

Bone mineral density measurement in the calcaneus with DXL: comparison with hip and spine measurements in a cross-sectional study of an elderly female population

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Abstract We investigated the relationship between calcaneal and axial bone mineral density in an elderly female population. We also investigated the influence of changing the reference populations on *T*-score values. Bone mineral density (BMD) was determined in 388 women (mean age 73 years) participating in a cross-sectional study. BMD values were determined at the left hip and the lumbar spine, L1–L4, using Hologic QDR 4500 equipment for dual X-ray absorptiometry (DXA). The calcaneal measurements were made with DEXA-T, a device using a dual X-ray and laser (DXL) technique that combines DXA measurement with measurement of the heel thickness using a laser reflection technique. DEXA-T is an older version of the Calscan DXL device now commercially available. *T*-score values were calculated for hip measurements with both the original reference population of the Hologic device and the NHANES III reference population. *T* scores for heel measurements were calculated with the original reference population of the peripheral device and the Calscan database, a new calcaneal reference population. Changing the reference populations had a great influence on both the heel and the hip *T* scores, especially those of the femoral neck where the percentage of sub-

jects identified as osteoporotic decreased from 53% to 23%. We conclude that, with the NHANES III and the larger Calscan database, using the cut-off point of -2.5 SD, the heel measurements had optimal accuracy for detecting osteoporosis at either the combination of the lumbar spine and the femoral neck or the combination of the lumbar spine, the femoral neck, the total hip and the trochanter. BMD measurements of the calcaneus with DXL correlated fairly well with measurements at axial sites at the group level, while in individual subjects large deviations were observed between all the measured sites. We also conclude that the influence of the reference populations on the *T* scores is substantial when different DXA methods are being compared; the total number of subjects classified as osteoporotic varied from 7% to 53% between the sites and with different reference populations.

Keywords Bone mineral density · Calcaneus · DXL technique · Osteoporosis

Introduction

The Scandinavian countries have the highest incidence of osteoporotic fractures in the world [1, 2]. Individuals at high risk of osteoporosis should be identified and measures taken to prevent future fractures.

One of the major risk factors for fracture, low bone mineral density, is accurately determined by dual X-ray absorptiometry (DXA). Several studies have established that both axial and appendicular bone density predict fractures in older women [3, 4, 5]. In a meta-analysis of prospective cohort studies published between 1985 and 1994 that was conducted on behalf of the Swedish Council of Technology Assessment in Health Care [6], all the measuring sites (proximal radius, distal radius, hip, lumbar spine and calcaneus) had similar predictive abilities for future osteoporotic fracture, with a pooled RR of 1.5 for a decrease of 1 SD in bone mineral density (BMD). Higher predictive ability had measurement of

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