

The apparent diffusion coefficient value reflects the microscopic structural changes of prostate which affect lower urinary tract function

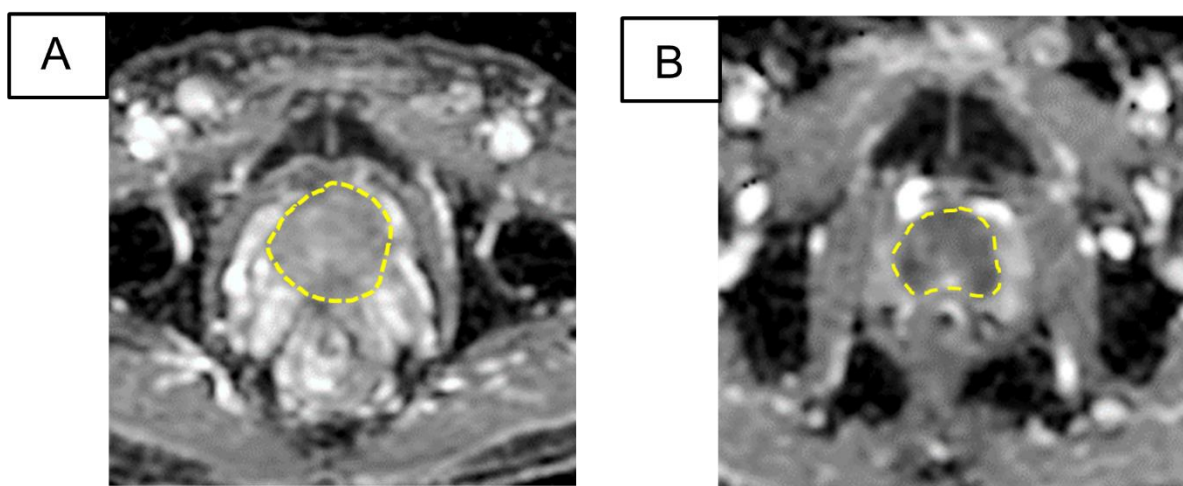
Hidenori Akaihata, Tomoyuki Kumekawa, Yuki Harigane, Kei Yaginuma, Yu Endo, Hitomi Imai, Yuta Matsuoka, Akifumi Onagi, Kanako Matsuoka, Seiji Hoshi, Tomoyuki Koguchi, Junya Hata, Yuichi Sato, Masao Kataoka, Yoshiyuki Kojima

Department of Urology, Fukushima Medical University of School of Medicine, Fukushima, Japan.

Aims of study

Lower urinary tract symptoms (LUTS) represent one of the most common and bothersome conditions seen in daily urologic practice, affecting at least one in every four men older than 40 years.¹⁾ The prostate volume and morphological features of the prostate are well known to be associated with LUTS in the male patients. However, whether microscopic structural changes of prostate contribute to LUTS and lower urinary tract dysfunction (LUTD) has not been established. Recently, the field of quantifying tissue microscopic structural change with magnetic resonance imaging (MRI) has been gaining increasing attention, with the number of publications growing exponentially. The apparent diffusion coefficient (ADC), which is a non-invasive functional MRI technique, can assess changes in diffusion of water molecules due to microscopic structural changes.

