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ENTRE A OSSEOINTEGRAÇÃO E A OSTEONECROSE: TOMADA DE DECISÃO EM IMPLANTODONTIA EM PACIENTES EXPOSTOS À TERAPIA ANTI REABSORTIVA

BETWEEN OSSEOINTEGRATION AND OSTEONECROSIS: DENTAL IMPLANT DECISION-MAKING IN PATIENTS EXPOSED TO ANTIRESORPTIVE THERAPY

ENTRE LA OSTEOINTEGRACIÓN Y LA OSTEONECROSIS: TOMA DE DECISIONES EN IMPLANTOLOGÍA DENTAL EN PACIENTES EXPUESTOS A TERAPIA ANTIRRESORTIVA

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Resumo

Objetivo: Examinar a tomada de decisão clínica relacionada à terapia com implantes dentários em pacientes em uso atual ou com exposição prévia a medicamentos anti reabsortivos, com ênfase nas diferenças entre terapias em dose para osteoporose e em dose oncológica, osseointegração, sobrevivência dos implantes, osteonecrose dos maxilares relacionada a medicamentos (MRONJ) e estratificação individualizada de risco. **Métodos:** Foi realizada uma revisão narrativa da literatura utilizando PubMed/MEDLINE e Scopus, complementada por buscas direcionadas em diretrizes clínicas, documentos de consenso, documentos de posicionamento e listas de referências. As buscas foram realizadas em 5 de setembro de 2026. A estratégia principal

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combinou termos relacionados a implantes dentários, medicamentos anti reabsortivos, osteoporose, MRONJ e osteonecrose. Buscas adicionais foram realizadas especificamente para denosumab e terapia em dose oncológica. As evidências foram priorizadas de acordo com sua hierarquia metodológica, considerando diretrizes e documentos de consenso juntamente com revisões sistemáticas, meta-análises e estudos primários relevantes. **Resultados:** As implicações clínicas da terapia anti reabsortiva diferem substancialmente de acordo com a indicação terapêutica, dose, exposição cumulativa, classe medicamentosa, fatores de risco sistêmicos, condições orais e complexidade cirúrgica. Em pacientes tratados para osteoporose, as evidências atuais não sustentam considerar a terapia anti reabsortiva isoladamente como contraindicação absoluta à instalação de implantes. Entretanto, a certeza da evidência permanece baixa ou muito baixa, e o baixo risco absoluto de MRONJ não deve ser interpretado como ausência de risco. Em contraste, a instalação eletiva de implantes deve, em geral, ser evitada durante terapia ativa com agentes modificadores ósseos em dose oncológica. Os bisfosfonatos permanecem clinicamente relevantes após sua suspensão devido à sua retenção prolongada no esqueleto, enquanto o denosumab exige atenção especial aos intervalos entre doses, à interrupção do tratamento, ao aumento rebote do turnover ósseo e à limitada evidência específica para implantes. A sobrevivência do implante também deve ser diferenciada da MRONJ tardia relacionada ao implante, incluindo complicações que se desenvolvem ao redor de implantes previamente osseointegrados. **Conclusão:** A terapia com implantes pode ser considerada em pacientes adequadamente selecionados tratados com medicamentos anti reabsortivos para osteoporose, após avaliação individualizada do risco, consentimento informado, controle da inflamação periodontal e peri-implantar e manutenção a longo prazo. Essa abordagem não deve ser extrapolada para pacientes em terapia ativa em dose oncológica, nos quais a instalação eletiva de implantes deve, em geral, ser evitada. Decisões relacionadas à modificação ou interrupção da terapia anti reabsortiva devem ser coordenadas com o médico prescritor e considerar a indicação, o regime terapêutico, a exposição cumulativa, a terapia sequencial, os fatores sistêmicos de risco e o procedimento cirúrgico planejado.

Palavras-chave: Implantes dentários; Bifosfonatos; Osteonecrose dos maxilares relacionada a medicamentos; Osteoporose; Agentes modificadores ósseos.

Abstract

Objective: To examine clinical decision-making regarding dental implant therapy in patients currently receiving or previously exposed to antiresorptive medications, with emphasis on differences between osteoporosis-dose and oncologic-dose therapy, osseointegration, implant survival, medication-related osteonecrosis of the jaw (MRONJ), and individualized risk stratification. **Methods:** A narrative review of the literature was conducted using PubMed/MEDLINE and Scopus, supplemented by targeted searches of clinical guidelines, consensus statements, position papers, and reference lists. The updated searches were performed on September 5, 2026. The principal search strategy combined terms related to dental implants, antiresorptive medications, osteoporosis, MRONJ, and osteonecrosis. Additional targeted searches addressed denosumab and oncologic-dose therapy. Evidence was prioritized according to methodological hierarchy, with clinical guidelines and consensus statements considered alongside systematic reviews, meta-analyses, and relevant primary studies. **Results:** The clinical implications of antiresorptive therapy differ substantially according to treatment

