

Calcium isotopes ($\delta^{44/42}\text{Ca}$) in Fracture Risk Assessment of osteoporotic fractures

ALEXANDER HEUSER¹, ANTON KRACKHARDT^{2,3},
JASPER AMTSFELD³, RALF SCHWANBECK³, NILS
REIMERS³, MICHAEL MÜLLER⁴, AMARIN LUBNOW⁴
AND ANTON EISENHAEUER¹

¹GEOMAR Helmholtz Centre for Ocean Research Kiel

²Universität zu Lübeck

³Stryker Trauma GmbH

⁴Department of Orthopedics and trauma surgery Univ. Medical
Center Schleswig-Holstein (UKSH)

Osteoporosis is a serious skeletal disease that reduces bone density, increases the risk of fractures, particularly in the hip and spine, leading to chronic pain and in a reduced quality of life. Current fracture risk calculators estimate the probability of major osteoporotic fractures over 5–10 years based on factors such as age, sex, weight, and bone mineral density (BMD). However, they do not incorporate calcium (Ca) isotope biomarkers, despite the evidence that $\delta^{44/42}\text{Ca}$ in blood serum and urine is a highly sensitive and specific indicator of bone Ca balance and early indicator for osteoporosis.

To address this gap, the OSTEO-FRAK-RISK study was initiated in the frame of the BLUEHEALTHTECH alliance (www.bluehealthtech.de), enrolling 160 women (aged ≥ 60 years, BMI $< 30 \text{ kg/m}^2$). After screening, five participants were excluded. The remaining participants underwent BMD measurement via dual-energy X-ray absorptiometry (DXA), completed a risk factor questionnaire, and had $\delta^{44/42}\text{Ca}$ levels measured in blood serum and urine at baseline (V1). Follow-up measurements were taken after one (V2) and two years (V3).

Initial DXA results classified 30% (n=46) of participants as osteoporotic, 49% (n=76) as osteopenic, and 21% (n=33) as having normal bone density. In V1, 31% of both $\delta^{44/42}\text{Ca}_{\text{serum}}$ and $\delta^{44/42}\text{Ca}_{\text{urine}}$ values fell below threshold levels, indicating a negative bone Ca balance in accordance with the DXA findings. $\delta^{44/42}\text{Ca}_{\text{serum}}$ and $\delta^{44/42}\text{Ca}_{\text{urine}}$ were $-0.86 \pm 0.14\text{‰}$ and $0.24 \pm 0.28\text{‰}$ (1SD), respectively. In V2, 144 participants returned for follow-up, and no major osteoporotic fractures were reported within the past year. Data analysis is ongoing.

Based on the data of the earlier OsteoGeo study [1] a first version of a Ca isotope-based fracture risk calculator (“CIMPredict”) was developed. OSTEO-FRAK-RISK data will be further used to refine and enhance osteoporosis fracture risk prediction by CIMPredict.

[1] Eisenhauer et al. (2019) *Bone Reports*, **10**, 100200.
doi:10.1016/j.bonr.2019.100200