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ABSTRACT

Objective: To investigate the most accurate MR sequence for tumor detection, maximal tumor diameter and parametrial invasion, compared with histopathologic diagnoses.

Methods: Fifty-one patients with FIGO 2018 IB1 to IIB cervical cancer underwent preoperative MRI and surgical resection. Two radiologists independently evaluated the tumor detection, parametrial invasion, and tumor size in each of T2WI, DWI, and contrast enhanced-T1WI (CE-T1WI). Results obtained for squamous cell carcinoma and adenocarcinoma were also compared.

Results: Neither the tumor detection rate nor parametrial invasion was found to be significantly different among sequences. Tumor size assessment using MRI with pathology showed good correlation: $r = 0.63\text{--}0.72$. The adenocarcinoma size tended to be more underestimated than SCC in comparison to the pathological specimen.

Conclusion: Cervical cancer staging by MR images showed no significant difference among T2WI, DWI, and CE-T1WI. Adenocarcinoma was prone to be measured as smaller than the pathologic specimen, compared with SCC.

INTRODUCTION

17 Cervical cancer is the fourth most common cancer among women worldwide (1). The
18 International Federation of Gynecology and Obstetrics (FIGO) classification, commonly used for
19 staging, was recently updated in 2018 (2,3). The role of imaging has been expanding because FIGO
20 2018 allowed the use of imaging to evaluate tumor extension and tumor diameter. Furthermore, an
21 important point of revised FIGO 2018 is that stage IB was divided into three subgroups, considering
22 the prognosis and indication of fertility preserving surgery. Accurate pretreatment assessment of the
23 maximum diameter of early stage cancer is more important than ever, as is assessment of parametrial
24 invasion.

25 Magnetic resonance imaging (MRI) has been reported as the most accurate modality to
26 evaluate local tumor extension with excellent soft tissue contrast (4). Mainly, three sequences are used
27 in the evaluation of tumor extent: T2-weighted image (WI), diffusion weighted image (DWI), and
28 contrast enhancement-T1WI (CE-T1WI). T2WI has been the fundamental sequence for evaluation,
29 but the tumor extent can be overestimated on T2WI in cases with large tumors because of inflammation
30 and/or vascular congestion in peritumoral tissues, obscuring tumor margins and mimicking invasion
31 (5). Diffusion weighted image (DWI), a relatively new technique regarded as reflecting differences of
32 cellularity, gives excellent contrast between tumor and peritumoral tissue. That contrast facilitates
33 differentiation of tumor infiltration from reactive changes (6,7). The use of intravenous contrast
34 medium for cervical cancer detection and staging has not yet reached a consensus (8).The superiority
35 of CE-T1WI to T2WI has been reported in small tumor detection and in local tumor assessment (9),

although others were against it (10). Still, CE-T1WI is considered in FIGO 2018, NCCN, and ACR guidelines unless contraindicated (3,11,12). It is sometimes confusing to ascertain which is the most reliable sequence to evaluate the maximal tumor diameter and extent in clinical practice (Figure 1). Knowledge of characteristics and accuracy of respective sequences based on radiological pathological correlations is expected to aid reliable preoperative evaluation.

Pathologic variations might also affect the diagnostic performance of MRI in the evaluation of local extent, but they have not been investigated sufficiently. Downey et al. reported that adenocarcinoma is likely to show a higher ADC value than squamous cell carcinoma (SCC), reflecting the glandular content (13). It might diminish the contrast between a tumor and surrounding tissue on DWI. Using MRI, adenocarcinoma is currently diagnosed in the same manner as SCC. Validation of the accuracy of MRI on local tumor extent of adenocarcinoma with radiologic–pathologic correlation has not been performed yet.

This study was conducted to investigate which MR sequence is the most accurate for the tumor detection, maximal tumor diameter, and parametrial invasion, compared with pathological diagnosis for operable cervical cancer. Differences between SCC and adenocarcinoma were considered during sub-analysis.

MATERIALS AND METHODS

Patients

55 This retrospective single-institution study was approved by our institutional review board,
56 with a waiver of informed consent (IRB# R2799).

57 From a maintained database of cancer registration between January 2015 and December 2019,
58 we enrolled 132 consecutive patients with FIGO stage (2018) IB or II cervical carcinoma that had been
59 surgically resected and for whom preoperative MR images were available at our institution. The
60 following patients were excluded: neo-adjuvant chemotherapy ($n = 42$); no residual tumor on MR
61 examination, removed by biopsy or conization ($n = 13$); inappropriate pathologic specimen because of
62 contamination ($n = 1$); unmeasurable tumor extent because of difficulty differentiating
63 adenocarcinoma from background adenoma in situ (AIS) ($n = 2$); the interval between preoperative
64 MRI and the surgery greater than 60 days ($n = 1$); and MR examination not satisfying minimal
65 technical standards ($n = 22$). Finally, our study included 51 patients (Figure 2). Details about patients'
66 characteristics are presented in Table 1.

