. Titanium implants have shown high long-term success rates, with predictable osseointegration and sufficient mechanical strength to withstand different prosthetic configurations. The marginal bone stability around these implants was consistent even under high functional loads, providing high predictability to the treatment. Even so, a relevant portion of the cases exhibited signs of peri-implantitis, characterized by gingival inflammation, marginal bone loss, and, in some cases, implant mobility. This condition was shown to be multifactorial, associated with periodontal history, inadequate oral hygiene, systemic conditions, and characteristics of the prosthetic connection and the implant surface that modulate bacterial colonization (FERNANDES et al., 2025).

On the other hand, ceramic implants, especially zirconia implants (FIGURE I), have demonstrated unequivocal aesthetic advantages due to their color similar to that of natural teeth, minimizing the visibility of metallic structures, especially in thin gingival phenotype or in the presence of gingival recession. In addition, lower bacterial adhesion was observed on ceramic surfaces, correlated with a lower incidence of peri-implantitis compared to titanium. Regarding the clinical outcomes, despite the greater intrinsic rigidity of the material, adequate bone stability was recorded in short and medium-term follow-ups and a low rate of mechanical failure in regions of moderate loading. In areas of high functional demand, however, cases of

fracture or microcracks have been reported, which reinforces the need for careful prosthetic planning and selection of the implant installation site (QUEIROZ, 2025).

Figure 1

Zirconia Ceramic Implants



Source: Azevedo et al., 2021

The evaluation of quality of life related to oral health indicated greater aesthetic satisfaction, a feeling of naturalness of the smile and functional comfort among patients rehabilitated with ceramic implants. The aesthetic dimension was especially relevant in individuals with high visual expectations, with a positive impact on self-confidence and social interaction. In titanium implants, the aesthetic perception was, in general, satisfactory; However, the visibility of the metal in contexts of gingival recession or fine phenotype reduced subjective satisfaction in some cases. Regarding function, chewing and phonetics showed comparable results between the two materials, suggesting that both are capable of adequately restoring essential oral functions (THOME, 2025).

Regarding peri-implantitis, the studies analyzed reported a higher prevalence in titanium implants than in ceramic ones. This difference was attributed to greater bacterial colonization and a more intense inflammatory response in the peri-implant tissues of metal implants, especially in patients with an unfavorable periodontal history or inadequate oral hygiene. Ceramic implants exhibited a more favorable biological profile, with lower expression of inflammatory mediators and better integration with soft tissues, factors associated with a lower incidence of peri-implantitis. It is noteworthy, however, that surface design and topography influence peri-implant health regardless of the material, reinforcing the importance of treated surfaces and precise surgical protocols to mitigate inflammation and bone loss (FERNANDES et al., 2025).

In addition to the clinical outcomes, it was observed that the patient's experience with ceramic implants favors adherence to maintenance care and oral hygiene habits. Higher levels of satisfaction with aesthetics and functional comfort were associated with better hygiene and greater follow-up of postoperative recommendations, with a potential reduction in long-term complications. In contrast, among titanium implant users with aesthetic dissatisfaction or perception of implant visibility, lower adherence to maintenance care was reported, which may contribute to a higher risk of peri-implantitis in the medium and long term (GOMES, 2025).

Clinical follow-up showed that, in both implant modalities, individual factors, age, periodontal history, smoking habits, and systemic conditions, exerted a significant influence on the outcomes. Osseointegration and peri-implant health were modulated by the host's immune response, local bone density, and adjacent soft tissue quality. Regarding durability, titanium implants maintained high long-term success rates, while ceramic implants showed promising results in short and medium-term follow-ups, requiring additional monitoring to consolidate evidence of long-term performance (FERNANDES et al., 2025).

Comparative analysis indicated that both materials provide adequate functional restoration; However, the choice between ceramic and titanium must integrate aesthetic, biomechanical, and biological considerations, in addition to the patient's expectations. While titanium implants stand out for their mechanical robustness and consolidated track record of clinical success, ceramic implants confer aesthetic advantages and indicate a potential reduction in the incidence of peri-implantitis, reflecting positively on the subjective perception of quality of life. This duality reinforces the centrality of individualized planning, which must articulate the properties of the biomaterial, the patient's clinical profile, and therapeutic objectives to maximize effectiveness and mitigate the risk of complications (PEREIRA, 2023; MATOS, 2024).

In summary, the findings support that both titanium and ceramic implants are effective in oral rehabilitation, although they present relevant differences in aesthetic outcomes and in the prevalence of peri-implantitis. Quality of life is related to objective factors, bone integrity and health of peri-implant tissues, and subjective aesthetic satisfaction and functional comfort. The results suggest that ceramic implants exhibit a favorable biological profile and lower risk of peri-implant inflammation, while titanium implants maintain consistent long-term performance and high mechanical strength. Thus, the selection of material must combine clinical and biomechanical evaluation with the patient's perception, ensuring functional,

aesthetic, and long-lasting rehabilitation, in line with the principles of evidence-based dental practice (MATOS, 2024; PEREIRA, 2023).

4 DISCUSSION

Queiroz (2025) reinforced titanium as the gold standard of implantology due to its high mechanical strength and proven biocompatibility, attributes that support high clinical predictability in the long term. Pereira (2023), however, countered by pointing out that, although the mechanical performance of titanium is widely validated, peri-implantitis remains a relevant challenge, especially in patients with a periodontal history and/or poor hygiene. In this sense, Costa (2024) highlighted that the metallic nature of the surface can favor greater bacterial adhesion and, consequently, peri-implant inflammation. Oliveira Ribeiro (2022) added that the choice of material should contemplate not only durability, but also biological determinants that condition the longevity of rehabilitation.

