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The clinical role of REMS in bone health assessment and imminent fracture risk evaluation across musculoskeletal conditions

Authors

Author Affiliations

- A Kurth
- F Conversano
- G Del Vecchio
- R Franchini
- Lombardi
- G Peluso
- Pisani
- C Stomaci
- S Casciaro

Introduction: * Equal contribution in alphabetic orderRadiofrequency Echographic Multi-Spectometry (REMS) is an innovative ultrasound-based technology used to assess bone health and predict an imminent (within 5 years) fracture risk at the reference anatomical sites (lumbar vertebrae and femoral neck). It provides data of bone quantity (BMD, T-score and Z-score) and quality (insights into bone microarchitecture via Fragility Score, FS). REMS is characterized by a radiation-free nature, portability, and ability to avoid any artefacts, that make it a safe and versatile tool. Recent scientific studies have underscored its clinical utility, demonstrating that REMS is effective in evaluating bone fragility, even in cases where traditional methods like Dual Energy X-Ray Absorptiometry (DXA) may be limited by anatomical deformities, artefacts, or accessibility issues.

Methods: This review was conducted following a structured literature examination to identify relevant clinical studies published on important peer-review scientific journals that addressed the effectiveness of REMS technology in assessing bone health and imminent fracture risk across various conditions, in presence of anatomical deformities, bone artifacts and accessibility issues. Scientific evidence was screened for relevance, followed by full-text reviews conducted independently by two authors and discussed through consultation with a third reviewer.

Results: This review focuses on six key studies published between 2022 and 2025 on the REMS clinical application for bone assessment. Overall, the evidence shows that REMS can identify bone fragility and quality alterations that conventional DXA may overlook. In inflammatory and degenerative conditions such as axial spondyloarthritis (Badea et al., 2025) and hip or spinal osteoarthritis (Caffarelli et al., 2022; Caffarelli et al., 2024) REMS provided more accurate BMD evaluations by minimizing artefact-related overestimation. Its automated analysis was shown to reliably exclude low-quality frames and detect anatomical or positioning errors, improving measurement consistency (Ishizu et al., 2023). In patients with previous fragility fractures, REMS combined BMD and bone quality parameters to estimate imminent 5-year fracture risk (Kirilov et al., 2023). Finally, REMS proved suitable for bedside, radiation-free evaluation in individuals with severe disability or immobility, supporting its use in rehabilitation and low-resource settings (Sakai et al., 2024).

Discussion: Overall, these findings suggest that REMS offers several advantages including no ionizing radiation allowing safe, repeatable monitoring; enhanced diagnostic reliability in the presence of bone artifacts; the possibility to estimate an imminent fracture risk by combining BMD and bone quality, and portability and accessibility, reaching underserved populations.

Korrespondenzadresse: Andreas Kurth, Orthopädisches Privatinstitut Dr. Baron & Kollegen, Goethestraße 31-33, 60313 Frankfurt/Main, Deutschland, E-Mail: ahakurth@t-online.de

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