Typical ADC map of prostate

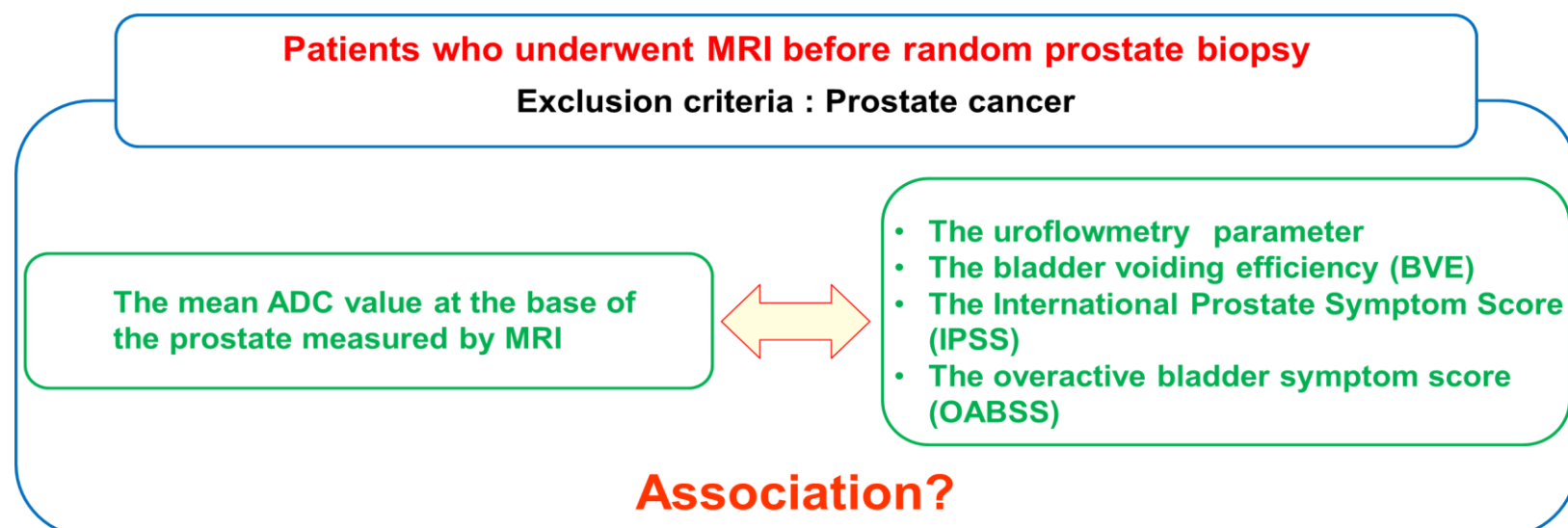


A) The mean ADC value at the base of prostate was high.
B) The mean ADC value at the base of prostate was low.

We considered that the ADC can provide the quantitative information about the microscopic structural changes of the prostate. The aim of this study was to evaluate the effect of microscopic structural changes of prostate on LUTS and LUTD by evaluating the association between ADC values and LUTS and lower urinary tract function.

Methods and Materials

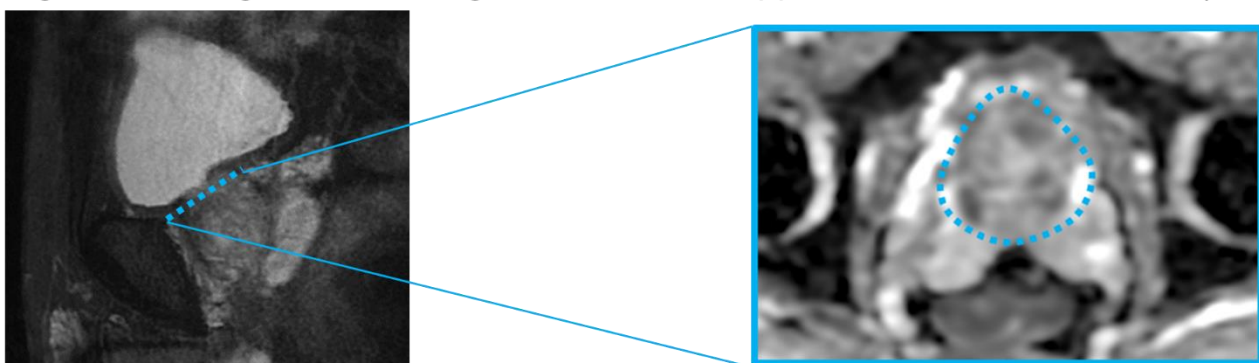
Study design



Patients who underwent MRI before random transrectal ultrasonography-guided prostate biopsy and had a diagnosis of benign by the biopsy at our hospital between May 2019 and January 2021 were included in this study. Before the biopsy, uroflowmetry parameter, bladder voiding efficiency (BVE); (voided volume/total bladder capacity) × 100, International Prostate Symptom Score (IPSS) and overactive bladder symptom score (OABSS) were evaluated. The voiding and storage IPSS sub-score (IPSS-V and IPSS-S, respectively) were recorded separately.

The ADC measurement in prostate

【The sagittal T2-weighted MRI image】 【The axial apparent diffusion coefficient (ADC) map of prostate】



We measured mean ADC value at the base of the prostate by MRI. The relationship between the mean ADC value and parameters evaluated before the biopsy was analyzed.

Statistical analysis

All values were expressed as mean ± standard deviation. A linear regression analysis was used for continuous variables. P-values of <0.05 were considered to be statistically significant.

Results

Table 1. Patients' characteristics

Age (years)	68.9 ± 6.3 (55 - 82)
IPSS	8.6 ± 6.3 (0 - 28)
IPSS-V	4.0 ± 3.9 (0 - 15)
IPSS-S	3.9 ± 2.7 (0 - 12)
OABSS	3.8 ± 2.5 (0 - 13)
Prostate volume (mL)	41.0 ± 18.7 (4.5 - 96.4)
Maximum flow rate (mL/sec)	13.1 ± 7.1 (2.0 - 47.0)
Bladder capacity (mL)	250 ± 129 (54 - 680)
BVE (%)	82.0 ± 16.8 (29.9 - 100.0)
Mean ADC value of prostate (mm ² /sec)	1,468 ± 190 (2,039 - 450)

Values were expressed as mean ± standard deviation.