On the other hand, Matos (2024) observed that, despite titanium's susceptibility to bacterial colonization, clinical performance remains favorable when associated with strict maintenance protocols, converging with Queiroz (2025) in emphasizing that titanium osseointegration ensures long-term stability. Thus, although there is consensus regarding the mechanical robustness of titanium, there is still divergence about the impact of the metal surface on peri-implant health, which reinforces the need for systematic clinical follow-up to mitigate inflammatory risks.

Regarding ceramic implants, Pereira (2023) highlighted aesthetic advantages, especially with zirconia, given the color similar to that of natural teeth, favoring superior results in anterior regions. Perea (2023) added that the absence of metallic components is particularly beneficial in thin gingival phenotype or in the presence of recession, contexts in which the visibility of titanium can compromise aesthetic satisfaction. In line with this, Ribeiro et al. (2022) pointed out that the high biocompatibility of zirconia contributes to greater aesthetic and functional acceptance, favoring treatment adherence.

Additionally, Fernandes et al. (2025) reported lower bacterial adhesion to ceramic surfaces and, thus, lower prevalence of peri-implantitis when compared to titanium; The authors described a more controlled inflammatory response and better integration of soft tissues, favoring the maintenance of peri-implant health. This perspective converges with Pereira (2023), who recognized zirconia as a promising alternative in the prevention of inflammatory complications.

Notwithstanding the aesthetic and biological advantages, Matos (2024) and Pereira (2023) warned that ceramic implants are more susceptible to failure under high masticatory loads. Reports of fractures and microcracks in regions of high functional demand support the cautious indication of zirconia in posterior areas. In contrast, the authors underline the mechanical reliability of titanium: while it withstands situations of higher load with predictability, ceramics still require additional research to guide its long-term performance.

The assessment of quality of life also showed important nuances. Thome (2025) observed that patients rehabilitated with ceramics reported greater aesthetic satisfaction and a feeling of naturalness of the smile, with a positive impact on self-esteem and social interaction. In cases with titanium, although chewing and phonetics are generally satisfactory, metallic visibility in gingival recession scenarios can reduce subjective satisfaction. In summary, ceramic implants tended to improve aesthetic perception and, consequently, subjective dimensions of quality of life, while titanium implants were sustained, above all, by functional robustness.

Gomes (2025) added that greater aesthetic satisfaction with ceramic implants is associated with better adherence to maintenance care, including proper hygiene and, potentially, a lower rate of long-term complications. On the other hand, the aesthetic dissatisfaction reported on the part of titanium implant users was related to lower adherence to maintenance recommendations, which may contribute to a higher incidence of peri-implantitis in these contexts. This comparison evidenced the interdependence between aesthetic perception and therapeutic adherence, aspects that have not yet been explored, but are clinically relevant.

Finally, Fernandes et al. (2025) highlighted that individual variables, age, smoking, bone density, and systemic conditions, exerted a decisive influence on the outcomes in both materials. While titanium has a long and consistent track record of success in diverse clinical profiles, ceramics need additional longitudinal studies to consolidate their durability. Thus, Matos (2024) and Pereira (2023) converge: the choice between titanium and ceramic must be individualized, integrating aesthetic expectations, biomechanical constraints, and biological characteristics of the patient, with the aim of maximizing benefits and mitigating risks.

In summary, although titanium maintains the role of the gold standard for its robustness and reliability, ceramic implants emerge as a promising alternative, especially when aesthetics, biocompatibility and modulation of peri-implant inflammation take priority. The

strategic use of each material, combined with individualized assessment, enhances clinical, functional, and psychosocial benefits, strengthening a truly evidence-based and patient-centered dental practice.

5 CONCLUSION

The comparative analysis between ceramic and titanium implants indicated that both materials are effective in oral rehabilitation, providing adequate functional restoration and satisfactory osseointegration.

However, relevant differences emerge when considering aesthetic, biological, and subjective aspects related to the patient's quality of life. Ceramic implants showed expressive aesthetic advantages, coloration similar to natural dentition, and less propensity for bacterial colonization, associated with a more controlled inflammatory response and lower incidence of peri-implantitis, which translates into greater subjective satisfaction.

On the other hand, titanium implants have demonstrated consolidated mechanical strength and high clinical predictability in the long term, although they may exhibit greater susceptibility to peri-implantitis in certain contexts, especially in the presence of inadequate oral hygiene and unfavorable periodontal history.

The findings reinforced that the choice of material should be individualized, integrating durability and biomechanical stability with aesthetic factors, health of peri-implant tissues, and perception of quality of life. Subjective dimensions, functional comfort, aesthetic harmony and social acceptance exert a direct influence on adherence to maintenance care and, consequently, on the long-term sustainability of treatment.

In addition, the review emphasizes the importance of thorough clinical planning, rigorous evaluation of the patient's profile, and selection of the implant according to the site of installation, the demand for functional load, and aesthetic expectations. The combination of evidence-based clinical decisions, peri-implant health surveillance, and explicit consideration of patient preferences tends to maximize clinical and subjective outcomes, while mitigating risks of complications such as peri-implantitis and aesthetic dissatisfaction.

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