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MRI Comparison between Intraprostatic Fiducial Marker Matching and Prostate Gland Matching for Target Localization in Prostate Proton Therapy

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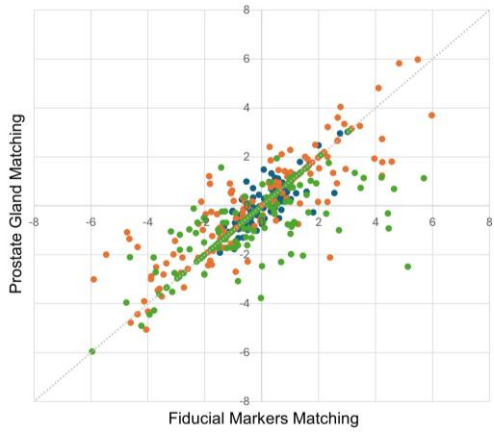
Background / Aims:

For proton therapy (PT) system equipped with orthogonal X-ray, image-guidance for prostate PT is commonly based on fiducial markers. Pre-treatment MRI offers simultaneous verification of the prostate and fiducial markers position that is critical in prostate PT. Current study compared the localization based upon fiducial markers and prostate gland from pre-treatment MRI and summarized the occurrence of the discrepancy between two matching schemes.

Subjects and Methods:

Thirty prostate cancer patients that underwent 5-fraction stereotactic body proton therapy were included. All patients were implanted with fiducial markers for prostate localization. T1-weighted Dixon MRI was acquired before each fraction at treatment position for positional verification. Pre-treatment MRI was first registered to planning CT based on bony structure. Two translational corrections 1) based on fiducial markers (ΔFM); and 2) based on the prostate gland (ΔGland) were obtained. Pearson's correlation analysis was applied. The difference in translational correction between fiducial marker matching and prostate gland matching was calculated.

Result:



	LR	AP	SI
Pearson Corr. Coef.	0.818	0.874	0.700
p-value	<0.0001	<0.0001	<0.0001

The translational correction based on fiducial markers matching and prostate gland matching were significantly correlated in all axes.

		# of Fractions / # of Patients		
		LR	**AP**	**SI**
|ΔFM - ΔGland|	> 2mm	2 / 1	18 / 11	21 / 12
|ΔFM - ΔGland|	> 3mm	0 / 0	5 / 4	9 / 5
|ΔFM - ΔGland|	> 5mm	0 / 0	0 / 0	2 / 2

		Maximum Deviation		
		LR	**AP**	**SI**
|ΔFM - ΔGland|	max	2.1mm	4.5mm	7.6mm

The difference in translational correction between the two matching schemes were mostly within 2mm suggesting that fiducial markers consistently indicate the prostate position for target localization. The discrepancy in translational correction between the two matching schemes were more frequently found and in a larger extent in anterior-posterior (AP) and superior-inferior (SI) directions, as compared to left-right (LR) directions. The maximum deviation was 2.1mm, 4.5mm and 7.6mm in LR, AP and SI, respectively. The discrepancy might be related to fiducial marker migration occasionally found across patients and over the course of treatment. Attention is needed especially for hypo-fractionated treatment that uses fiducial markers only as image-guidance.