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indication, dose, cumulative exposure, drug class, systemic risk factors, oral conditions, and surgical complexity. In patients treated for osteoporosis, current evidence does not support considering antiresorptive therapy alone an absolute contraindication to dental implant placement. However, the certainty of evidence remains low or very low, and a low absolute risk of MRONJ should not be interpreted as absence of risk. In contrast, elective implant placement should generally be avoided during active oncologic-dose bone-modifying therapy. Bisphosphonates remain clinically relevant after discontinuation because of their prolonged skeletal retention, whereas denosumab requires particular attention to dosing intervals, treatment interruption, rebound bone turnover, and the limited implant-specific evidence available. Implant survival should also be distinguished from late implant-related MRONJ, including complications arising around previously osseointegrated implants. **Conclusion:** Dental implant therapy may be considered in appropriately selected patients receiving antiresorptive therapy for osteoporosis, following individualized risk assessment, informed consent, control of periodontal and peri-implant inflammation, and long-term maintenance. This approach should not be extrapolated to patients receiving active oncologic-dose therapy, in whom elective implant placement should ordinarily be avoided. Decisions regarding modification or interruption of antiresorptive treatment should be coordinated with the prescribing physician and should consider the indication, regimen, cumulative exposure, sequential therapy, systemic risk factors, and planned surgical procedure. **Keywords:** Dental implants; Antiresorptive agents; Bisphosphonates; Osteoporosis; Bone-modifying agents.

Resumen

Objetivo: Examinar la toma de decisiones clínicas relacionada con la terapia con implantes dentales en pacientes en tratamiento actual o con exposición previa a medicamentos antirresortivos, con énfasis en las diferencias entre las terapias administradas a dosis para osteoporosis y a dosis oncológicas, la osteointegración, la supervivencia de los implantes, la osteonecrosis de los maxilares relacionada con medicamentos (MRONJ) y la estratificación individualizada del riesgo. **Métodos:** Se realizó una revisión narrativa de la literatura utilizando PubMed/MEDLINE y Scopus, complementada con búsquedas dirigidas en guías clínicas, documentos de consenso, documentos de posicionamiento y listas de referencias. Las búsquedas se realizaron el 5 de septiembre de 2026. La estrategia principal combinó términos relacionados con implantes dentales, medicamentos antirresortivos, osteoporosis, MRONJ y osteonecrosis. Se realizaron búsquedas adicionales específicamente para denosumab y para la terapia a dosis oncológica. Las evidencias se priorizaron de acuerdo con su jerarquía metodológica, considerando las guías y los documentos de consenso junto con revisiones sistemáticas, metaanálisis y estudios primarios relevantes. **Resultados:** Las implicaciones clínicas de la terapia antirresortiva difieren sustancialmente según la indicación terapéutica, la dosis, la exposición acumulada, la clase farmacológica, los factores de riesgo sistémicos, las condiciones orales y la complejidad quirúrgica. En pacientes tratados por osteoporosis, la evidencia actual no respalda considerar la terapia antirresortiva por sí sola como una contraindicación absoluta para la colocación

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de implantes. Sin embargo, la certeza de la evidencia sigue siendo baja o muy baja, y el bajo riesgo absoluto de MRONJ no debe interpretarse como ausencia de riesgo. En contraste, la colocación electiva de implantes debe, en general, evitarse durante la terapia activa con agentes modificadores del hueso a dosis oncológicas. Los bisfosfonatos siguen siendo clínicamente relevantes después de su suspensión debido a su retención prolongada en el esqueleto, mientras que el denosumab requiere especial atención a los intervalos entre dosis, la interrupción del tratamiento, el aumento de rebote del recambio óseo y la limitada evidencia específica relacionada con los implantes. La supervivencia del implante también debe diferenciarse de la MRONJ tardía relacionada con el implante, incluidas las complicaciones que se desarrollan alrededor de implantes previamente osteointegrados. **Conclusión:** La terapia con implantes puede considerarse en pacientes adecuadamente seleccionados tratados con medicamentos antirresortivos para la osteoporosis, después de una evaluación individualizada del riesgo, consentimiento informado, control de la inflamación periodontal y periimplantaria y mantenimiento a largo plazo. Este enfoque no debe extrapolarse a pacientes en terapia activa a dosis oncológicas, en quienes la colocación electiva de implantes debe, en general, evitarse. Las decisiones relacionadas con la modificación o interrupción de la terapia antirresortiva deben coordinarse con el médico prescriptor y considerar la indicación, el régimen terapéutico, la exposición acumulada, la terapia secuencial, los factores de riesgo sistémicos y el procedimiento quirúrgico planificado.

