

MR imaging based treatment planning for radiotherapy of prostate cancer is limited for patients with sizes over 38 cm in lateral dimensions due to uncertainties of external contours caused by MR imaging system related geometrical distortions on our low Tesla open MR unit. The Gradient Distortion Correction (GDC) software for post-processing of the MR images can be used to reduce these uncertainties. However, the remaining MRI distortions for large fields of view (FOV) may be outside our clinical criteria. In this work, phantom measurements to quantify and calibrate MR system related residual geometric distortions after GDC post-processing were performed for large FOV at different axial planes to derive distortion maps for phantoms. These maps with measured distortions were also compared with real patients using CT images. Once calibrated, the distortion maps were used to perform point-by-point corrections for patients with large dimensions. Computer software was developed to further correct the residual distortion defects of the images point by point based on the distortion maps by linear interpolation to image intensities. Object-induced effects to the image distortion were also studied and a T2 weighted fast spin echo sequence was selected with the bandwidth 139 Hz/pixel to minimize object-induced geometric distortions. For some points that may be outside the field of view due to image distortion, a knowledge based distortion correction method was applied which, combined with the point by point correction approach, can reduce geometrical uncertainties to $< 5\text{mm}$ for external contour determination.