INTRODUCTION
Osteoporosis is known to deteriorate mechanical and morphological properties of cancellous bone. The extent of this process is usually evaluated on small excised specimens. In such studies it usually is assumed that the results are not critically dependent on the actual sampling location. In particular in the elderly, cancellous bone inhomogeneities have been observed, and it should be questioned to what extent the results are affected by the inhomogeneity of the bone properties and variability of the sampling site.

The aim for this study was to answer this question by quantifying the variation in cancellous bone morphological and mechanical properties within thoracic and lumbar vertebral bodies.

METHODS
A micro-CT system was used to create high-resolution (60-80 µm) 3-D reconstructions of 43 excised vertebrae taken from 28 donors (average age 79 years) from two sites (thoracic vertebra 10 and lumbar vertebra 4). Within the core of each vertebral body eight volumes of interest (VOI’s) with sides of 6 mm were identified, one for each octant (Figure 1). For each VOI morphological and mechanical parameters were calculated. Morphological parameters included volume fraction (BV/TV), trabecular thickness (Tb.Th), architectural anisotropy (DA) and connectivity density (Conn.D). Mechanical parameters included Young’s moduli (Ei), shear moduli (Gi,j) and Poisson’s ratios (vij).

The intra-vertebral variation of each of these parameters was quantified with the coefficient of variation (CV) defined as the standard deviation over the 8 VOI’s, normalized with the vertebral mean (CV = (SD/mean)*100). Non-parametric statistics were used to determine if differences between the eight VOI-positions were significant.

RESULTS
Figure 2 shows the means and standard deviations of the individual CV’s over all individual vertebral bodies. The data are separated to show the differences between the two sites (T10 and L4).

DISCUSSION
This study demonstrates that the variance in cancellous bone morphological and mechanical parameters of vertebrae from the elderly is considerable, with CV values on the order of 80%. Tb.Th and DA show relatively little variance within the individual vertebral bodies, whereas Conn.D and mechanical properties show a relative large variance within the vertebral bodies. CV values found for L4 were larger than those for T10, potentially due to the smaller size of the T10 vertebrae.