Palabras clave: Implantes dentales; Bisfosfonatos; Osteonecrosis de los maxilares relacionada con medicamentos; Osteoporosis; Agentes modificadores del hueso.

1. Introduction

Antiresorptive medications are central to the management of disorders characterized by increased bone resorption, particularly osteoporosis and skeletal complications associated with malignant disease. Bisphosphonates and denosumab are among the most widely used agents; however, their pharmacological characteristics, indications, doses, and clinical risk profiles differ substantially. Consequently, the presence of an antiresorptive medication in a patient's history should not be interpreted as a single, homogeneous risk category.

Dental implant therapy presents a particular clinical challenge in this population. Successful osseointegration depends on coordinated bone healing and remodeling, whereas antiresorptive therapy modifies osteoclast-mediated bone turnover. In susceptible individuals, surgical trauma, infection, and persistent local inflammation may contribute to the development of MRONJ. Therefore, implant

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therapy should be evaluated not only in terms of implant survival but also with regard to short- and long-term biological complications.

The indication for antiresorptive therapy should precede the name of the medication in clinical risk assessment. A patient receiving denosumab for osteoporosis is not equivalent to a patient receiving denosumab at an oncologic dose to prevent skeletal-related events. Likewise, intravenous administration alone should not be regarded as synonymous with oncologic therapy. Dose, frequency, cumulative exposure, underlying disease, concomitant therapies, and patient-specific risk factors must be considered together.

The distinction between bisphosphonates and denosumab is also clinically important. Bisphosphonates bind to mineralized bone and may remain incorporated into skeletal tissue for prolonged periods, whereas denosumab does not accumulate in bone in the same manner and its antiresorptive effect is more closely related to the timing of administration. These pharmacological differences have important implications for treatment interruption and the interpretation of previous exposure.

Contemporary evidence has further complicated the traditional assumption that antiresorptive therapy is uniformly incompatible with implant treatment. The 2025 International ONJ Taskforce consensus specifically addressing patients with osteoporosis concluded that antiresorptive therapy does not need to be stopped before dental implant placement, although this recommendation was weak and based on very low-quality evidence. In contrast, the MASCC/ISOO/ASCO guideline recommends that elective dentoalveolar procedures, explicitly including implants, should not be performed during active oncologic-dose bone-modifying therapy except in carefully selected circumstances involving specialist and oncology-team assessment.

This distinction is particularly important because a low absolute risk of MRONJ in osteoporosis should not be interpreted as absence of risk. The AAOMS 2022 position paper reported estimated MRONJ risks of approximately 0.02–0.05% among osteoporosis patients receiving bisphosphonates and a wider estimated range of approximately 0.04–0.3% for denosumab, emphasizing uncertainty and the need for additional research.

Furthermore, implant survival alone does not capture the entire clinical problem. MRONJ may occur after successful osseointegration, including around implants that were placed before or during antiresorptive therapy. A 2024 systematic review specifically examining antiresorptive effects on previously osseointegrated

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implants found that most implant failures in the selected studies were associated with MRONJ, although substantial methodological limitations prevented estimation of a population-level risk.

The evidence concerning denosumab remains particularly limited. A 2025 meta-analysis included 21 studies and found an association between bisphosphonate use and implant failure at the implant level but not at the patient level, while evidence regarding denosumab remained uncertain. A systematic review published in 2026 identified only 10 eligible studies concerning implants in osteoporotic patients treated with denosumab and highlighted heterogeneity, small sample sizes, sequential bisphosphonate-to-denosumab exposure, timing of implant placement, and peri-implantitis as clinically relevant considerations.

Therefore, the central question is not simply whether a patient uses an antiresorptive medication. Rather, clinical decision-making should address why the medication is being used, at what dose and frequency, for how long, whether exposure is current or previous, whether sequential therapy has occurred, what systemic and local risk factors are present, and what surgical procedure is being proposed.

This narrative review aims to synthesize current evidence regarding dental implant therapy in patients currently receiving or previously exposed to antiresorptive medications, with particular emphasis on risk stratification according to therapeutic indication, medication regimen, current versus previous exposure, denosumab-specific considerations, implant-related MRONJ, peri-implant health, and surgical complexity.

2. Materials and Methods

Study design

This study was designed as a narrative review addressing clinical decision-making regarding dental implant therapy in patients currently receiving or previously exposed to antiresorptive medications. The review focused primarily on bisphosphonates and denosumab and their implications for bone remodeling, osseointegration, implant survival, MRONJ, medication interruption, and long-term peri-implant health.

Because the objective was to integrate heterogeneous evidence and clinical recommendations rather than estimate a pooled treatment effect, no formal meta-

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analysis was undertaken and no quantitative effect estimate was generated by the present review.

Literature search

An updated literature search was conducted on September 5, 2026, using PubMed/MEDLINE and Scopus. The search covered publications from 2000 through September 5, 2026. No language restriction was applied during the database searches.

