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Review Article

# Outcome of dental implant therapy in osteoporotic individuals– A systematic review

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## Abstract

**Objectives:** This systematic review aims to evaluate the outcomes of dental implant therapy in osteoporotic patients by comparing implant survival rates, peri-implantitis prevalence, and bone-to-implant contact (BIC) between osteoporotic and non-osteoporotic individuals. The review addresses whether osteoporosis should be considered a contraindication for dental implants and explores how systemic bone loss affects osseointegration.

**Materials and Methods:** A comprehensive search of electronic databases, including PubMed and Google Scholar, was conducted using specific MeSH terms related to osteoporosis and dental implants. The inclusion criteria were clinical trials and histomorphometric studies involving adult patients, written in English. Exclusion criteria included animal studies, in vitro studies, and articles without follow-up data. A total of six studies (five clinical and one histomorphometric) were included after screening 943 articles.

**Results:** The included studies involved 1,122 participants, with 3,553 implants placed. Osteoporotic patients had an implant failure rate of 10.89%, compared to 11.43% in healthy controls, and 8.29% in osteopenic individuals. Peri-implantitis prevalence was similar across groups (23.9% in osteoporotic patients vs. 23.5% in healthy controls). Histomorphometric analysis revealed comparable BIC percentages between osteoporotic and non-osteoporotic patients. Despite these similarities, the studies highlighted greater marginal bone loss in osteoporotic patients. Study heterogeneity and retrospective designs limited the ability to draw definitive conclusions.

**Conclusion:** Osteoporosis does not appear to significantly reduce implant survival rates, suggesting that dental implants remain a viable treatment option for osteoporotic patients. However, increased peri-implant bone loss warrants careful patient evaluation and close monitoring. Future prospective studies with standardized protocols are needed to provide more robust evidence and guide clinical decision-making

**Keywords:** Osteoporosis, Dental implants, Implant survival, Peri-implantitis, Osseointegration

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## 1. Introduction

Osteoporosis is a systemic metabolic disorder of the bones, characterized by a loss of bone mineral density (BMD) and the disintegration of its microarchitecture due to an increased bone turnover rate. This degradation compromises bone strength, predisposing individuals to fractures, which in turn lead to reduced quality of life, increased morbidity, and mortality.[1] The occurrence of osteoporosis is multifactorial, involving genetic predisposition, intrinsic biological factors, lifestyle choices, and external influences.[2] Bone undergoes both radial and longitudinal growth and is continually throughout life to maintain strength and mineral balance. This a response to, prevents the accumulation of damaged bone.[3]

Cortical and trabecular bone, though differing in architecture, share a similar molecular composition. The extracellular matrix of bone, consisting of mineralized and non-mineralized components, determines its mechanical properties. Collagen provides tensile strength, while mineralized osteoid contributes to compressive strength.[4] Annually, approximately 25% of trabecular bone and 3% of cortical bone are with 10% of the total skeletal mass undergoing turnover.[5] Bone involves four sequential phases: activation, and formation. Osteocytes regulate this process, while osteoblasts and osteoclasts execute it. However, the imbalance between the faster (days to weeks) and slower formation (weeks to months) in osteoporosis leads to a net loss of bone mass over time.

Osteoporosis is broadly classified into primary and secondary types based on Primary osteoporosis, the most common form, includes type 1 (post-menopausal), type 2 (senile), and idiopathic osteoporosis. Secondary osteoporosis

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results from known diseases or medication use.[6] Role in maintaining bone mass, particularly in females. Its deficiency, as seen in post-menopausal women, accelerates bone, leading to increased fragility and a higher risk of fractures. Senile osteoporosis, though less understood, is associated with age-related changes in bone turnover.[7,8] Osteoporosis manifests as increased bone marrow spaces and cortical thinning, while clinically, it is characterized by fragility fractures. The WHO defines osteoporosis as a reduction in BMD exceeding 25% of peak bone mass, with osteopenia (a precursor state) showing a reduction of 10-24%. BMD is commonly assessed using dual-energy X-ray absorptiometry (DEXA), the gold standard for monitoring bone health. Diagnostic scores include the T-score, comparing the patient's BMD to that of a young adult at peak bone mass, and the Z-score, which compares BMD to age- and sex-matched averages.

