



Contents lists available at ScienceDirect

# The Journal of Arthroplasty

journal homepage: [www.arthroplastyjournal.org](http://www.arthroplastyjournal.org)



World Expert Meeting in Arthroplasty 2024

## Should Patients Who Have Periprosthetic Fractures Around the Hip or Knee Be Screened and Treated for Osteoporosis?



Seyed Mohammad Javad Mortazavi, MD <sup>a,\*</sup>, Seyed Hadi Kalantar, MD <sup>b</sup>,  
Shiro Kajiyama, MD <sup>c</sup>, David Choon, MD <sup>d</sup>, Antony Palmer, MD <sup>e</sup>,  
Henrique Cabrita, MD <sup>f</sup>, Riccardo Compagnoni, MD <sup>g</sup>, Jiri Gallo, MD <sup>h</sup>,  
Ali Soltani Farsani <sup>a</sup>

<sup>a</sup> Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran

<sup>b</sup> Department of Orthopedic Surgery, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

<sup>c</sup> Department of Orthopaedic Surgery and Sports Medicine Center, Nagasaki University Hospital, Nagasaki, Japan

<sup>d</sup> Department of Orthopaedic Surgery, University of Malaya Medical Centre, Kuala Lumpur, Malaysia

<sup>e</sup> Nuffield Department of Orthopaedics, Rheumatology, and Musculoskeletal Sciences, University of Oxford, Oxford, UK

<sup>f</sup> Instituto Vita, São Paulo, Brazil

<sup>g</sup> Orthopaedic Department, Department of Biomedical, Surgical and Dental Sciences, University of Milan, Milan, Italy

<sup>h</sup> Faculty of Medicine and Dentistry, Department of Orthopaedics, Palacky University Olomouc, Teaching Hospital Zdravotník, Olomouc, Czech Republic

### ARTICLE INFO

#### Article history:

Received 20 September 2024

Received in revised form

14 October 2024

Accepted 15 October 2024

Available online 24 October 2024

#### Keywords:

osteoporosis

knee arthroplasty

hip arthroplasty

periprosthetic fracture

screening

osteoporosis treatment

### Should patients who have periprosthetic fractures around the hip or knee be screened, and treated, for osteoporosis?

**Response/Recommendation:** While it is well established that patients who have osteopenia or osteoporosis face a heightened risk of periprosthetic fractures (PPFs) around the hip or knee, current literature lacks conclusive evidence demonstrating that screening and treating these underlying bone conditions markedly reduces the incidence of PPF.

**Level of Evidence:** moderate.

**Expert Vote:** agree 75.9%, disagree 18.1%, and abstain 6%

### Rationale

Periprosthetic fractures (PPFs) can occur at any age following total hip arthroplasty and total knee arthroplasty, but their incidence is notably higher in postmenopausal women and men over the age of 50 years, likely due to the increased prevalence of osteoporosis in these populations [1]. Based on this, the Bone

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to <https://doi.org/10.1016/j.arth.2024.10.067>.

\* Address correspondence to: Seyed Mohammad Javad Mortazavi, MD, Joint Reconstruction Research Center, Tehran University of Medical Sciences, End of Keshavarz Blvd, Tehran 1419733141, Iran.

Health and Osteoporosis Foundation advocates for the prevention, risk assessment, diagnosis, and treatment of osteoporosis in postmenopausal women and men aged 50 years and older [2]. Several studies have focused on the prevention of PPF after total hip arthroplasty and total knee arthroplasty, with some suggesting that a low T-score on dual-energy X-ray absorptiometry scans and reduced bone density around implants may predict the likelihood of PPF [3,4]. Furthermore, the prophylactic use of antiosteoporotic medications, such as bisphosphonates, which are Food and Drug Administration-approved, has been explored. These agents have demonstrated promising results in enhancing bone density around implants in multiple studies [5,6].

We conducted a comprehensive review of the literature, thoroughly screening and analyzing studies published from 2000 onwards. A total of 16 studies were included in our systematic review, comprising eight randomized controlled trials (RCTs) and eight cohort studies [3,4,7–18]. Larger cohort studies, which incorporated data from smaller cohorts, were prioritized for final analysis to reduce the potential for data overlap. To further explore the effect of prophylactic bisphosphonate use, we performed four separate meta-analyses.

