

Bone size may affect accuracy of QUS measurements

Influence of region of interest and bone size on calcaneal BMD: implications for the accuracy of quantitative ultrasound assessments at the calcaneus

Cheng S, Njeh CF, Fan B, Cheng X, Hans D, Wang L, Fuerst T, Genant HK, *Br J Radiol* 2002;75:59-68.

Background: Bone strength is determined by BMD and bone micro-architectural characteristics that reflect bone quality. Quantitative ultrasound (QUS) provides a measure of bone strength and quality that has been shown to differentiate between patients with osteoporosis and controls. The transducers in most ultrasound devices are in a fixed position relative to the instrument footplate. Thus, the spot on the calcaneus that is measured will vary somewhat depending on the foot size and length of the subject. As a result, measurements on subjects with differing foot size may not be directly comparable.

Study and Results: The Achilles+ (GE Medical Systems Lunar) and Sahara (Hologic) ultrasonometers were compared in regard to a) variation between BMD of the manufacturer's ROI with an ROI fixed at 20% of calcaneal length, b) effect of foot size on QUS variables, and c) effect of different transducer diameter on QUS. Agreement of BMD between the manufacturer's ROI and the ROI fixed at 20% of calcaneal length was 81% for Sahara and 88% for Achilles. There was a significant difference between the two ROIs for the Sahara ($p = 0.014$), but not for the Achilles ($p = 0.82$). More than 50% of the subjects had a greater than 5% difference between ROIs using the Sahara, compared with only 20% with the Achilles+. This difference was most likely due to a smaller ROI in the Sahara device. Heel width had a significant effect on Achilles+ SOS, but not BUA and, presumably, Stiffness. Calcaneal length and soft tissue thickness had a significant effect on Sahara results, but did not affect results from Achilles+.

Conclusion: Heel width had a significant effect on Achilles+ SOS measurements and calcaneus length and soft tissue mass had substantial effects on Sahara assessments. Variations in ROI and bone size affected the accuracy of Sahara QUS measurements to a greater degree than Achilles+ measurements.

Femoral geometry improves the ability to predict hip fracture in women over age 60 years.

Improving risk assessment: Hip geometry, bone mineral distribution and bone strength in hip fracture cases and controls. The EPOS Study

Crabtree NJ, Kroger H, Martin A, Pols HAP, Lorenc R, Nijs J, Stepan JJ, Falch JA, Miazgowski T, Grazio S, Raptou P, Adams J, Collings A, Khaw K-T, Ruston N, Lunt M, Dixon AK, Reeve, *Osteoporos Int* 2002;13:48-54.

Background: Previous studies have shown that femur geometric variables are related to hip fracture independently of hip BMD. Hip axis length is one such variable.

Study and Results: BMD and hip geometric measurements were made on 800 female control subjects and 68 hip fracture patients from the European Prospective Osteoporosis Study (EPOS). All measurements were made with the Lunar DPX, a pencil-beam densitometer. Geometric measurements were made with 'beta' versions of hip strength analysis (HSA) software. Geometric variables included a measure of the bone's resistance to bending (cross-sectional moment of inertia, or CSMI), hip axis length (HAL), and compressive stress (Cstress), a calculation of stress on the femur neck resulting from an 'idealized' fall that incorporates body height and weight. HAL was excluded from predictive models because of unavailability on some patients. Cstress combined with age and body mass index (BMI) provided a better prediction of hip fracture than femur neck BMD. However, the combination of femur neck BMD, age, and BMI provided nearly equal predictive ability as Cstress + age + BMI. HAL was significantly longer in patients with cervical (106.7 mm) and trochanteric (108.8 mm) fractures than in controls (103.3 mm).

Conclusion: The addition of femur geometric and body size variables to the standard BMD measurements increased substantially the ability to predict hip fracture risk in women over 60 years of age.

Femur geometric variables distinguish between cervical and trochanteric hip fractures

Proximal femur geometry to detect and distinguish femoral neck fractures from trochanteric fractures in postmenopausal women

Gnudi S, Ripamonti C, Lisi L, Fini M, Giardino R, Giavaresi G, *Osteoporosis Int* 2002;13:69-73.

Background: Hip fractures can be categorized as femoral neck (cervical or intracapsular) fractures or trochanteric (extracapsular) fractures. These hip fracture types differ in regard to femoral BMD, geometry, and patient risk factors. Studies have shown that hip axis length (HAL) and other geometric variables such as neck-shaft angle (NSA) are able to differentiate between fracture and non-fracture patients, but few studies have examined the role of these factors in discriminating between trochanteric and cervical neck fractures.