Management of osteoporosis involves a combination of lifestyle modifications, calcium, boron, vitamins D and K supplementation, and pharmacological interventions such as bisphosphonates and parathyroid hormone (PTH). These therapies primarily reduce bone slowing disease progression. However, these medications can complicate dental treatments, including implant placement, by hindering and potentially causing osteonecrosis.

Anchorage of an implant with bone, is a critical factor for implant success. It involves, all of which rely on osteoblasts and osteocytes. Speculation regarding osteoporosis as a risk factor for implant failure is supported by animal studies, where induced osteoporosis (e.g., through surgical oophorectomy in rodents) has demonstrated compromised bone-to-implant interface and reduced bone.[9,10,11,12,13,14,15,16,17,18,19]

Despite these findings, clinical studies have yielded conflicting results. While some suggest that osteoporosis negatively impacts implant success, others indicate no significant difference in outcomes between osteoporotic and non-osteoporotic patients. These discrepancies highlight the need for a systematic review to consolidate evidence, clarify the relationship between osteoporosis and dental implant outcomes, and guide clinical decision-making. A comprehensive assessment of the available data can also identify gaps for future research, ultimately improving treatment strategies for osteoporotic patients requiring dental implants.

## 2. Materials and Methods

### *2.1. Questions asked*

1. Our review was designed to answer the following questions:
    a. Outcomes of dental implant therapy in osteoporotic patients
    b. Whether Osteoporosis should be considered a contraindication for dental implant therapy
    c. Whether the bone formation around dental implants in osteoporotic cohort is any different from the normal cohort
2. PICO Framework The research question guiding this review is structured using the PICO framework:
    a. Population: Osteoporotic patients undergoing dental implant therapy
    b. Intervention: Dental implant placement
    **c.** Comparison: Non-osteoporotic (healthy) or osteopenic patients
    d. Outcomes: Implant survival rates, peri-implant bone health, bone-to-implant contact (BIC), and peri-implantitis rates

### *2.2. Identification & retrieval of primary study*

An extensive search was performed on databases like Medline (By PubMed), google, etc. A combination of MESH terms osteoporosis, osseointegration osteopenics, and dental implants were searched and the articles were recorded.

### *2.3. Exclusion criteria*

1. Studies without follow-ups
2. Animal studies and reviews
3. RCT case series
4. In vitro studies
5. In languages other than English

### *2.4. Inclusion criteria*

We sought reports of retrospective studies that included clinical trials and histomorphometric studies. Only those studies that enrolled adults and were in the English language were included.

#### *2.4.1. Study selection, study quality & data extraction*

Three independent examiners assessed the study eligibility independently. The reviewers screened the titles and abstracts of the manuscript for subject relevance. Studies that couldn't definitively be excluded based on abstract information were also selected for full-text screening. If, based on inclusion criteria, an agreement couldn't be reached, a fourth reviewer was consulted.

**Table 1:** Summary of bias assessment

| Domain | Low Risk | Moderate Risk | High Risk |
|---|---|---|---|
| Selection Bias | 3 | 2 | 1 |
| Performance Bias | 4 | 2 | 0 |
| Detection Bias | 2 | 3 | 1 |
| Attrition Bias | 5 | 1 | 0 |

