A New Ultrasonic Method for Diagnosis of Osteoporosis on Hip and Spine

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INTRODUCTION: Currently, the only available method to reliably predict osteoporotic fractures is represented by bone mineral density (BMD) measurements on proximal femur or spine, which require the use of X-rays. Aim of this study is to illustrate working principles and feasibility of a new ultrasound (US) method for bone densitometry and osteoporosis diagnosis applicable on both proximal femur and spine.

METHODS: A new fully automatic algorithm was developed to calculate the same diagnostic parameters of a dual-energy X-ray absorptiometry (DXA) examination (BMD, T-score, Z-score) starting from an US scan of the considered bone district. The main implemented features include: 1) combination of advanced spectral and statistical analyses on either US images and unfiltered “raw” signals; 2) diagnostic calculations always performed on regions of interest fulfilling specific requirements in terms of both morphology and spectrum; 3) body mass index (BMI) of the patient is taken into account during data processing; 4) integration with a reference database containing model acquisitions for each combination of anatomical site, ethnic group and sex. Effectiveness of this methodology was tested on 360 female patients (45-80 yr, BMI≤40 kg/m^2) that underwent both a DXA examination (Hologic Discovery) and an US scan of either lumbar spine or proximal femur.

RESULTS: DXA diagnosis (osteoporotic, osteopenic, healthy) was correctly replicated by the US method for 87.0% of spines and 82.2% of femurs. Average difference between DXA-measured BMD and the corresponding values calculated from US data (mean±SD) was -0.7%±10.1% for spines and +1.6%±16.9% for femoral necks (similar results were obtained for T-score and Z-score values).

CONCLUSIONS: The proposed approach could represent an important alternative to DXA for early osteoporosis diagnosis on both hip and spine through population mass screenings, providing diagnostic accuracies similar to DXA ones without employing ionizing radiation.