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Are femoral bone mass measurements symmetrical?

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This issue of the journal offers an interesting article on possible differences in femur densitometry related to the dominance of the upper extremities between left and right handed[1].

Dual-energy X-ray absorptiometry (DXA) is based on the measurement of areal bone mineral density centimeter (BMD, g/cm^2) in the proximal femur and lumbar spine. Conditions such as osteoarthritis or osteophytic calcifications influence spinal BMD and confer a great value to femoral measurement. Since the DXA technique began being used on the hips, the presumption that there may be a minimal bilateral asymmetry between the proximal femurs has been maintained, but with no clinical relevance. Several research groups have studied this question. It has not been established whether there are systematic differences between the BMD of both hips, and in order to answer the questions: is the bone density in one of the femurs similar to same in the opposite side? which of them to choose?

In this sense, the forearm example is paradigmatic, for it is a region of interest consigned to an alternative sector and yet used in situations where measurements in conventional regions are not reliable. Due to the regarded differences in the BMD of the dominant and non-dominant forearms, the measurement of the BMD of the non-dominant forearm to reduce the variance is recommended.

The answer to "are the left and right proximal femurs symmetrical?" is important, since the result of the measurement in the chosen hip affects the fracture risk estimation in the subject. In their quest to find ideal hip replacements and improving surgical techniques, orthopaedic surgeons show special interest towards possible anatomical differences.

Research on anatomical variations of the proximal femur has revealed differences regarding gender and ethnicity between femurs. Differences in femoral dimensions and compensations between men and women have been identified[2-5]. Other studies have found differences in some morphological characteristics in femurs from European and Asian populations, specifically in the diameter of the femoral head, femoral displacement, and diameter of the shaft[6]. Different properties such as bone mineral density, mechanical resistance, cortical thickness, angles or length of the femur have also been studied[7-11]. The assessment of possible differences in 160 paired femurs from both sides of corpses showed absolutely no differences regarding any femoral measurement exceeding 1.5 mm[9]. The percentage of asymmetry did not exceed 4% for all anthropometric measurements and they found no link between absolute differences and the percentage of asymmetry, gender and/or ethnicity. Age or weight did also have nothing to do with absolute differences or percentage of asymmetry. This study, as well as other publications, supports the assumption of a high degree of symmetry in the left and right proximal femurs despite their shape and the shape of the body[12,13]. Symmetry is generally independent of demographic data and overall dimensions of the proximal femur.

By applying the DXA method with different technological approaches, other groups have assessed the variations in femoral BMD and geometric characteristics such as the length of the hip axis (HAL) between left / right femur and have found a high correlation (r=0.81-0.96) in the relevant regions of interest. They did not detect significant differences between both sides, so even though there is a dominant forearm, there does not appear to be a dominant hip. The authors of these studies[1,14,15] have concluded that the measurement of a single femur is usually sufficient for the clinical evaluation of BMD and/or the length of the hip axis.

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