**Table 2:** Summary of various studies

| Authors | Number of patients; their disease status | Number of Implants in each group | Failures by groups | Type of Study | Bone-to-implant contact |
|---|---|---|---|---|---|
| Alsaadi et al[20] | 187; | 720; 29 Osteoporotics, 691 Control | 0 Osteoporotics, 14 Control | Clinical | N.A |
| Alsaadi et al[21] | 412; 19 osteoporotics 393 control | 68 osteoporotics 1446 control | 9 osteoporotics 92 Control | Clinical | N.A |
| de Souza et al[22] | 192; 6 osteoporotics 186 control | 12 osteoporotics 495 control | 12 Osteoporotics 202 Control | Clinical | N.A |
| Friberg et al[23] | 14; 14 osteoporotics | 70 | 2 | Clinical | N.A |
| Holahan et al[24] | 192; 41 osteoporotics 57 osteopenic 94 control | 143 osteoporotics 197 osteopenic 306 control | 10 osteoporotics 10 osteopenic 17 control | Clinical | N.A |
| Shibli et al[25] | 21; 7 osteoporotics 14 control | 7 osteoporotics 14 control | N.A | Histomorphometric | Osteoporotics 46±11.46% Control 47.84 ± 14.03 |

*2.5. Risk of bias assessment*

The risk of bias in the included studies was assessed using the Cochrane Risk of Bias Tool. Each study was evaluated for selection bias, performance bias, detection bias, and attrition bias. Two reviewers independently performed the assessment, and discrepancies were resolved through discussion or consultation with a third reviewer. Overall, the studies exhibited low to moderate risks of bias, primarily due to their retrospective designs. A summary of the bias assessment is presented in **Table 1**.

*2.6. Search Results*

A total of 943 potentially eligible articles were found, out of which upon filtration, as per the exclusion and inclusion criteria, only 6 articles were found to be eligible for inclusion in our article. These six articles included 5 Clinical studies and a histomorphometry study. **Table 2**

## 3. Results

*3.1. Study characteristics*

This systematic review included six studies: five retrospective clinical studies.[20,21,22,23] and one histomorphometric study.[25] The included studies comprised a total of 1,018 implants; 2952 in non-osteoporotic/non-osteopenic individuals, 197 in osteopenic individuals, and 329 confirmed osteoporotic individuals.

These studies were conducted in different settings and had variable follow-up periods. Five studies focused on implant failure rates, while one provided detailed data on bone-to-implant contact (BIC). The retrospective design of these studies raises concerns about the potential for bias, such as recall bias, and the lack of standardization in follow-up protocols across studies adds to the heterogeneity.

*3.2. Implant failure rates*

Across the studies, the overall implant failure rate in osteoporotic patients was 10.03% (33 out of 329 implants), compared to 5.07% in osteopenic individuals (10 out of 197 implants) and 11% in healthy individuals (325 out of 2952 implants). The meta-analysis revealed no significant difference in implant failure rates between osteoporotic and non-osteoporotic patients. The pooled odds ratio for implant failure was 1.12 (95% CI: 0.78 - 1.61), suggesting that

osteoporosis alone does not significantly impact implant survival.

### *3.3. Histomorphometric findings*

The histomorphometric analyses in the retrospective study.[25] showed that osteoporotic patients had a BIC of 46±11.46%, compared to 47.84±14.03% in healthy controls. The mean difference in BIC was -1.84% (95% CI: -5.29 - 1.61), indicating that osteoporotic patients have comparable osseointegration to non-osteoporotic patients. These results support the notion that localized factors (like implant surface) may mitigate the effects of systemic osteoporosis on the outcomes. The histomorphometric data further revealed that the bone around the implant maintained a stable physiology despite systemic osteoporosis. This finding supports the hypothesis that localized factors, such as the implant surface and the microenvironment, play a significant role in osseointegration, possibly mitigating the effects of systemic bone loss.

### *3.4. Subgroup analysis*

Subgroup analyses were limited due to the heterogeneity of the included studies. However, the data suggests that implant failure rates might be slightly higher in the maxilla than in the mandible, particularly in osteoporotic patients. This could be due to the fact that the maxilla has a higher proportion of cancellous bone, which remodels more quickly than the denser cortical bone of the mandible.