In the first set of studies, two meta-analyses were conducted to compare the rate of PPF between treatment and control groups in RCTs and cohort studies. The analysis of RCTs revealed no statistically significant difference in PPF rates (relative risk (RR) = 1.08, 95% confidence interval (CI): [0.15 to 7.66],  $P = 0.94$ ). Interestingly, in cohort studies involving over 126,000 patients, the PPF rate was unexpectedly higher in the treatment group compared to the control group, although this difference was not statistically significant (relative risk [RR] = 2.56, 95% confidence interval [CI]: [0.73 to 9.03],  $P = 0.14$ ). In the second set of studies, two meta-analyses examined the rate of PPF in relation to the timing of bisphosphonate prophylaxis, comparing preoperative to postoperative administration. Similar to the first analysis, no significant differences in PPF rates were found in either the preoperative prophylaxis group (RR = 2.56, 95% CI: [0.72 to 9.03],  $P = 0.14$ ) or the postoperative prophylaxis group (RR = 1.08, 95% CI: [0.15 to 7.66],  $P = 0.94$ ).

Although PPF can occur at various intervals following surgery, they most frequently arise within the first two years post-operatively. In a study conducted by Namba et al., which included over 34,000 patients aged 40 years and older, the mean time to PPF was reported to be 1.8 years [15]. Additionally, atypical femur fractures, characterized by unusual radiologic features and occurring with minimal trauma, are more prevalent among patients on long-term bisphosphonate therapy [19]. However, the exact incidence of atypical femur fractures was not clearly defined in the studies reviewed, and the distinction between insufficiency fractures and atypical fractures was not established. Importantly, most patients included in the analysis had been on bisphosphonate treatment for a relatively short duration, typically up to six months.

In conclusion, although bisphosphonates have been shown to enhance bone mineral density, their effect on reducing the incidence of PPF remains unproven. Patients receiving prophylactic bisphosphonate treatment appear to experience a similar rate of PPF as those receiving only calcium supplements at a dose of 500 mg. The existing literature indicates that the rate of PPF, particularly around the hip, is affected by the use of uncemented components, both in the early postoperative period and later on by contributing to stress shielding and a subsequent reduction in bone mineral density [20,21].

#### CRediT authorship contribution statement

**Seyed Mohammad Javad Mortazavi:** Writing – review & editing, Project administration, Investigation, Data curation. **Seyed Hadi Kalantar:** Investigation, Data curation. **Shiro Kajiyama:** Writing – review & editing. **David Choon:** Writing – review & editing, Conceptualization. **Antony Palmer:** Writing – review & editing, Conceptualization. **Henrique Cabrita:** Writing – review & editing, Validation. **Riccardo Compagnoni:** Writing – review & editing, Validation. **Jiri Gallo:** Writing – review & editing. **Ali Soltani Farsani:** Writing – original draft, Investigation, Formal analysis, Data curation.