The principal search strategy combined concepts related to dental implants, antiresorptive medications, and osteoporosis or MRONJ. In PubMed, the principal strategy used combinations of controlled vocabulary and title/abstract terms related to dental implants, antiresorptive agents, bisphosphonates, denosumab, osteoporosis, MRONJ, and osteonecrosis. The complete database-specific search strategies are provided in Supplementary Table S1.

The principal PubMed search identified 307 records, whereas the corresponding principal Scopus search identified 93 records.

Additional targeted searches were conducted to reduce the risk of underrepresentation of clinically important subtopics. A denosumab-focused search in PubMed identified 38 records, and the corresponding Scopus search identified 78 records. A targeted Scopus search addressing dental implants, antiresorptive medications, and oncologic disease identified 367 records.

Because the targeted searches were intentionally overlapping, their results were not summed and were used to identify literature addressing specific clinical domains.

Eligibility and source prioritization

Evidence was considered eligible when it addressed one or more of the following topics:

1. dental implant placement in patients receiving or previously exposed to antiresorptive medications;
2. implant survival, implant failure, or osseointegration;
3. MRONJ associated with implant placement or previously osseointegrated implants;

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4. bisphosphonate- or denosumab-related outcomes;
5. osteoporosis-dose or oncologic-dose bone-modifying therapy;
6. medication interruption or drug-holiday strategies;
7. peri-implantitis, periodontal disease, or local inflammatory factors;
8. bone grafting or other procedures associated with implant rehabilitation; or
9. clinical guidelines, consensus statements, or position papers relevant to these decisions.

Sources were prioritized according to the following hierarchy: clinical practice guidelines and international consensus statements; systematic reviews and meta-analyses; position papers; prospective and retrospective observational studies; and case series or case reports when higher-level evidence was unavailable.

Particular attention was given to the distinction between osteoporosis and malignant disease, current versus previous exposure, low-dose versus oncologic-dose therapy, bisphosphonate versus denosumab exposure, sequential antiresorptive therapy, and implant placement versus complications involving previously osseointegrated implants.

Evidence synthesis

The selected literature was narratively synthesized into the following clinical domains:

1. pharmacological characteristics of bisphosphonates and denosumab;
2. MRONJ risk according to treatment indication and regimen;
3. osseointegration and implant survival;
4. MRONJ associated with implant placement;
5. MRONJ associated with previously osseointegrated implants;
6. denosumab-specific considerations and treatment interruption;
7. sequential antiresorptive exposure;
8. peri-implant inflammation and maintenance;
9. surgical complexity and bone augmentation; and
10. clinical decision-making and informed consent.

The certainty of evidence and limitations of the available literature were considered when formulating clinical recommendations. Statements were therefore expressed proportionally to the strength of available evidence rather than using categorical terminology such as “safe” or “unsafe.”

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3. Results

ANTIREABSORPTIVE THERAPY AND BONE REMODELING

Antiresorptive medications reduce osteoclast-mediated bone resorption but differ substantially in their pharmacological mechanisms and persistence. Bisphosphonates bind to mineralized bone and may remain incorporated into the skeleton for prolonged periods. Denosumab is a monoclonal antibody targeting the RANK/RANKL pathway and does not accumulate in bone in the same manner. Its effects are therefore more closely related to the interval between administrations.

These differences are clinically relevant to implant dentistry. Osseointegration requires a coordinated sequence of bone injury, remodeling, and maturation. Reduced bone turnover does not necessarily result in implant failure, but the biological consequences of antiresorptive treatment may vary according to dose, duration, indication, and individual susceptibility.

The 2018 systematic review and meta-analysis by Stavropoulos et al. found that available implant evidence was predominantly derived from patients receiving low-dose bisphosphonates for osteoporosis and specifically emphasized the paucity of evidence regarding high-dose therapy, denosumab, and bone-grafting procedures. Thus, conclusions from older bisphosphonate literature should not be extrapolated automatically to denosumab or oncologic-dose treatment.

MRONJ RISK: OSTEOPOROSIS VERSUS ONCOLOGY

The indication for antiresorptive therapy is one of the most important determinants of MRONJ risk.

Patients receiving treatment for osteoporosis generally receive substantially lower cumulative antiresorptive exposure than patients treated for malignant disease. According to AAOMS estimates, the MRONJ risk among osteoporosis patients receiving bisphosphonates is approximately 0.02–0.05%, whereas estimates for denosumab range from approximately 0.04–0.3%. These figures illustrate that the absolute risk is low but not negligible and varies according to the population and methodological approach.

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Patients receiving oncologic-dose bone-modifying agents constitute a fundamentally different clinical group. High-dose bisphosphonates or denosumab are used to reduce skeletal-related events in patients with malignant disease, often in the presence of additional risk factors such as immunosuppression, chemotherapy, corticosteroid exposure, and systemic disease burden.