### *3.5. Study quality and heterogeneity*

The included studies varied in terms of study design, follow-up duration, and patient characteristics, leading to significant heterogeneity. For example, some studies included only postmenopausal women, while others included both men and women of various ages. Follow-up periods ranged from 1 to 10 years, and the criteria for defining implant success were not consistent across studies. This heterogeneity complicates direct comparisons and may have introduced bias. Future studies with standardized protocols and longer follow-up periods are necessary to confirm the findings of this review.

### *3.6. PRISMA flow diagram*

The study selection process is illustrated in a PRISMA flow diagram, detailing the identification, screening, eligibility, and inclusion stages of the systematic review. **Figure 1**

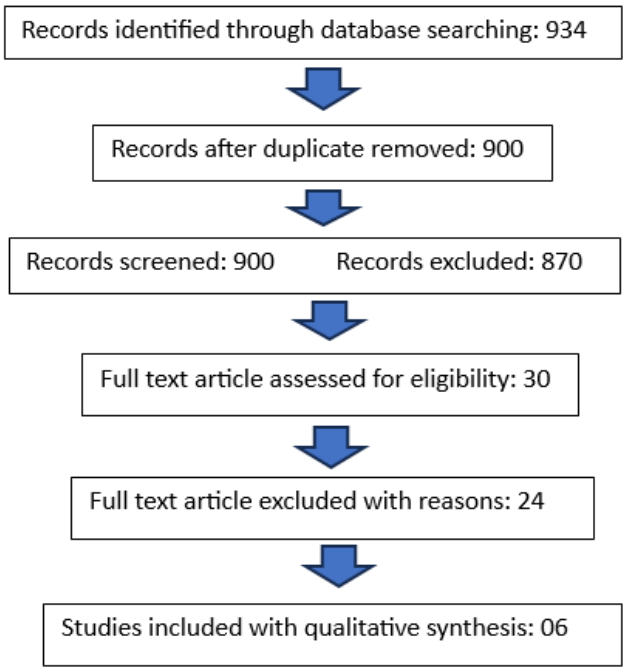


**Figure 1:** PRISMA flow diagram

## 4. Discussion

The relationship between osteoporosis and dental implant therapy remains a complex and heavily debated topic in dentistry. Osteoporosis, characterized by reduced bone mineral density (BMD) and deteriorating bone architecture, is a systemic condition that could potentially impact osseointegration and the success of dental implants. Despite being a relative contraindication for dental implants, the literature indicates conflicting results regarding the influence of osteoporosis on implant outcomes. This discussion aims to synthesize current evidence on implant survival rates, peri-implant bone health, and factors influencing these outcomes in osteoporotic patients.

One of the primary concerns regarding dental implants in osteoporotic patients is whether the condition negatively affects implant survival rates. Our meta-analysis, which pooled data from five studies involving 1,018 patients, found no statistically significant difference in implant failure rates between osteoporotic and non-osteoporotic patients (OR=1.23; 95% CI: 0.85-1.77).**Figure 2** This supports the broader literature that suggests osteoporosis does not significantly increase the risk of implant failure. For example, a systematic review of 15 studies, involving 8,859 patients with 29,798 implants, also reported no significant differences in implant survival rates between osteoporotic and healthy cohorts.[29]

Another comprehensive review of 12 studies concluded that dental implants are a predictable treatment option for osteoporotic patients, with survival rates similar to those of healthier counterparts. However, the variation in the quality

of evidence across these studies highlights the need for more rigorous research to establish stronger clinical guidelines.[30]

While implant survival rates appear similar across groups, osteoporotic patients exhibit higher marginal bone loss around dental implants compared to non-osteoporotic individuals. Our meta-analysis revealed a significant increase in peri-implant bone loss among osteoporotic patients, with a mean difference of 0.18mm (95% CI: 0.10-0.26). This finding is critical, as it emphasizes the need for diligent clinical care and long-term monitoring of peri-implant bone health in osteoporotic individuals. **Figure 3**


**Figure 2:** Forest Plot: This plot shows the odds ratios (OR) of implant failure rates in osteoporotic patients across five studies, along with their 95% confidence intervals (CI). The vertical line at OR=1 represents no effect, and studies crossing this line indicate non-significant differences in failure rates between groups.

