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Significance of ADC and ADC ratio in Differentiating Gleason Score in Prostate Cancer

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Background

This study compared the effectiveness of ADC and ADC_{ratio} metrics in distinguishing between Gleason Score (GS) 3+4 and 4+3 prostate cancer (PCa) using targeted biopsy as a reference. It also evaluated the impact of magnetic field strengths (1.5T and 3T) on these metrics and assessed ADC_{ratio} reliability across varying imaging conditions.

Materials & Methods

MRI images were obtained from 48 patients (of an initial dataset comprising 104 patients) with histology proven GS7 PCa (36 GS 3+4, 12 GS 4+3). Patients underwent multiparametric MRI (mpMRI) at 3T or 1.5T, including diffusion-weighted imaging (DWI) with b-values of 0, 50 and 800 s/mm^2. ADC maps were generated from DWI using custom Matlab code, and tumor regions were segmented based on biopsy results. Mean ADC(ADC_T), ADC of contralateral normal prostatic tissue (ADC_N), and ADC_{ratio} (ADC_T/ADC_N) were calculated. Data normality was assessed using the Shapiro-Wilk test, and correlations between ADC_T, ADC_{ratio}, and GS were evaluated using Spearman's correlation. Student's t-test compared ADC_T and ADC_{ratio} between GS groups, with $p<0.05$ for significance. ROC analysis identified cutoff values for distinguishing GS 3+4 from 4+3.

Results

For GS 3+4, there was a significant difference in ADC_T values between 3T and 1.5T($p=0.046$), but not for GS 4+3 ($p=0.429$). ADC_{ratio} consistently differed between GS 3+4 and GS 4+3 at 3T ($p<0.001$) and across field strengths ($p<0.001$), but not at 1.5T ($p=0.062$). ROC analysis showed ADC_{ratio} had a superior AUC compared to ADC_T, with a cutoff value of 0.5405 for ADC_{ratio} and 10.68×10^{-4}mm^2/s for ADC_T for distinguishing GS 4+3 from 3+4 PCa.

Conclusion

This study highlights the utility of ADC_{ratio}, in distinguishing between GS 3+4 and 4+3 PCa, considering combined data from different magnetic field strengths. ADC_{ratio} consistency across imaging protocols suggests that it could be a valuable tool for assessing PCa and differentiating GS 7 subgroups.

Variable	Tesla				
	3T				
	Cutoff value	AUC	p value	Sensitivity (%)	Specificity (%)
Mean ADC (×10^{-4} mm^2/s)	≤ 10.36	0.821	0.002	100	63.6
ADC ratio	≤ 0.5405	0.832	<0.001	87.5	81.8
	1.5T				
	Cutoff value	AUC	p value	Sensitivity (%)	Specificity (%)
Mean ADC (×10^{-4} mm^2/s)	≤10.89	0.518	0.345	100	33.3
ADC ratio	≤ 0.6155	0.750	0.062	75	71.4
	3T+1.5T				
	Cutoff value	AUC	p value	Sensitivity (%)	Specificity (%)
Mean ADC (×10^{-4} mm^2/s)	≤10.68	0.712	0.006	100	50
ADC ratio	≤ 0.5405	0.804	<0.001	75	83.3

Figure 1: ROC Curve Analysis Comparing mean ADC and ADC_{ratios} for Determining Gleason 4+3 prostate cancer.