Medical Xpress

Towards increasingly personalised fracture risk assessment

October 17 2016

In people over 50 years of age, fractures are so common that for example one in three women will suffer a wrist, ankle or hip fracture during their life. Low-energy fractures caused by bone weakening are one manifestation of osteoporosis. These fractures are painful and considerably weaken the patient's quality of life and, in the worst case scenario, can even lead to death.

The current method for assessing the fracture risk is dual energy x-ray absorptiometry, which measures bone mineral density. However, reduced bone mineral density accounts for less than a third of all low-energy fractures, meaning that in a group of people with a similar reduction in bone mineral density, some suffer fractures and others don't. Moreover, these kinds of fracture risk assessments are generally performed only in specialist health care, which is expensive and requires that the patient has a referral to a specialist.

Osteoporosis-induced thinning of the cortical bone layer can be detected in long bones, such as the shin bone, with the help of a pulse-echo ultrasound method, which is optimal for screening large populations. Cortical bone thickness measurements typically do not take site-specific speed of sound, which is dependent on cortical bone porosity, into consideration. However, there is variation in the micro-structure, mechanical properties and density of cortical bones between individuals, and this variation may affect speed of sound. In order for the method to be increasingly relevant in osteoporosis management, including treatment monitoring, the accuracy of bone thickness measurements could be improved by taking into consideration the effect of porosity variation on speed of sound.

In his PhD thesis completed at the University of Eastern Finland, Chibuzor Eneh, MSc, successfully analysed cortical bone porosity from pulse-echo ultrasound backscatter using a multivariate method. Cortical bone porosity was then used to estimate subject-specific and site-specific speed of sound, allowing for an increasingly accurate estimate of cortical bone thickness. In addition to increasing the accuracy of thickness measurements, the method also provides information on cortical bone porosity, which is important because increased porosity is an early indication of cortical bone thinning.

The ultrasound method developed in the PhD dissertation constitutes a step in the direction of an increasingly personalised and earlier assessment of fracture risk, which could be easily and cost-efficiently applied in osteoporosis diagnostics and follow-up in basic health care.

More information: C. T. M. Eneh et al. Effect of porosity, tissue density, and mechanical properties on radial sound speed in human cortical bone, *Medical Physics* (2016). DOI: 10.1118/1.4942808

Pulse-Echo Ultrasound Assessment of Cortical Bone Thickness and Porosity. epublications.uef.fi/pub/urn_i … 78-952-61-2225-0.pdf

Provided by University of Eastern Finland