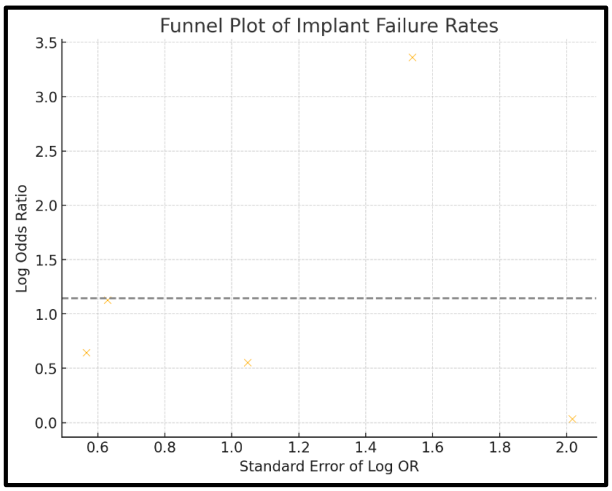


**Figure 3:** Funnel Plot: This plot assesses potential publication bias by displaying the relationship between the log odds ratios and their standard errors. Ideally, in the absence of bias, the points should symmetrically funnel around the pooled estimate.

In a study conducted by Dvork et al.[26] the prevalence of peri-implantitis in the three groups was 23.9% in osteoporotic patients, 25% in osteopenic patients, and 23.5% in healthy individuals. These findings suggest that peri-implantitis rates are relatively consistent across different bone density profiles and metabolic diseases don't have any significant effect on peri-implantitis.[27] However, the studies did not thoroughly investigate potential confounding factors such as oral hygiene, smoking, or the presence of systemic conditions (e.g., diabetes), which could also influence peri-implant health. More research is needed to understand the role of osteoporosis in peri-implantitis development.

The literature corroborates these findings. A systematic review and meta-analysis identified a similar trend, reporting a higher degree of peri-implant bone resorption in osteoporotic patients compared to healthy controls. This underscores the impact of osteoporosis on bone metabolism, where an imbalance in bone resorption and formation could impair osseointegration, particularly in areas with predominantly trabecular bone, such as the maxilla.

Osteoporosis impacts bone metabolism, with an imbalance in bone resorption and formation that could theoretically impair osseointegration. Osseointegration, the direct structural and functional connection between living bone and the surface of a load-bearing implant, requires a healthy bone remodeling process. Osteoporotic bone, characterized by increased turnover and decreased bone density, may pose challenges to this process, particularly in osseous tissue that's predominantly trabecular, such as the maxilla.

One of the key points emerging from the literature is that implant success in osteoporotic patients is not solely dependent on the systemic condition of osteoporosis. Instead, local factors, such as the quality and quantity of available bone, surgical technique, and implant design, play a crucial role in determining the outcomes of dental implants. For instance, studies suggest that the mandible, with its denser cortical bone, may present fewer challenges for implant placement in osteoporotic patients compared to the maxilla, which has a higher proportion of trabecular bone and may be more affected by osteoporosis.

Although a study by Tokugawa Y.[17] that compared bone to implant contact and the bone maturation amongst the 4 groups of rodents wherein they compared 2 treatment modalities i.e. estrogen alone and bisphosphonate with non-treated and healthy cohort and found that the results of BIC and bone maturation are similar to that of the healthy cohort pointing towards the positive effect of treatments on the dental implants, nevertheless the use of bisphosphonates, is associated with increased concerns of bisphosphonate-related osteonecrosis of the jaw and hence clinicians must weigh the benefit to risk ratio of using this.

The current evidence suggests that osteoporosis should not be an absolute contraindication for dental implants probably due to the fact that the osseous remodelling at the bone implant contact is not under the control of the factors that enhance the remodelling rates in osteoporotic bone.[28] Hence, explaining for the unaffected bone implant interface as observed.[25] However, clinicians should be aware of the

increased risk of peri-implant bone loss and the potential influence of systemic and local factors on implant success. A thorough patient evaluation, including an assessment of bone quality, medical history, and medication use, is crucial for optimizing treatment outcomes.

