

Purpose: To develop methods to distinguish between weak and strong bone non-invasively by analyzing radiographic trabecular bone patterns.

Materials and Methods: Femoral neck specimens were radiographed using a direct exposure technique with high resolution film. Films were digitized with 0.121-mm resolution and 1024 gray levels. Strength testing was performed on the specimens to determine their actual strength. A region of interest (ROI) was selected in the medial portion of the femoral neck. The fractal dimension of each ROI was calculated from the slope of the least-squares fit of the logarithm of surface area as a function of the logarithm of the effective pixel size. In addition, an artificial neural network (ANN) was employed to distinguish between strong and weak bone by using the raw data (surface area) as inputs and continuous strength data as truth during training. Correlation and ROC analysis were used to evaluate the ability of the fractal dimension measure and ANN output in distinguishing between strong and weak bone.

Results: Using thirty-four specimens, analysis yielded correlations of -0.532 and 0.774, and ROC analysis in the task of distinguishing between weak and strong bone yielded Az values of 0.85 and 0.88 for the fractal dimension and ANN, respectively.

Conclusions: Fractal dimension measures of radiographic bone pattern show potential in distinguishing between strong and weak bone, and can be improved with the use of an artificial neural network.

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