Mechanical compressive strength and local variations in morphometry in trabecular bone of proximal human femur

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**Aim**
The present study investigated the compressive strength of trabecular bone determined experimentally together with morphometric parameters obtained by microcomputed tomography (microCT), with the aim to assess if mechanical failure can be linked to detectable local variations in the morphometric parameters.

**Materials and Methods**
Human femoral head bone samples were used in this study. From each femoral head, one trabecular bone specimen of cylindrical shape was extracted (length 26mm, diameter 10mm), aligning the milling tool to the main direction of the trabeculae. The specimens were examined by microCT for the calculation of the morphometric parameters, such as bone volume fraction (BV/TV), trabecular separation (Tb.Sp), trabecular thickness (Tb.Th). Then they were submitted to uniaxial compression testing in a material testing machine for the determination of the ultimate stress. After testing to failure, the samples were rescanned by microCT for the visualization of the failure region.

**Results and Discussion**
The results confirm that the compressive properties of trabecular bone of the human femoral head, when loaded along the main axis of the structure, are significantly related to the morphometric parameters BV/TV, Tb.Th, Tb.Sp. The failure regions were identified by comparing the microCT images of the specimens before and after the mechanical test. It was investigated whether there exist significant differences in the morphometric parameters between the failure regions and the non-failure regions. It was found, that due to the heterogeneity of the trabecular bone within the single specimen, there exists a region characterized by a different microarchitecture, where the specimen is more likely to fail.

**References**