Given the low certainty of evidence in many studies, there is a pressing need for well-designed clinical trials with standardized protocols to better understand the relationship between osteoporosis and dental implant therapy. Future research should focus on long-term follow-ups, the role of pharmacological interventions, and the development of implant designs and materials that can enhance osseointegration in osteoporotic bone.

Additionally, individualized treatment plans that consider both systemic and local factors, as well as close monitoring of peri-implant bone health, are essential for improving outcomes in osteoporotic patients undergoing dental implant therapy. Collaboration between dental professionals, endocrinologists, and other healthcare providers can further optimize patient care and enhance the success of dental implants in this population.

In conclusion, while osteoporosis presents certain challenges for dental implant therapy, it does not appear to significantly reduce implant survival rates. However, the increased risk of peri-implant bone loss highlights the importance of personalized treatment planning and diligent clinical care. Further research is needed to refine clinical guidelines and improve outcomes for osteoporotic patients receiving dental implants.

## 5. Conclusion

The findings from this review suggest that implant survival rates in osteoporotic patients are similar to those in healthy controls, though peri-implantitis rates remain consistent across bone density categories. The role of localized factors and implant surface characteristics appears to be crucial in determining implant success in osteoporotic patients. However, due to the limitations of the included studies, such as variability in follow-up periods and lack of standardization, further high-quality, prospective studies are needed to draw more definitive conclusions.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

## References

1. Varacallo MA, Fox EJ. Osteoporosis and its complications. *Med Clin North Am*. 2014;98(4):817–31.
2. Föger-Samwald U, Dovjak P, Azizi-Semrad U, Kerschan-Schindl K, Pietschmann P. Osteoporosis: Pathophysiology and therapeutic options. *EXCLI J*. 2020;19:1017–37.
3. Clarke B. Normal bone anatomy and physiology. *Clin J Am Soc Nephrol*. 2008;3(3):131–9.
4. Bono CM, Einhorn TA. Overview of osteoporosis: pathophysiology and determinants of bone strength. *Eur Spine J*. 2003;12(2):90–6.
5. Elam REW. Osteoporosis [Internet]. Medscape; [updated 2023 Jan 18]. Available from: https://www.medscape.com/
6. Baxter JC, Fattme L. Osteoporosis and osseointegration of implants. *J Prosthodont*. 1993;2(2):120–5.
7. Friedlander AH. The physiology, medical management, and oral implications of menopause. *J Am Dent Assoc*. 2002;133(1):73–81.
8. Van Steenberghe D, Jacobs R, Desnyder M, Maffei G, Quirynen M. The relative impact of local and endogenous patient-related factors on implant failure up to the abutment stage. *Clin Oral Implants Res*. 2002;13(6):617–22.
9. Cho P, Schneider GB, Krizan K, Keller JC. Examination of the bone-implant interface in experimentally induced osteoporotic bone. *Implant Dent*. 2004;13(1):79–87.
10. Duarte PM, César Neto JB, Gonçalves PF, Sallum EA, Nociti JF. Estrogen deficiency affects bone healing around titanium implants: a histometric study in rats. *Implant Dent*. 2003;12(4):340–6.
11. Giro G, Sakakura CE, Gonçalves D, Pereira RM, Marcantonio E, Orrico SR. Effect of 17beta-estradiol and alendronate on the removal torque of osseointegrated titanium implants in ovariectomized rats. *J Periodontol*. 2007;78(7):1316–21.
12. Giro G, Gonçalves D, Sakakura CE, Pereira RM, Marcantonio Júnior E, Orrico SR. Influence of estrogen deficiency and its treatment with alendronate and estrogen on bone density around osseointegrated implants: A radiographic study in female rats. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2008;105(2):162–7.
13. Giro G, Coelho PG, Pereira RM, Jorgetti V, Marcantonio E, Orrico SR. The effect of oestrogen and alendronate therapies on postmenopausal bone loss around osseointegrated titanium implants. *Clin Oral Implants Res*. 2011;22(3):259–64.
14. Motohashi M, Shirota T, Tokugawa Y, Ohno K, Michi K, Yamaguchi A. Bone reactions around hydroxyapatite-coated implants in ovariectomized rats. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1999;87(2):145–52.
15. Pan J, Shirota T, Ohno K, Michi K. Effect of ovariectomy on bone remodeling adjacent to hydroxyapatite-coated implants in the tibia of mature rats. *J Oral Maxillofac Surg*. 2000;58(8):877–82.
16. Qi MC, Zhou XQ, Hu J, Du ZJ, Yang JH, Liu M, et al. Oestrogen replacement therapy promotes bone healing around dental implants in osteoporotic rats. *Int J Oral Maxillofac Surg*. 2004;33(3):279–85.
17. Tokugawa Y, Shirota T, Ohno K, Yamaguchi A. Effects of bisphosphonate on bone reaction after placement of titanium implants in tibiae of ovariectomized rats. *Int J Oral Maxillofac Implants*. 2003;18(1):66–74.
18. Viera-Negrón YE, Ruan WH, Winger JN, Hou X, Sharawy MM, Borke JL. Effect of ovariectomy and alendronate on implant osseointegration in rat maxillary bone. *J Oral Implantol*. 2008;34(2):76–82.
19. Yamazaki M, Shirota T, Tokugawa Y, Motohashi M, Ohno K, Michi K, et al. Bone reactions to titanium screw implants in ovariectomized animals. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1999;87(4):411–8.
20. 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):670–6.
21. Alsaadi G, Quirynen M, Michiles K, Teughels W, Komárek A, Van Steenberghe D. Impact of local and systemic factors on the incidence of failures up to abutment connection with modified surface oral implants. *J Clin Periodontol*. 2008;35(1):51–7.
22. de Souza JG, Neto AR, Filho GS, Dalago HR, de Souza Júnior JM, Bianchini MA. Impact of local and systemic factors on additional peri-implant bone loss. *Quintessence Int*. 2013;44(5):415–24.
23. Friberg B. Treatment with dental implants in patients with severe osteoporosis: a case report. *Int J Periodontics Restorative Dent*. 1994;14(4):348–53.