67

68 *MR Imaging technique*

69 MRI examinations were performed using a 3.0-T unit (Prisma and Skyra; Siemens Health
70 Care, Erlangen, Germany) ($n=50$) or a 1.5-T unit (Avanto; Siemens Health Care, Erlangen, Germany)
71 ($n=1$) using a phased-array coil. Before examination, 20 mg of butyl scopolamine (Buscopan®;
72 Nippon Boehringer Ingelheim Co., Ltd., Tokyo, Japan) was administered to reduce bowel motion,
73 unless contraindicated. The minimal technical standards which we required in this study were axial,

74 sagittal, and oblique axial T2WI, axial and sagittal DWI, and axial and sagittal CE-T1WI with or
75 without fat suppression. When dynamic contrast enhancement T1WI was performed, the images at
76 180 s after injection were assessed. The parameters were the following: for T2WI, 4000/81 ms
77 repetition time (TR)/echo time (TE), 260 mm field of view (FOV), 4 mm slice thickness, 150° flip
78 angle (FA), and 372 Hz/pixel bandwidth; for T1WI, 608/11 ms TR/TE, 260 mm FOV, 4 mm slice
79 thickness, 80°FA, and 250 Hz/pixel bandwidth; for DWI, TR/TE was 5000/58 ms at 3.0-tesla and
80 3000/70 ms at 1.5-T, with 4 mm slice thickness. The b-values of DWI were 0, 100, 500, and 1000
81 s/mm². Using a mono-exponential decay model with four b-values, ADC maps were generated
82 automatically. Fat suppression technique was spectral adiabatic inversion recovery (SPAIR) at 3.0-T
83 and chemical shift selective (CHESS) at 1.5-T. Three-dimensional CE T1-WI on sagittal or axial
84 planes were obtained after intravenous injection of 0.2 or 0.1 mmol/kg gadolinium contrast
85 enhancement (Magnevist or Gadvist; Bayer Yakuhin, Ltd., Osaka, Japan): 600/9.4 TR/TE, 260 mm
86 FOV, 4 mm slice thickness, 120° FA, and 228 Hz/pixel bandwidth. Neither an endovaginal coil nor
87 gel was used.

88 *Imaging analysis*

89 All MR examinations were interpreted independently by two board-certified radiologists with
90 24 years (A.K., reader 1) and 11 years (Y.M., reader 2) of experience in gynecologic cancer imaging.
91 The readers knew all patients and their age, and that they had biopsy-proven cervical carcinoma, but
92 they were blinded to all other clinical information.

93 After randomization of the patient order for each sequence, T2WI, DWI, CE-T1WI and the
94 combination of T2WI and DWI were evaluated separately with more than two-week intervals to
95 diminish recall bias. First, (a) the tumor detection assessment was performed. A tumor was considered
96 visible when the reader found a lesion that had higher signal intensity (SI) on T2WI, higher SI on DWI
97 with low ADC, or lower enhancement than the adjacent cervical stroma on CE-T1WI. In assessments
98 of DWI / CE-T1WI, T2WI was used only for an anatomical reference. When evaluating the combined
99 accuracy of T2WI and DWI, each reader made an overall judgment. The tumor detection confidence
100 levels were recorded using a Likert scale: 1, definitely absent; 2, probably absent; 3, indeterminate; 4,
101 probably present; and 5, definitely present. A cutoff of >3 was pre-defined: 1–3, negative; 4 and 5,
102 positive. Next, among cases in which a tumor was detected, (b) the presence or absence of parametrial
103 invasion, and (c) maximal tumor diameter were assessed. Parametrial invasion of the tumor was
104 assumed to be positive if the reader found full-thickness cervical stromal invasion and one of the
105 following additional imaging findings on T2WI: spiculated or nodular tumor-to-parametrial interface
106 or encased parametrial vessel by the tumor (4,14). The same definition was used for DWI and CE-
107 T1WI. Parametrial invasion was scored as follows: 1, definitely absent; 2, probably absent; 3,
108 indeterminate (i.e., impossible to evaluate); 4, probably present; and 5, definitely present. Right and
109 left sides of parametrial invasion were assessed separately. The maximum tumor diameters in three
110 orthogonal planes were recorded.

