Letter to the Editor / Editöre Mektup

DOI: 10.4274/tod.galenos.2025.43925
Turk J Osteoporos

Humanoid Assistance in Osteoporosis Care: A New Frontier in Digital Health

Osteoporoz Bakımında İnsansı Robot Destekli Yaklaşımlar: Dijital Sağlıkta Yeni Bir Ufuk

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Keywords: Artificial intelligence, digital health, humanoid robotics, osteoporosis, risk assessment
Anahtar kelimeler: Yapay zeka, dijital sağlık, insansı robotlar, osteoporoz, risk değerlendirmesi

Dear Editor,

Osteoporosis is one of the most underdiagnosed and undertreated public health problems globally, especially among older adults (1). It is characterized by low bone mass and the microarchitectural deterioration of bone tissue, and it results in increased fragility and susceptibility to fractures. Despite the availability of effective diagnostic tools and evidence-based therapeutic strategies, important gaps in screening, delayed diagnosis, low treatment initiation rates, and poor long-term adherence remain relevant for optimal disease management. The barriers lead to high incidence of fragility fractures, morbidity, loss of independence and in turn, considerable healthcare costs worldwide (1).

Given these challenges, we propose an innovative and forward-looking solution based on the integration of humanoid robots, such as Pepper, NAO or TIAGo, to osteoporosis care pathways. Used in geriatric rehabilitation and chronic disease management, these semi-autonomous robotic platforms have the potential to yield meaningful contributions along the continuum of osteoporosis prevention, treatment, and rehabilitation (2). We recommend their incorporation into the areas of osteoporosis care listed below in five domains:

1. Dual Energy X-ray Absorptiometry (DEXA) scan coordination: Humanoid robots can help patients for DEXA-scans, contributing with instructions, adjusting to recovery, and making the process less stressful.

2. Medication adherence monitoring: Robots can prompt patients to take antiresorptive (e.g., bisphosphonates, vitamin D) medications or supplements in a timely manner, keep records of missed doses, and send alerts to healthcare providers (3).

3. Patient education and fall prevention: Via interactive auditory and visual articulation, robots are able to provide personalized education on topics such as osteoporosis, lifestyle changes, nutrition, and fall risk prevention strategies-all important features of long-term disease management (4).

4. Artificial intelligence (AI)-based risk stratification: Humanoid systems can help to identify high fracture risk individuals, and encourage timely referral for further evaluation or treatment initiation, using risk tools like FRAX or QFracture integrated into the humanoid system.

5. Post-fracture rehabilitation and monitoring: Robots can assist home-based exercise protocols after osteoporotic fractures, provide input on movement, track compliance, and promote re-entry to functional activity in a graded fashion, "particularly relevant to elderly individuals" (5).

When integrated together, these functions can help alleviate some burden from healthcare providers, with particular benefit for those in resource-limited contexts, and improve the accuracy and continuity of osteoporosis care. The empathic interfaces and natural language processing capabilities of humanoid robots position them as ideal prescribers for older adults, enhancing engagement, satisfaction and consequently, therapeutic outcomes.

However, before its widespread implementation, ethical and practical issues must be resolved. These are related to the data privacy, cost effectiveness, user acceptance, and training needs.

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Received/Geliş Tarihi: 12.04.2025 **Accepted/Kabul Tarihi:** 21.05.2025 **Epub:** 05.08.2025

Cite this article as/Atıf: Sarıkaya T, Öztürk B, Yalçın Ü, Bağcıer F. Humanoid assistance in osteoporosis care: a new frontier in digital health. Turk J Osteoporos. [Epub Ahead of Print]

However, we believe the advantages significantly outweigh the barriers, and this represents an opportunity to advance care for metabolic bone diseases through smart, human-centered technology.

We call on academic medical centers, rehabilitation hospitals, geriatrics units, and developers in the health tech industry to collaborate on pilot projects and clinical research evaluating the feasibility and efficacy of humanoid-assisted osteoporosis care. The convergence of robotics, AI, and rehabilitative science holds immense potential to address the pressing needs of our aging population and shift the paradigm of osteoporosis management from reactive to proactive.

Footnotes

Authorship Contributions

Concept: B.Ö., F.B., Design: T.S., Ü.Y., Data Collection or Processing: B.Ö., Analysis or Interpretation: Ü.Y., Literature Search: T.S., Writing: T.S., F.B.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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