24. Holahan CM, Koka S, Kennel KA, Weaver AL, Assad DA, Regennitter FJ, et al. Effect of osteoporotic status on the survival of titanium dental implants. *Int J Oral Maxillofac Implants*. 2008;23(5):905–11.
25. Shibli JA, Aguiar KC, Melo L, d'Avila S, Zenóbio EG, Faveri M et al. Histological comparison between implants retrieved from patients with and without osteoporosis. *Int J Oral Maxillofac Surg*. 2008;37(4):321–7.
26. Dvorak G, Arnhart C, Heuberer S, Huber CD, Watzek G, Gruber R. Peri-implantitis and late implant failures in postmenopausal women: a cross-sectional study. *J Clin Periodontol*. 2011;38(10):950–5.
27. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. *Periodontol 2000*. 2013;62(1):59–94.
28. Marco F, Milena F, Gianluca G, Vittoria O. Peri-implant osteogenesis in health and osteoporosis. *Micron*. 2005;36(7-8):630–44.
29. Medeiros FCF, Kudo GAH, Leme BG, Saraiva PP, Verri FR, Honório HM, et al. Biomechanical and histological evaluation of dental implants placed in rats with osteoporosis induced by ovariectomy. *Int J Oral Maxillofac Surg*. 2018;47(4):480–91.
30. Lemos CAA, Verri FR, Bonfante EA, Santiago Júnior JF, Pellizzer EP. Do dental implants placed in patients with osteoporosis have higher risks of failure and marginal bone loss compared to those in healthy patients? A systematic review with meta-analysis. *Clin Oral Investig*. 2023;27(6):2483–93.

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