The MASCC/ISOO/ASCO guideline explicitly recommends that elective dentoalveolar surgery, including dental implant placement, should not be performed during active oncologic-dose BMA therapy. Exceptions may be considered only after specialist assessment and discussion with the oncology team.

Accordingly, osteoporosis-dose therapy and active oncologic-dose therapy should not be represented as equivalent clinical scenarios.

CURRENT AND PREVIOUS EXPOSURE

Clinical evaluation should document both current treatment and previous antiresorptive exposure.

For bisphosphonates, previous treatment remains relevant because these medications may remain incorporated into bone for prolonged periods. Consequently, treatment discontinuation does not immediately eliminate the biological relevance of previous exposure.

For denosumab, the timing of the most recent dose and the planned timing of subsequent doses are particularly important. Unlike bisphosphonates, denosumab does not accumulate in bone in the same manner, and delayed or discontinued treatment may lead to rebound increases in bone turnover and increased risk of vertebral fractures.

Therefore, medication history should include:

- indication for therapy;
- specific medication;
- dose;
- route of administration;
- dosing frequency;
- duration of therapy;

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- cumulative exposure;
- date of the last dose;
- previous antiresorptive medications;
- sequential exposure, particularly bisphosphonate followed by denosumab; and
- reason for any medication transition.

A simple classification based solely on “current” versus “previous” exposure is therefore insufficient.

ANTIREASORPTIVE EXPOSURE AND IMPLANT SURVIVAL

Available evidence does not demonstrate that antiresorptive therapy universally compromises implant osseointegration.

The 2018 systematic review by Stavropoulos et al. found no significant difference in implant loss between patients receiving predominantly low-dose bisphosphonate therapy for osteoporosis and controls. However, the authors emphasized that there was almost no evidence concerning high-dose bisphosphonates, denosumab, or bone-grafting procedures.

More recently, a 2025 systematic review with meta-analysis involving 21 studies found that bisphosphonate exposure was associated with implant failure at the implant level (RR 1.74; 95% CI, 1.10–2.75), but not at the patient level (RR 1.01; 95% CI, 0.35–2.91). The same review reported an association between bisphosphonate use and MRONJ, while certainty of evidence was low or very low for several outcomes.

These findings reinforce an important distinction:

implant survival is not synonymous with absence of MRONJ.

A patient may achieve successful osseointegration and maintain implant function while remaining susceptible to a later biological complication.

MRONJ ASSOCIATED WITH IMPLANT PLACEMENT VERSUS PREVIOUSLY OSSEOINTEGRATED IMPLANTS

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At least two clinically distinct scenarios should be recognized.

Implant-surgery-triggered osteonecrosis

In this scenario, MRONJ develops following surgical implant placement. The procedure itself may represent the local traumatic event in a susceptible patient.

Implant-presence/peri-implantitis-associated osteonecrosis

In this scenario, the implant was already osseointegrated and functional, and MRONJ develops later around the implant, potentially in association with peri-implant inflammation or infection.

The distinction is particularly relevant because implant-related complications may occur years after successful osseointegration. The 2024 systematic review by Li and Leung specifically evaluated antiresorptive effects on osseointegrated implants and reported that most failures in the included studies were associated with MRONJ, while emphasizing substantial limitations in the underlying evidence.

Accordingly, implant survival at early follow-up should not be interpreted as proof of long-term absence of risk.

DENOSUMAB: A DISTINCT CLINICAL SCENARIO

Denosumab deserves specific consideration because its pharmacology differs from that of bisphosphonates and because implant-specific evidence remains limited.

The 2026 systematic review by Pereira Santos et al. identified only 10 eligible studies involving osteoporotic patients treated with denosumab and dental implants. The included evidence comprised case series, cohort studies, a case-control study, and a randomized controlled trial. The authors emphasized heterogeneity, small samples, and lack of standardized reporting.

Importantly, the review identified several potentially relevant clinical factors, including the timing of implant placement, peri-implantitis, comorbidities, and sequential treatment involving previous bisphosphonate exposure followed by denosumab.

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Therefore, no universal interval between denosumab administration and implant placement can currently be considered evidence-based.

A dentist should not independently prolong or interrupt denosumab therapy to "allow osseointegration." Any alteration in treatment timing should be coordinated with the prescribing physician and balanced against the underlying fracture risk.

SEQUENTIAL ANTIRESORPTIVE EXPOSURE

Sequential exposure should be explicitly incorporated into risk assessment.

Patients may receive bisphosphonates and subsequently transition to denosumab. In such cases, the clinical history should not be recorded simply as "denosumab use." Previous bisphosphonate exposure, duration of cumulative antiresorptive therapy, reason for treatment transition, and timing of the transition should be documented.

