Purpose:A method that could enable dose calculations to be performed using magnetic resonance (MR) images for conventional treatment planning and adaptive planning using MR-accelerator systems would be to apply bulk electron densities to the MR images. However currently bone must be manually segmented making this impractical. This work develops and tests an atlas-based method to automatically segment bone on pelvic MR images for dose calculations.

Methods:An MR whole-pelvic atlas was created using manually delineated scans from 39 patients. Atlas-based pelvic-bone auto-segmentations were then created for 25 patient scans using deformable image registration of the atlas to each patients scan with a leave-one-out atlas approach. These and corresponding expert manual segmentations were compared using the Dice similarity coefficient. Bone was assigned a density of 1.19 g/cm3 and all other tissues a water equivalent density. Treatment plans were generated on the whole-pelvis MR images and doses compared for the manual and auto-segmented bone plans.

Results:The average Dice coefficient was 0.83 (standard deviation = 0.05). The average manual bone volume was 834.6 cm3 compared to the atlas based average volume of 840.0 cm3, with a mean difference of 5.4 cm3 (0.64%). The average ICRU point dose calculated on the MR images using the atlas-based bone segmentations was 0.2% lower (standard deviation 0.3%) than the dose calculated using the manual bone segmentations.

Conclusions:The atlas based method for auto-segmentation of pelvic bone enables MR-based prostate radiotherapy dose calculations for treatment and adaptive planning.

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