Methods: One hundred and thirty-nine females (55–94 years) and sixty males (60–93 years) who had sustained atraumatic hip fractures underwent QCT scans within 48 hours of the fracture, and we used BIT software which directed automatic the lowest area the mid-femoral neck cross-section perpendicular to the femoral neck axis to measure cortical thickness (C.Th) in anatomical quadrants of the femoral neck. For elderly females, the estimated C.Th in superoanterior (SA) quadrants, inferoanterior (IA) quadrants, inferoposterior (IP) quadrants and superoposterior (SP) quadrants were (0.90±0.61) mm, (2.20±0.83) mm, (3.70±0.96) mm and (0.85±0.54) mm respectively, for elderly males the corresponding parameters being (1.13±0.71) mm, (2.22±0.90) mm, (3.72±0.79) mm and (1.20±0.79) mm. Although the elderly females had significantly thinner mean C.Th in SP and SA quadrants than the parameters of the males (p<0.05), the sexes did not differ in cortical thickness in IA and IP quadrants. Comparing age-related decrease changes of C.Th in anatomical quadrants for females, there was no age-related changes for males.

Conclusion: When comparing males and females in our study, there is no difference in C.Th in infero quadrants, but women have thinner C.Th in supero quadrants. Thinner cortical thickness in the superior region of the femoral neck may be a stronger predictor for hip fracture, implying the mechanism causes a higher fracture incidence in women.

Results: For elderly females, the estimated C.Th in anatomic quadrants of the femoral neck. Perpendicular to the femoral neck axis to measure cortical thickness directed automatic the lowest area the mid-femoral neck cross-section used for individual fracture risk assessment as well as for longitudinal studies monitoring of treatment effect. New therapies may not only improve the cancellous bone, but also strengthen the rather compact cortex, where this is achievable by endosteal or periosteal apposition, increasing mineralization, or reduction in resorption space. To assess bone parameters on clinical CT data, one has to deal with limited spatial resolution and significant partial volume effects, which heavily blur this very thin structure (typically 150-350 µm, Ritzel 1997).

Methods: We analyzed CT data of 9 excised embedded vertebrae scanned using 3 different CT protocols (fig. 1): (I) High Resolution peripheral Quantitative CT (HR-pQCT) (Scanco, Medical Xytreme CT, voxel size (0.082*0.082*0.082)mm³, 60kV, 190mAs) used as gold standard, (II) High Resolution Quantitative CT (HR-QCT) (Siemens Sensation 64, voxel size (0.156*0.156*0.300)mm³, 120kV, 360mAs) and (III) Quantitative CT (QCT) (Siemens Sensation 64, voxel size (0.234*0.234*1.000)mm³, 120kVp, 100mAs).

We developed a method for measuring radial BMD profiles along the cortex (i.e. density distribution orthogonal to the cortical surface) based on cortical segmentation as part of our quantitative CT analysis software Structuralin-sight (ITK-based). Using a priori knowledge of vertebral skeletal structure by fitting a radial BMD profile to the measured data directly returns a deconvolved cortical thickness (dCtTh) and the CT system’s point spread function (PSF) as a measure of spatial resolution. For comparison we also calculated a direct maximum-sphere based cortical thickness (CtTh) and, as a simple correction for partial volume effects, weighted cortical thickness (wCtTh = cortical BMD x CtTh).

Results: Cortical thickness by HR-pQCT was (370±70)µm. Compared to these results the table shows the mean offsets and the root mean square errors (RMSE) of QCT and HR-QCT based estimates. Here dCtTh shows very low random residual errors even in QCT data analysis.

Conclusion: Our results document that uncorrected cortical thickness of 370 µm is overestimated by factors of 4.8 and 4.2 by QCT and HR-QCT at measured levels of (1.78±0.58)mm and (1.54±0.29)mm respectively. This factor can be reduced to 1.4 to 1.2 by dCtTh to levels of (522±93)µm and (434±71)µm, respectively, and the residual error is reduced to 36µm and 17µm respectively, for the two techniques. For accurate modeling of mechanical strength such corrections are of specific importance.

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3D ANGIOARCHITECTURE OF SPINAL CORD IN A RAT MODEL DETECTED BY SYNCHROTRON RADIATION MICRO-COMPUTED TOMOGRAPHY

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Objective: A high-resolution three-dimensional (3D) visualization of spinal angiarchitecture is essential to reveal its patho-morphological alterations causing the dysfunction of the local microcirculation in the neural parenchyma. However, acquiring such high-resolution vascular imaging remains an experimental challenge. Herein, we used the high-resolution X-ray attenuation imaging based on the synchrotron radiation coupled with angiography to reconstruct the vessel skeleton of spinal cord digitally.

Methods: This method was applied to a rat model of traumatic spinal cord injury using a modified Allen’s weight drop apparatus. Following vascular perfusion with contrast agent, the T10 thoracic cord segment (about 6mm) was harvested and scanned by synchrotron radiation micro-computed tomography.

Results: With a minimum resolution as 3.7µm, the 3D vascular architecture of rat spinal cord was reconstructed optimize and quantified (Fig 1). Compared with conventional histological sections, the reconstructed images were consistent with that obtained from histomorphology sections. Meanwhile, the vascular pathological change after spinal cord injury could be reflected by some characteristic parameters (Fig 2).

Conclusion: In summary, the high-resolution X-ray attenuation imaging based on the synchrotron radiation coupled with angiography is a potential and powerful tool to investigate the 3D neurovascular morphology of the rat spinal cord. It could help to evaluate the angiogenesis on microvascular repair or regeneration research.