

A comparison of two immobilization systems for prostate radiotherapy

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Purpose: Immobilization systems and their corresponding set-up errors influence the clinical target volume to planning target volume (CTV-PTV) margins and thus may result in undesirable treatment outcomes. This study compared the reproducibility of patient positioning with a Civco Combi Fix (CCF) system and a Medical Intelligence Vacloc (MIV) system for localized prostate cancer.

Methods: Six consecutive patients (5 fractions per patient) with localized prostate cancer and implanted marker seeds in the prostate were selected. Patients were treated on a Novalis linear accelerator and were positioned using the ExacTrac6D Robotics (ETR) system. Three patients were immobilized with the CCF system and three patients immobilized with the MIV system. Once the patient was positioned at the isocenter, planar x-ray images were acquired pre-treatment with the ETR. Then, following treatment delivery, post-treatment planar x-ray images were acquired with the ETR system. The planar x-ray images were registered with DRRs from the treatment planning CT by matching the implanted marker seeds. DRRs and ExacTrac x-ray images were aligned either manually or automatically. The residual differences between planning DRR and x-ray images in the vertical, longitudinal, and lateral directions were recorded for the pre-treatment and post-treatment images. To find the intrafraction displacements of the prostate, the post-treatment values were subtracted from the pre-treatment values.

Results: The average displacements for patients who were immobilized with CCF were 0.9 ± 0.2 mm, 1.7 ± 0.4 mm, and 1.3 ± 0.3 mm in lateral, longitudinal and vertical directions, respectively. The average displacements for patients who were immobilized with MIV were 0.5 ± 0.2 mm, 0.6 ± 0.2 mm, and 0.8 ± 0.2 mm in lateral, longitudinal and vertical directions, respectively. Averaged over all patients and treatment fractions, the three-dimensional displacements were 2.8 ± 0.4 mm for the CCF system and 1.3 ± 0.3 mm for the MIV system.

Conclusion: In conclusion, the use of MIV resulted in smaller intra-fractional displacement compared to the CCF, this may require adjustment of PTV margins to accommodate this movement when using CCF. However, the substantial cost difference of CCF versus MIV also needs to be considered.



a)



b)

Figure 1. a) Image of immobilization from Civco Combi Fix (CCF) system, and b) image of immobilization from Medical Intelligence Vacloc (MIV) system.

Table 1. Average displacement in all directions for five fractions (To find the intra-fraction displacements of the prostate the post-treatment values were subtracted from the pre-treatment values), and average total patient displacement distance from the treatment position for six patients in five fractions each.

CCF				MIV		
Average Displacement (mm)	Lateral	Longitudinal	Vertical	Lateral	Longitudinal	Vertical
Patient #1	0.4 ± 0.2	1.7 ± 0.3	1.6 ± 0.3			
Patient #2	0.7 ± 0.1	1.6 ± 0.4	1.3 ± 0.4			
Patient #3	1.5 ± 0.4	1.9 ± 0.4	1.0 ± 0.4			
Patient #4				0.7 ± 0.2	0.6 ± 0.1	0.5 ± 0.05
Patient #5				0.3 ± 0.1	0.7 ± 0.2	1.0 ± 0.3
Patient #6				0.6 ± 0.2	0.5 ± 0.1	1.1 ± 0.3
Average distance (mm)						
Patient #1	2.4 ± 0.4					
Patient #2	2.4 ± 0.4					
Patient #3	2.9 ± 0.7					
Patient #4				1.1 ± 0.2		
Patient #5				1.3 ± 0.3		
Patient #6				1.5 ± 0.4		