It is well established that the organization of trabecular bone tissue and its mineral content, as well as the thickness of cortical bone contribute to the strength of the proximal femur. However, in contrast to mineral content measurement, there is no non-invasive method to measure the trabecular pattern of bone. The purpose of the present study is to evaluate such a method, based on optical processing of bone radiographs.

Seventeen intact cadaveric femora without signs of fracture, callus or metastatic disease were examined in this study. A laser beam transmitted through a radiograph of the proximal femur formed, at the focal plane of a lens, a two-dimensional optical Fourier-transform of the trabecular pattern. The light distribution at the Fourier plane was grabbed and analyzed by an algorithm which calculated a Trabecular Bone Index (TBI), based on the relative contribution of high and low spatial frequencies in the optical Fourier spectrum. The trochanteric cortical area of each femur was measured by QCT on slices positioned between the greater and lesser trochanters. The mineral content of the intertrochanteric region was measured for each femur by Dual Energy Absorptiometry.

The TBI was found to be significantly correlated ($p < 0.005$) with both the trochanteric cortical area ($R = 0.84$, linear regression) and the intertrochanteric mineral content ($R = 0.71$, logarithmic regression).

The TBI based on optical processing of trabecular bone pattern is a new measure which may effectively detect early changes in trabecular pattern and serve as an estimate for hip fracture risk.