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**Two-dimensional simulation of circumferential wave propagation in  
cortical bone at the femoral neck: sensitivity to bone geometry**

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Assessment of bone status using ultrasound techniques has proved to be efficient to quantify the risk of osteoporotic fracture. A prototype scanner is currently developed (European FEMUS project) to assess bone quality at the hip. Circumferential waves in femoral neck cortical bone are expected to propagate in the prototype configuration. In this work, the relationships between time of flight (TOF) of circumferential waves and femoral neck cross-section geometrical parameters were investigated. Two-dimensional finite-difference time-domain simulations of through transmission propagation of a plane wave at 0.5 MHz central frequency were performed on eight femoral neck cross-section models reconstructed from X-ray computed tomography data of one human femur. An ellipse with major radius ( $a$ ) and minor radius ( $b$ ) was fitted on the external circumference of each cross-section. The TOF was highly correlated to the ellipticity  $a/b$  ( $R = -0.9607$ ,  $p < 10^{-3}$ ) and to the area delineated by the endosteal surface ( $R = -0.9717$ ,  $p < 10^{-4}$ ). These results indicate that the TOF is sensitive to the shape of the femoral neck cross-section. This is interesting insofar as previous studies highlighted the importance of the relationships between geometrical parameters and bone strength. In future works, these 2-D results will be challenged in 3-D configurations.