The 2026 systematic review of denosumab and dental implants identified transition from bisphosphonates to denosumab among potentially relevant factors in reported MRONJ cases.

Although causality cannot be established from the available evidence, sequential exposure represents a clinically meaningful modifier that should be considered when obtaining informed consent and planning long-term monitoring.

THE DRUG HOLIDAY CONTROVERSY

The concept of a drug holiday has historically been proposed to reduce the risk of MRONJ associated with invasive dental procedures. However, the evidence does not support a universal strategy of antiresorptive interruption.

For patients with osteoporosis, the 2025 International ONJ Taskforce specifically suggested that antiresorptive therapy does not need to be stopped before dental implant placement. This recommendation was classified as weak and based on very low-quality evidence.

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Therefore, routine discontinuation is not recommended solely to facilitate implant placement.

In patients receiving denosumab, prolonged or unsupervised interruption is particularly problematic because delayed administration may result in rebound bone turnover and increased vertebral fracture risk.

Drug-holiday decisions should therefore be divided into two fundamentally different scenarios:

Drug holiday in osteoporosis

Routine interruption before implant placement is not supported by current evidence. If treatment modification is considered, the decision should involve the prescribing physician and account for fracture risk and the patient's overall skeletal status.

Medication modification in oncologic-dose therapy

The central issue is not whether a drug holiday can make implant placement acceptable. During active oncologic-dose therapy, elective implant placement should ordinarily be avoided. The MASCC/ISOO/ASCO guideline explicitly recommends against elective implants during active oncologic-dose BMA therapy, with exceptions reserved for individualized specialist and oncology-team assessment.

Thus, drug-holiday discussions should not be used to imply that routine interruption makes elective implants acceptable during active oncologic therapy.

PERI-IMPLANT INFLAMMATION AND LONG-TERM MAINTENANCE

The risk assessment does not end when the implant is placed.

Periodontal disease, peri-implantitis, poor oral hygiene, uncontrolled diabetes, smoking, and other systemic or local conditions may increase the risk of complications in susceptible patients. The MASCC/ISOO/ASCO guideline identifies poor oral health, invasive dental procedures, uncontrolled diabetes, and tobacco use among relevant risk factors.

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The ITI Consensus Report of 2023 emphasizes the importance of peri-implant supportive care and recognizes the need for caution when antiresorptive therapy is associated with implant-related outcomes.

Therefore, preventive care should include:

- periodontal stabilization before implant surgery;
- treatment of active oral infection;
- optimization of oral hygiene;
- prosthetic design that permits effective plaque control;
- regular professional maintenance;
- early identification and treatment of peri-implant inflammation;
- monitoring for bleeding, suppuration, pain, exposed bone, or unexplained radiographic changes; and
- long-term follow-up.

Clinically healthy implants should not be removed prophylactically solely because a patient is initiating antiresorptive therapy. Instead, the emphasis should be placed on maintaining peri-implant health and identifying complications at an early stage.

SURGICAL COMPLEXITY AND BONE AUGMENTATION

The proposed procedure is an additional determinant of risk.

An uncomplicated single implant placed in adequately healed bone should not automatically be considered equivalent to:

- multiple implant placement;
- guided bone regeneration;
- sinus floor elevation;
- block grafting;
- extensive ridge reconstruction; or
- complex reconstructive procedures.

The evidence supporting implant therapy under antiresorptive exposure is substantially stronger for uncomplicated implant therapy than for extensive augmentation procedures. Stavropoulos et al. specifically identified a lack of evidence

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concerning the safety of bone-grafting procedures in patients receiving antiresorptive therapy.

Therefore, the requirement for substantial augmentation should prompt additional caution, specialist assessment, and explicit discussion of the limited evidence base.

CLINICAL DECISION-MAKING

The first question in clinical assessment should be:

Why is the patient receiving antiresorptive therapy?

The second should be:

What medication, dose, frequency, and cumulative exposure has the patient received?

The third should be:

What procedure is being proposed, and what local and systemic risk factors are present?

Clinical assessment should include:

1. therapeutic indication;
2. medication and dose;
3. route and frequency;
4. cumulative duration of exposure;
5. current versus previous exposure;
6. sequential antiresorptive therapy;
7. corticosteroid use;
8. diabetes and other systemic comorbidities;
9. smoking;
10. periodontal status;
11. peri-implant status in existing implants;
12. oral hygiene;
13. presence of active infection;
14. planned surgical complexity;

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15. need for bone augmentation;
16. fracture risk associated with medication interruption; and
17. certainty of the available evidence.

Profile A — Osteoporosis / standard-dose therapy

Dental implants may be considered in appropriately selected patients after individualized assessment.

The 2025 International ONJ Taskforce suggests that antiresorptive therapy does not need to be discontinued before implant placement in patients with osteoporosis, although the recommendation is weak and based on very low-quality evidence.

