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FRACTURE RISK PREDICTION: COMPARATIVE EVALUATION OF ULTRASOUND-BASED FRAGILITY SCORE AND DXA-MEASURED BMD AGAINST FRAX®

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Background: A high percentage of fragility fractures occur in subjects showing low bone strength in presence of a normal bone mineral density (BMD). Consequently, the approach to bone health assessment and fracture prevention is gradually changing, moving the focus from the identification of osteoporotic patients (based on BMD thresholds) towards the detection of individuals at high risk of fracture. Currently, the only validated tool that provides a precise quantification of the osteoporotic fracture risk is FRAX®, which is based on age, sex, body mass index (BMI) and a series of clinical risk factors, taking into account epidemiological data that are specific for patient country. FRAX® calculation can also include femoral neck BMD measured by dual X-ray absorptiometry (DXA), since it has been shown that integration of BMD and clinical risk factors provides improved fracture predictions. Nevertheless, DXA availability is limited by the typical issues related to ionizing radiation employment (high costs, need of dedicated structures with certified operators, long-term safety risks).

Objectives: Aim of this work was to compare the performance of DXA-measured BMD and a novel ultrasound (US) parameter measured on lumbar spine in the estimation of osteoporotic fracture risk as calculated by FRAX®.

Methods: 80 female patients [40-80 years; BMI (body mass index) ≤ 30 kg/m^2] were enrolled for the study. Each of them answered the FRAX® questionnaire and underwent the following diagnostic examinations: a conventional DXA investigation of lumbar spine and proximal femur (Hologic Discovery) and an abdominal US scan of lumbar spine. US data were analyzed by an innovative algorithm that processed both echographic images and “raw” radiofrequency (RF) signals, providing as final output a new parameter named Fragility Score (F.S.), which quantifies bone strength. For each patient, FRAX® 10-year probability of a major osteoporotic fracture was calculated both with and without femoral neck BMD inclusion. Pearson coefficient (r) was used to compare the performance of F.S. and BMD values in the estimation of fracture risk provided by FRAX®.

Results: Fracture risk provided by FRAX® with femoral BMD included in the calculation showed a good correlation with F.S. ($r = 0.70$, $p<0.001$) and, as expected, with femoral neck BMD ($r = -0.72$, $p<0.001$), while the correlation was weaker for lumbar BMD ($r = -0.44$, $p<0.001$). Furthermore, F.S. was the only considered diagnostic parameter that kept an appreciable correlation with FRAX® predictions even when their calculation did not include femoral BMD ($r = 0.52$ for F.S., $r = -0.21$ for femoral BMD, $r = -0.07$ for lumbar BMD; $p<0.001$ for all).

Conclusions: The proposed US-based F.S. alone showed a good correlation with osteoporotic fracture risk calculated by FRAX® integrated with femoral neck BMD, which represents the most reliable value. The performance of F.S. in fracture risk estimation was significantly better than lumbar BMD and comparable with femoral BMD. Therefore, F.S. is a suitable candidate to be employed for fracture risk prediction in primary healthcare settings.

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