Study and Results: The ability of BMD and proximal femoral geometry to discriminate patients with femoral neck or trochanteric fracture from controls was evaluated. Femoral geometric variables included HAL, NSA, femoral neck diameter, and femoral shaft diameter. Femoral DXA scans were obtained from 547 postmenopausal women without hip fracture, 88 women with femoral neck fracture, and 93 women with trochanteric fracture. Women with femoral neck fractures had lower BMD, wider NSA, and a longer HAL than controls. Odds ratios (OR) showed that a one standard deviation change in BMD or geometric variable increased the risk of a femoral neck fracture by 90% for neck BMD, 60% for the trochanter BMD, 70% for Ward's BMD, 120% for neck-shaft angle, and 30% for HAL. Similar calculations for predicting trochanteric fracture risk were significant for BMD, but not for the geometric variables. Overall, NSA was the best discriminator between controls and women with femoral neck fracture, while BMDs of the trochanter and femoral neck were the best predictors of trochanteric fractures.

Conclusions: BMD and femur geometry were both significant risk factors for femoral fracture. BMD was the main predictor of trochanteric fractures, while a combination of BMD and geometric variables provided the best prediction for femoral neck fractures. HAL was a significant predictor of femoral neck fracture.

Heel ultrasound is a good discriminator of postmenopausal women with multiple spine fractures

Discriminatory ability of quantitative ultrasound parameters and bone mineral density in a population-based sample of postmenopausal women with vertebral fractures: results of the Basel Osteoporosis Study

Hartl F, Tyndall A, Kraenzlin M, Bachmeier C, Guckel C, Senn U, Hans D, Theiler R, *J Bone Miner Res* 2002;17:321-330.

Background: Fracture prevention depends on a reliable means of assessing fracture risk. Measurement of BMD with DXA has been shown to be a strong indicator of fracture risk. Quantitative ultrasound (QUS) provides an assessment of bone quality. Many studies have reported associations between QUS and risk of osteoporotic fracture. QUS devices may be particularly appropriate for screening purposes because of their portability, reduced cost, and lack of ionizing radiation. The acceptance of QUS will depend in part on its proven ability to predict risk of fracture.

Study and Results: The discriminatory ability of QUS and DXA for vertebral fractures and the optimum fracture thresholds for various QUS devices (Achilles, Sahara, IGEA) were determined. QUS measurements of the calcaneus or of the proximal phalanges were performed on about 490 randomly selected, postmenopausal, elderly women (age 65 to 75 years) participating in the Basel Osteoporosis Study. DXA measurements (EXPERT) were performed at the lumbar spine and proximal femur. Vertebral fractures were determined by lateral and thoracic spine radiographs using a 20% height reduction criterion. Subjects were divided into one of three groups according to presence of vertebral fracture: a) no fracture, b) one fracture (n = 71), and c) two or more fractures (n = 19). QUS heel measurements, but not QUS finger measurements or DXA measurements at spine and femur, showed significant differences between subjects with no vertebral fracture and subjects with one vertebral fracture. All QUS and DXA measurements were able to discriminate between subjects with no fracture and subjects with two or more vertebral fractures. QUS sensitivity (ability to identify patients with vertebral fracture) was equivalent to or better than DXA

sensitivity. QUS specificity (ability to identify patients with no vertebral fracture) was better than DXA specificity.

Conclusions: QUS performed as well or better than DXA measurements for discriminating subjects with multiple vertebral fractures. QUS at the heel performed better than QUS at the phalanges or DXA at the spine and femur for discriminating subjects with one vertebral fracture.

Recognition of osteoporosis inadequate among primary care physicians

Recognition of osteoporosis by primary care physicians

Gehlbach SH, Fournier M, Bigelow C, *Am J Publ Health* 2002;92:271-273.

Background: Osteoporosis is an enormously widespread disease that accounts for over 400,000 hospital admissions, 2.5 million physician visits, and a public health cost of nearly \$14 billion dollars. Despite these figures and the recent availability of several drugs designed specifically to prevent and treat osteoporosis, the recognition of osteoporosis by primary physicians is less than adequate.

Study and Results: The National Ambulatory Medical Care Surveys for 1993 through 1997 were studied to determine how often women over age 60 years were diagnosed and treated for osteoporosis by primary care physicians. Results showed that despite the known 20% to 30% prevalence of osteoporosis among women older than 60 years, fewer than 2% of women were diagnosed with osteoporosis. Recognition improved only slightly with age, from 0.9% for women aged 60-69 years, to 1.5% for women aged 70 to 79 years, and 3.1% for women over 80 years of age. Appropriate treatment (antiresorptive agents, calcium, and vitamin D) of patients diagnosed with osteoporosis was offered in only 36% of cases, but this frequency rose from 20% in 1993 to 55% in 1997.

Conclusions: Primary care physicians during the years 1993 through 1997 identified fewer than 10% of women with osteoporosis or with vertebral fracture, one of the primary hallmarks of osteoporosis. Less than half of those identified were offered appropriate therapy.