#### References

- [1] Bernatz JT, Brooks AE, Squire MW, Illgen 2nd RL, Binkley NC, Anderson PA. Osteoporosis is common and undertreated prior to total joint arthroplasty. *J Arthroplasty* 2019;34:1347–53. <https://doi.org/10.1016/j.arth.2019.03.044>.
- [2] LeBoff MS, Greenspan SL, Insogna KL, Lewiecki EM, Saag KG, Singer AJ, et al. The clinician's guide to prevention and treatment of osteoporosis. *Osteoporos Int* 2022;33:2049–102. <https://doi.org/10.1007/s00198-021-05900-y>.
- [3] Jaroma AVJ, Soininvaara TA, Kröger H. Effect of one-year post-operative alendronate treatment on periprosthetic bone after total knee arthroplasty. *Bone Joint J* 2015;97B:337–45. <https://doi.org/10.1302/0301-620X.97B3.33643>.
- [4] Muren O, Akbarian E, Salemyr M, Bodén H, Eisler T, Stark A, et al. No effect of risendronate on femoral periprosthetic bone loss following total hip arthroplasty a 4-year follow-up of 61 patients in a double-blind, randomized placebo-controlled trial. *Acta Orthop* 2015;86:569–74. <https://doi.org/10.3109/17453674.2015.1041846>.
- [5] Arabmotlagh M, Pilz M, Warzecha J, Rauschmann M. Changes of femoral periprosthetic bone mineral density 6 years after treatment with alendronate following total hip arthroplasty. *J Orthop Res* 2009;27:183–8. <https://doi.org/10.1002/jor.20748>.
- [6] Shi M, Chen L, Xin Z, Wang Y, Wang W, Yan S. Bisphosphonates for the preservation of periprosthetic bone mineral density after total joint arthroplasty: a meta-analysis of 25 randomized controlled trials. *Osteoporos Int* 2018;29:1525–37. <https://doi.org/10.1007/s00198-018-4488-7>.
- [7] Venesmaa PK, Kröger HPJ, Miettinen HJA, Jurvelin JS, Suomalainen OT, Alhava EM. Alendronate reduces periprosthetic bone loss after uncemented primary total hip arthroplasty: a prospective randomized study. *J Bone Miner Res* 2001;16:2126–31. <https://doi.org/10.1359/jbmr.2001.16.11.2126>.
- [8] Wang CJ, Wang JW, Weng LH, Hsu CC, Huang CC, Chen HS. The effect of alendronate on bone mineral density in the distal part of the femur and proximal part of the tibia after total knee arthroplasty. *J Bone Joint Surg Am* 2003;85:2121–6. <https://doi.org/10.2106/0004623-200311000-00009>.
- [9] Wilkinson JM, Eggleton AC, Stockley I, Peel NFA, Hamer AJ, Eastell R. Effect of pamidronate on bone turnover and implant migration after total hip arthroplasty: a randomized trial. *J Orthop Res* 2005;23:1–8. <https://doi.org/10.1016/j.jorthres.2004.06.004>.
- [10] Wang CJ, Wang JW, Ko JY, Weng LH, Huang CC. Three-year changes in bone mineral density around the knee after a six-month course of oral alendronate following total knee arthroplasty – a prospective, randomized study. *J Bone Joint Surg Am* 2006;88A:267–72. <https://doi.org/10.2106/JBJS.E.00051>.
- [11] Tapaninen TS, Venesmaa PK, Jurvelin JS, Miettinen HJA, Kröger HPJ. Alendronate reduces periprosthetic bone loss after uncemented primary total hip arthroplasty – a 5-year follow-up of 16 patients. *Scand J Surg* 2010;99:32–7. <https://doi.org/10.1177/14574969100990108>.
- [12] Trevisan C, Ortolani S, Romano P, Isaia G, Agnese L, Dallari D, et al. Decreased periprosthetic bone loss in patients treated with clodronate: a 1-year randomized controlled study. *Calcif Tissue Int* 2010;86:436–46. <https://doi.org/10.1007/s00223-010-9356-1>.
- [13] Yukizawa Y, Inaba Y, Kobayashi N, Choe H, Kubota S, Saito T. Efficacy of alendronate for the prevention of bone loss in calcar region following total hip arthroplasty. *J Arthroplasty* 2017;32:2176–80. <https://doi.org/10.1016/j.jarth.2017.02.036>.
- [14] Fu GT, Lin LJ, Sheng PY, Li CC, Zhang JX, Shen J, et al. Efficiency of zoledronic acid in inhibiting accelerated periprosthetic bone loss after cementless total hip arthroplasty in osteoporotic patients: a prospective, cohort study. *Orthop Surg* 2019;11:653–63. <https://doi.org/10.1111/os.12513>.
- [15] Namba RS, Inacio MC, Cheetham TC, Dell RM, Paxton EW, Khadod MX. Lower total knee arthroplasty revision risk associated with bisphosphonate use, even in patients with normal bone density. *J Arthroplasty* 2016;31:537–41. <https://doi.org/10.1016/j.arth.2015.09.005>.
- [16] Jeong S, Lee JW, Boucher HR. The effect of preoperative bisphosphonate use on total hip arthroplasty outcomes. *J Arthroplasty* 2023;38:2393–2397.e2. <https://doi.org/10.1016/j.arth.2023.05.027>.
- [17] Lee A, Durst CR, Rajaei SS. Initiation of bisphosphonates prior to total joint arthroplasty does not lower periprosthetic fracture risk. *J Arthroplasty* 2024;39:1459–62. <https://doi.org/10.1016/j.jarth.2023.11.036>.
- [18] Serino 3rd J, Terhune EB, Harkin WE, Weintraub MT, Baim S, Della Valle CJ. Bisphosphonate use may be associated with an increased risk of periprosthetic hip fracture. *J Arthroplasty* 2024;39:448–451.e1. <https://doi.org/10.1016/j.jarth.2023.08.029>.
- [19] Black DM, Abrahamsen B, Bouxsein ML, Einhorn T, Napoli N. Atypical femur fractures: review of epidemiology, relationship to bisphosphonates, prevention, and clinical management. *Endocr Rev* 2018;40:333–68. <https://doi.org/10.1210/er.2018-00001>.
- [20] Chen W-P, Tai C-L, Lee M, Lee P-C, Liu C-P, Shih C-H. Comparison of stress shielding among different cement fixation modes of femoral stem in total hip arthroplasty – a three-dimensional finite element analysis. *J Med Biol Eng* 2004;24.
- [21] Burchard R, Graw JA, Soost C, Schmitt J. Stress shielding effect after total hip arthroplasty varies between combinations of stem design and stiffness-a comparing biomechanical finite element analysis. *Int Orthop* 2023;47:1981–7. <https://doi.org/10.1007/s00264-023-05825-7>.