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Estimation of Femoral Neck Bone Mineral Density by Ultrasound Scanning: Preliminary Results and Feasibility

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Abstract: Aim of this paper was to assess the diagnostic accuracy of a novel ultrasound (US) approach for femoral neck densitometry. A total of 173 female patients (56-75 years) were recruited and all of them underwent a dual X-ray absorptiometry (DXA) of the proximal femur and an US scan of the same anatomical district. Acquired US data were analysed through a novel algorithm that performed a series of spectral and statistical analyses in order to calculate bone mineral density employing an innovative method. Diagnostic accuracy of US investigations was quantitatively assessed through a direct comparison with DXA results. The average diagnostic agreement resulted pretty good (85.55%), with a maximum (88.00%) in correspondence of the youngest investigated patients (56-60 y). Overall, diagnostic accuracy showed only minimal variations with patient age, indicating that the proposed approach has the potential to be effectively employable for osteoporosis diagnosis in the whole considered age interval.

1. Introduction

Osteoporosis is the most common bone disease in humans, characterized by a low bone mass and a micro-architectural deterioration of bone tissue, with a subsequent increase in bone fragility and susceptibility to fracture, and representing a major public health problem [1,2]. This pathology affects more than 200 million people worldwide, causing over 8 million of new fractures each year; in Europe, almost 3 million of new osteoporotic fractures occur yearly, causing 43,000 deaths and accounting for a direct cost of about €40 billion [3]. The most frequent osteoporotic fractures occur at either spine or proximal femur, with the latter in particular representing a very common injury for elderly patients, requiring expensive therapies and/or surgeries and frequently resulting in reduced quality of life, disability and mortality [4]. The incidence of femoral fractures increases with age, with a 75% occurring in women [5], and typically accounts for more than 70% of total direct costs of osteoporotic fractures [6]. The mortality rates associated with femoral fractures within 1 year vary from 8% to 36%, depending on concomitant risk factors (age, comorbidity, pre-fracture functional status, etc.) [7], with a higher mortality in men than in women [8]. In addition, femoral fractures are followed by a 2.5-fold increased risk of future osteoporotic fractures [9] and only 40% of fractured patients fully regain their pre-fracture level of independence [2,10].

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