Profile B — Osteoporosis with important risk modifiers

Patients with prolonged exposure, sequential therapy, systemic comorbidities, corticosteroid use, diabetes, smoking, active periodontal/peri-implant inflammation, or a need for extensive surgery require enhanced risk assessment.

Informed consent should explicitly acknowledge the low but non-zero risk of MRONJ and the limited certainty of evidence, particularly for denosumab.

Profile C — Active oncologic-dose bone-modifying therapy

Elective implant placement should ordinarily be avoided.

The MASCC/ISOO/ASCO guideline specifically includes implants among elective dentoalveolar procedures that should not be performed during active oncologic-dose BMA therapy. Exceptions require individualized specialist and oncology-team assessment.

TABLE 1. AUTHOR-PROPOSED CLINICAL DECISION FRAMEWORK BASED ON CURRENT EVIDENCE AND CONSENSUS RECOMMENDATIONS

Clinical domain	Profile A: Osteoporosis	Profile B: Osteoporosis with important modifiers	Profile C: Active oncologic-dose therapy

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	/standard-dose therapy		
Therapeutic indication	Osteoporosis	Osteoporosis	Malignant disease / prevention of skeletal-related events
Dose/regimen	Standard osteoporosis regimen	Standard regimen with prolonged or sequential exposure	Oncologic-dose BMA
Current exposure	May be current	Current or previous	Usually active therapy
Previous antiresorptive therapy	Document	Specifically assess cumulative exposure	Document complete treatment history
Sequential therapy	Assess	Particularly relevant	Assess
Bisphosphonate exposure	Usually lower-dose	Prolonged/cumulative exposure may increase concern	High-dose therapy substantially increases concern

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Denosumab	Evidence remains limited	Timing, cumulative exposure, and previous BP exposure should be assessed	High-dose oncologic regimen; elective implant placement ordinarily avoided
MRONJ risk	Low absolute risk, not zero	Potentially increased according to risk modifiers	Substantially higher clinical concern
Periodontal/ peri-implant condition	Must be controlled	Must be optimized before surgery	Preventive dental management strongly recommended
Procedure	Simple implant may be considered	Simple implant requires enhanced assessment; extensive surgery requires greater caution	Elective implant ordinarily avoided
Bone augmentation	Evidence limited	Consider only after individualized assessment	Elective augmentation generally avoided

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Existing healthy implant	Maintain and monitor	Maintain with enhanced surveillance	Do not remove prophylactically solely because of BMA therapy
Drug holiday	Not routinely indicated	No universal interval; coordinate with prescriber	Do not use drug holiday as routine strategy to enable elective implant
Informed consent	Low but non-zero MRONJ risk; evidence limitations	Explicit discussion of additional risk modifiers	Discuss substantially increased risk and alternatives
Evidence certainty	Low/very low for several outcomes	Low/very low	Intermediate evidence supports avoidance of elective dentoalveolar surgery during active oncologic-dose therapy

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Proposed clinical approach	Implant may be considered	Individualized multidisciplinary assessment	Avoid elective implant placement during active therapy

Source: Author-proposed framework based on current clinical guidelines, consensus statements, systematic reviews, and meta-analyses.

4. Discussion

The central finding of this narrative review is that the clinical question should no longer be framed as whether antiresorptive therapy is compatible or incompatible with dental implants. Rather, treatment decisions should be based on the interaction between therapeutic indication, medication regimen, cumulative exposure, systemic and local risk factors, and the proposed surgical procedure.

The most important distinction is between osteoporosis-dose and oncologic-dose therapy. Current evidence supports a more permissive approach to implant placement in selected patients receiving antiresorptive therapy for osteoporosis. The 2025 International ONJ Taskforce specifically concluded that antiresorptive therapy does not need to be discontinued before implant placement in osteoporosis patients, but emphasized that this recommendation is weak and based on very low-quality evidence (ALI et al., 2025).

This conclusion should not be generalized to patients receiving active oncologic-dose therapy. The MASCC/ISOO/ASCO guideline recommends avoiding elective dentoalveolar surgery, including implants, during active oncologic-dose BMA treatment (YAROM et al., 2019). Thus, the same sentence should not be used to describe patients with osteoporosis and patients with malignant disease.

The distinction between low absolute risk and absence of risk is equally important. MRONJ remains uncommon in osteoporosis populations, but estimates vary according to medication and study design. AAOMS reports low absolute risks for osteoporosis-associated therapy while acknowledging uncertainty, particularly regarding denosumab (RUGGIERO et al., 2022). Consequently, the appropriate

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terminology is not “safe” but rather “low absolute risk with limited certainty of evidence.”

