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EVALUATION OF BONE MINERAL DENSITY ON FEMORAL NECK: PRELIMINARY CLINICAL VALIDATION OF A NEW ULTRASONIC METHOD

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Background: Hip fractures are a major cause of public health burden associated with osteoporosis in terms of mortality, disability and health care costs. The only possible way to reduce the occurrence of hip fractures is represented by the adoption of more effective strategies for osteoporosis diagnosis and hip fracture prevention through population mass screenings. "Gold standard" method for osteoporosis diagnosis is currently represented by measurement of bone mineral density (BMD) obtained through dual-energy X-ray absorptiometry (DXA) and it has been demonstrated that BMD measurements on proximal femur provide the most reliable predictions of hip fracture risk. However, because of high costs and issues related to X-ray employment, DXA cannot be used for screening purposes. Ultrasound (US) systems for bone status assessments have been also developed, but all the commercially-available devices are dedicated to peripheral bone districts and their results present poor correlations with femoral neck BMD.

Objectives: Aim of this work is to carry out a preliminary clinical validation of a novel ultrasonic methodology for bone densitometry directly applicable femoral neck and capable of providing significant agreement with DXA results.

Methods: A cohort of 100 female patients was recruited according to the following enrollment criteria: 60-80 years of age, body mass index (BMI) ≤ 40 kg/m², absence of important deambulation impairments, medical prescription for a femoral DXA, signed informed consent. All the enrolled patients underwent two different diagnostic investigations: a conventional DXA densitometry of the proximal femur (Hologic Discovery) and an US scan of the same bone district, acquiring both echographic images and unfiltered "raw" signals. US data were analyzed by a new algorithm that, through a series of spectral and statistical analyses on both the echographic images and the corresponding unfiltered "raw" signals, and taking into account for each patient the specific combination of age and BMI, calculated the same diagnostic parameters obtained from DXA examination (BMD, T-score, Z-score). Accuracy of each parameter calculated by this algorithm was then evaluated through a direct comparison with DXA results as a function of both patient age and BMI.

Results: For 81.0% of the studied patients US diagnosis (healthy, osteopenic or osteoporotic patient) was the same of the corresponding DXA one. Pearson correlation coefficient (r) between DXA and US measurements was evaluated for each diagnostic parameter: r=0.68 for BMD, r=0.68 for T-score and r=0.70 for Z-score. Analyzing the correlation values for each group of patients having both BMI and age in the same ranges, we found maximum correlation (r=0.80) for T-score and Z-score values measured on patients with both age in the range 71-75 yr and BMI in 30-40 kg/m², while minimum correlation (r=0.64) was found for BMD and T-score values measured on patients having both age in the range 61-65 yr and BMI in 25-30 kg/m².

Conclusions: The adopted US method for femoral bone densitometry showed an accuracy level comparable with DXA one, in terms of both diagnosis agreement and correlation of single parameter values, therefore showing a great potential for early osteoporosis diagnosis and hip fracture prevention through population mass screenings.

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