IPSS : International Prostate Symptom Score, IPSS-V : IPSS voiding sub-score, IPSS-S : IPSS storage sub-score, OABSS : overactive bladder symptom score, BVE : bladder voiding efficiency

A total of 111 patients entered the study.

Figure 1-1. The association between the ADC value of prostate and lower urinary tract symptoms

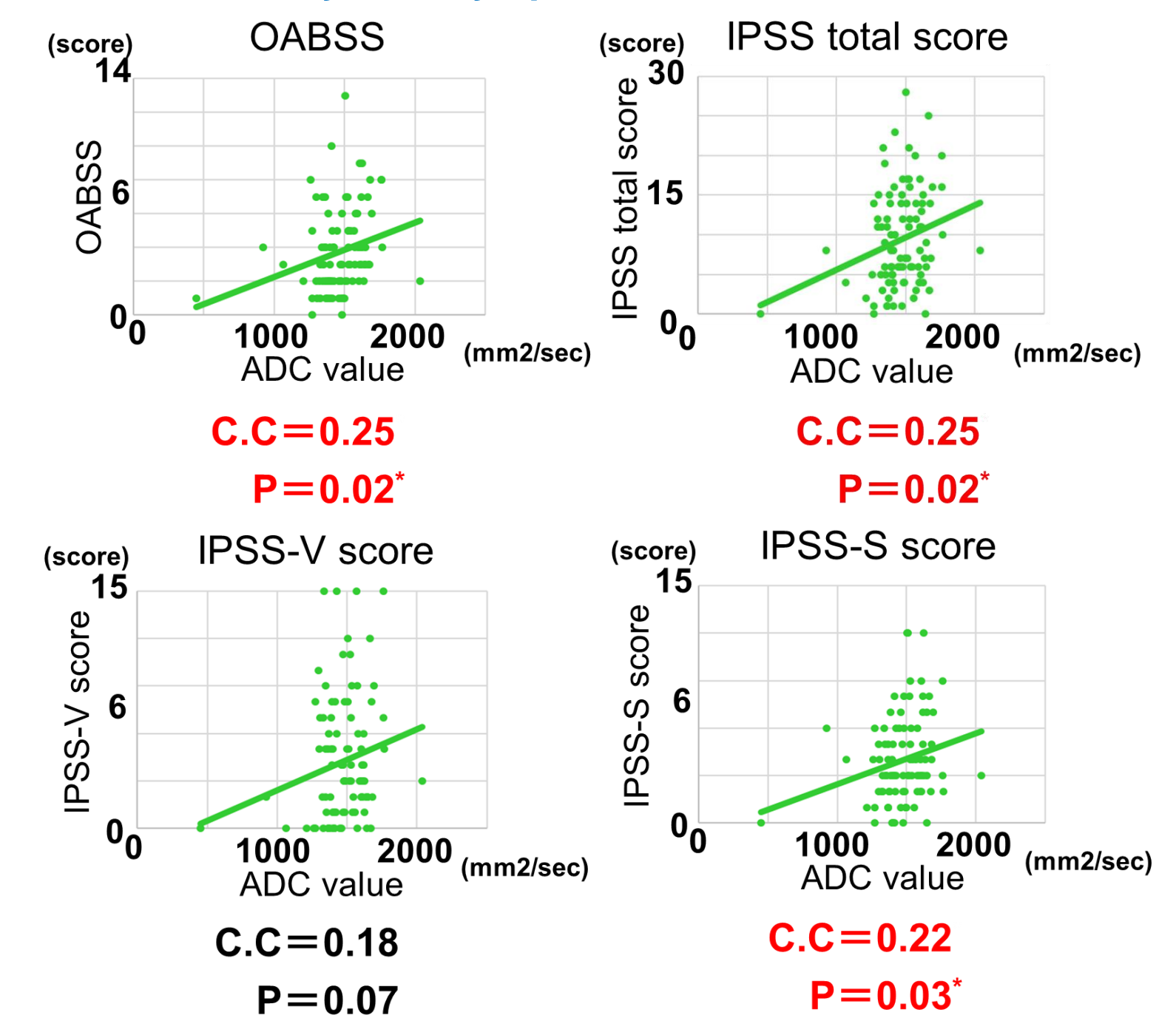
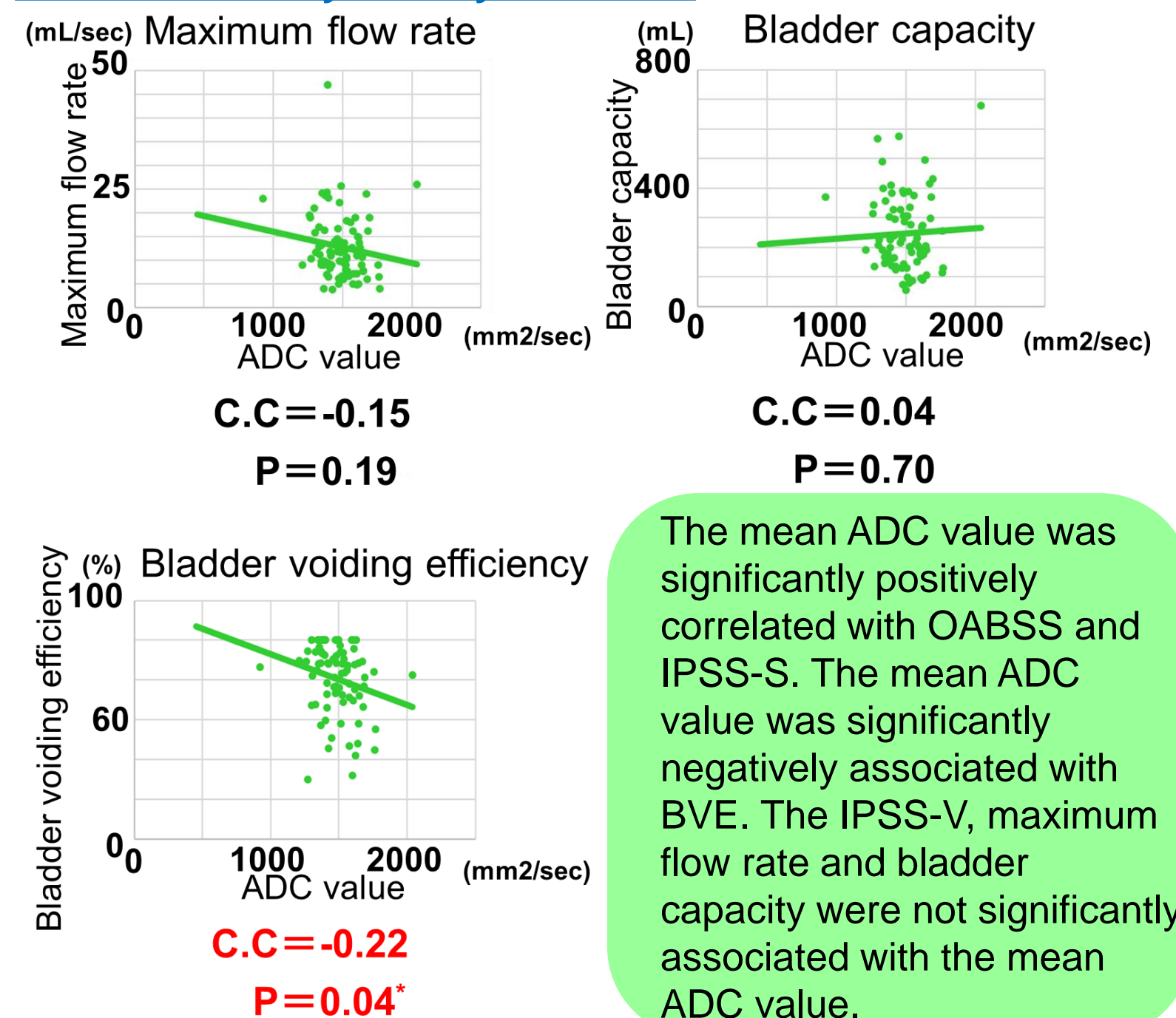


Figure 1-2. The association between the ADC value of prostate and lower urinary tract dysfunctions



Conclusions

The high ADC value at the base of prostate caused storage symptoms and decreased the BVE. BVE is used to evaluate bladder outlet obstruction (BOO). The microscopic structural changes of prostate reflected by high ADC value might contribute to storage symptoms through worsened BOO. On the other hands, some studies reported that inflammation affects prostate ADC value.²⁾ The high ADC value may also reflect the inflammation of prostate which affects storage symptoms. The microscopic structural changes of prostate reflected by high ADC value may affect lower urinary tract function through the different mechanism from the prostate volume and morphological features of prostate. The evaluating ADC value of prostate may provide individualized treatment options for patients.

References

1) Robertson C, Link CL, Onel E, et al. The impact of lower urinary tract symptoms and comorbidities on quality of life: The BACH and UREPIK studies. BJU Int. 2007;99:347-54.
2) Rourke E, Sunnapwar A, Mais D, et al. Inflammation appears as high Prostate Imaging-Reporting and Data System scores on prostate magnetic resonance imaging (MRI) leading to false positive MRI fusion biopsy. Clin Urol. 2019;60:388-395.