The evidence regarding implant survival is also more nuanced than earlier literature suggested. The 2018 review by Stavropoulos et al. largely represented low-dose bisphosphonate treatment for osteoporosis and explicitly identified insufficient evidence regarding denosumab, high-dose therapy, and bone augmentation (STAVROPOULOS et al., 2018). The 2025 meta-analysis similarly demonstrated that associations between bisphosphonates and implant failure differed according to whether the analysis was performed at the implant or patient level (LIN et al., 2025). These findings reinforce the importance of avoiding overinterpretation of older evidence.

The distinction between implant survival and MRONJ is particularly important. A successful implant may remain osseointegrated while a later peri-implant inflammatory process contributes to osteonecrosis. The 2024 systematic review addressing osseointegrated implants highlights this issue and supports the need for long-term surveillance rather than assessment limited to the initial healing period (LI; LEUNG, 2024).

Denosumab deserves separate consideration. The 2026 systematic review identified only 10 eligible studies and concluded that the evidence remains heterogeneous and insufficient for definitive conclusions. Sequential bisphosphonate-to-denosumab exposure, timing of implant placement, peri-implantitis, and comorbidities emerged as potentially relevant factors (PEREIRA SANTOS et al., 2026). Therefore, denosumab should not be treated as pharmacologically or evidentially equivalent to bisphosphonates.

The concept of drug holiday should consequently be interpreted cautiously. In osteoporosis, routine interruption before implant placement is not supported by the 2025 International ONJ Taskforce consensus (ALI et al., 2025). In denosumab-treated patients, interruption may have skeletal consequences because of rebound bone turnover (RUGGIERO et al., 2022). In oncology, the question is fundamentally different because elective implant placement should ordinarily be avoided during active oncologic-dose therapy rather than routinely facilitated through medication interruption (YAROM et al., 2019).

Long-term peri-implant maintenance should therefore be regarded as a central component of risk management. Prevention and early treatment of periodontal and peri-implant inflammation may be particularly important because local infection and

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inflammation can contribute to tissue breakdown in susceptible patients (RUGGIERO et al., 2022; PEREIRA SANTOS et al., 2026).

Finally, informed consent should reflect the actual certainty of the evidence. Patients should be informed that the absolute risk of MRONJ in osteoporosis is low, but not zero; that evidence regarding denosumab and implants remains limited; that MRONJ may develop around previously osseointegrated implants; and that future changes in systemic therapy may modify the clinical risk profile (ALI et al., 2025; LI; LEUNG, 2024; PEREIRA SANTOS et al., 2026).

CLINICAL IMPLICATIONS

Based on the current evidence, the following principles may guide clinical decision-making:

1. The indication for antiresorptive therapy should be established before assessing the medication itself.
2. Osteoporosis-dose and oncologic-dose therapy should be treated as distinct clinical scenarios.
3. Antiresorptive therapy alone should not be considered an absolute contraindication to implant placement in selected osteoporosis patients.
4. The low absolute risk of MRONJ in osteoporosis does not mean that risk is absent.
5. Elective implant placement should ordinarily be avoided during active oncologic-dose BMA therapy.
6. Implant survival and MRONJ should be evaluated as separate outcomes.
7. Previous bisphosphonate exposure remains clinically relevant after treatment discontinuation.
8. Denosumab requires specific consideration because its pharmacology differs from that of bisphosphonates and evidence regarding implants remains limited.
9. Sequential bisphosphonate-to-denosumab exposure should be documented.
10. There is no universally validated denosumab interval for implant placement.
11. The dentist should not independently interrupt or prolong denosumab therapy.
12. Clinically healthy pre-existing implants should not be removed prophylactically solely because antiresorptive therapy is initiated.

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13. Periodontal and peri-implant inflammation should be controlled before and after implant therapy.
14. Extensive grafting and reconstructive procedures should be approached more cautiously than uncomplicated implant placement because evidence is limited.
15. Long-term maintenance and surveillance are essential components of risk management.

5. Conclusion

Dental implant therapy in patients exposed to antiresorptive medications should not be governed by a binary rule of contraindication versus safety. The decision should be based on the therapeutic indication, medication type, dose, frequency, cumulative exposure, current and previous treatment, sequential antiresorptive therapy, systemic risk factors, oral conditions, and surgical complexity.

In patients treated for osteoporosis, antiresorptive therapy alone does not constitute an absolute contraindication to implant placement. However, the available evidence remains limited and frequently of low or very low certainty, and MRONJ remains a possible complication.

In patients receiving active oncologic-dose bone-modifying therapy, elective implant placement should ordinarily be avoided, consistent with current oncology-focused guidance.

Denosumab requires particular caution because of the limited implant-specific evidence, the consequences of treatment interruption, and the potential relevance of sequential exposure. No universal drug-holiday or implant-timing protocol can currently be recommended.

Ultimately, the most appropriate clinical approach is one of individualized risk assessment, interdisciplinary planning, meticulous control of periodontal and peri-implant inflammation, informed consent, and long-term follow-up.

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