Abstract:

We investigated the effects of low-dose multi detector computed tomography (MDCT) in combination with statistical iterative reconstruction algorithms on trabecular bone microstructure parameters. Twelve donated vertebrae were scanned with the routine radiation exposure used in our department (standard-dose) and a low-dose protocol. Reconstructions were performed with filtered backprojection (FBP) and maximum-likelihood based statistical iterative reconstruction (SIR). Trabecular bone microstructure parameters were assessed and statistically compared for each reconstruction. Moreover, fracture loads of the vertebrae were biomechanically determined and correlated to the assessed microstructure parameters. Trabecular bone microstructure parameters based on low-dose MDCT and SIR significantly correlated with vertebral bone strength. There was no significant difference between microstructure parameters calculated on low-dose SIR and standard-dose FBP images. However, the results revealed a strong dependency on the regularization strength applied during SIR. It was observed that stronger regularization might corrupt the microstructure analysis, because the trabecular structure is a very small detail that might get lost during the regularization process. As a
consequence, the introduction of SIR for trabecular bone microstructure analysis requires a specific optimization of the regularization parameters. Moreover, in comparison to other approaches, superior noise-resolution trade-offs can be found with the proposed methods.