111

112 *Standard of reference*

113 Pathological reports were used as a standard of reference for tumor presence, maximal tumor
114 diameter, presence of parametrial invasion with laterality, and the presence of coexisting lesion such
115 as LEGH. All pathological specimens were evaluated by board-certified pathologists as a part of
116 patient care. Histological classification was according to WHO 2014. In nine cases with insufficient
117 information about parametrial invasion on the pathologic reports, the specimens were reviewed again
118 by a gynecologic oncologist (Y.C.) and a board-certified pathologist specializing in gynecologic
119 oncology (S.M.). The pathological T stage was determined according to The American Joint
120 Committee on Cancer (AJCC) TNM classification. Cases with pathological 1b tumor were subdivided
121 to p1b1 (<2 cm), p1b2 (2–4 cm), and p1b3 (≥ 4 cm) according to FIGO 2018 for the following
122 evaluations.

123

124 *Clinical features*

125 The following clinical features were extracted from patient charts by one of the authors
126 (Y.M.): age, the date of preoperative MRI, history of conization, tumor demographic information,
127 pathological findings including histology, tumor size, tumor depth, and pathological tumor-node-
128 metastasis (pTNM) staging for cervical cancer.

129

130 *Comparison of sequences*

Among the respective MR sequences, (a) the detection rate for respective pT stage and tumor size, (b) the diagnostic performance (sensitivity, specificity, accuracy, positive predictive value, and negative predictive value) of parametrial invasion, and (c) the difference between sizes measured by MRI and on pathology were compared. Inter-reader agreement was also analyzed for each sequence. In further analysis, each result was compared between SCC and adenocarcinoma.

The detection rate was defined as the number of cases scored 4 and 5 divided by the number of cases scored 1, 2, 4, and 5. Regarding parametrial invasion, scores 4 and 5 were assumed as positive, although scores 1 and 2 were as negative. Then, the sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of MR imaging were calculated. Because of the presence of indeterminate results (score 3), the detection rate, sensitivity, specificity, PPV, NPV of parametrial invasion were calculated using definitions based on conditional probability (15). Finally, correlation between the maximal tumor diameter measured on respective MRI sequences and pathology were calculated.

Statistical analysis

All statistical analyses were performed using software (R ver.3.6.2; R Core Team, 2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria). Categorical data are expressed as a number or percentage. Normally distributed data are presented with mean $\pm$ standard deviation and non-normal-distributed data with median [1st quartile,

150 3rd quartile]. Tumor detection and parametrial invasions in each MRI sequence were compared with
 151 χ^2 test followed by a multiple comparison. Spearman's correlation coefficient was used to assess the
 152 correlation of tumor size for measurements taken using MRI and pathology. Size differences were
 153 compared between SCC and adenocarcinoma using Student's *t*-test. Two-sided *p* values lower than
 154 0.05 were inferred as significant; 95% confidence intervals (CIs) were estimated. Inter-reader
 155 agreement of the two readers for tumor detection and the assessment of parametrial invasion were
 156 analyzed using the weighted κ statistic, and that for tumor size was analyzed by using Intraclass
 157 correlation analysis (ICC), interpreted as follows: 0 = no agreement; 0–0.20 = slight agreement; 0.21–
 158 0.40 = fair agreement; 0.41–0.60 = moderate agreement; 0.61–0.80 = substantial agreement; and 0.81–
 159 1.0 = almost perfect agreement (16).

160

161 **Results**

162 *Patients*

163 Table 1 presents the patients' characteristics. No pT1b3 case (≥ 4 cm) was in our study. All
 164 tumors with maximal tumor diameter greater than 4 cm had vaginal or parametrial invasion (pT2a (*n*
 165 = 1) and pT2b (*n* = 6)).

166

167 *Tumor detection*

168 The detection rate for each pT stage is shown in Table 2. No significant difference was found
 169 among sequences. For pT1b1 ($n = 14$), the detection rate was limited to less than 50% in any sequence.
 170 Regarding pT1b2 ($n = 24$), the detection rate was 67–88%. pT2 tumors ($n = 12$) were all detected in
 171 every sequence, except for one case coexisting with lobular endocervical glandular hyperplasia
 172 (LEGH). The interreader agreement of the Likert scale was substantial on T2WI and almost perfect on
 173 DWI and CE-T1WI (weighted $\kappa = 0.76, 0.81, 0.88$).

174 In all MR sequences, the detection rate of adenocarcinoma was lower than that of SCC in
 175 pT1b1. Pathologic examination results show that the median depth of tumor invasion was 6 mm (3–
 176 11 mm range) for SCC and 4 mm (1.8–9 mm range) for adenocarcinoma.

177

178 *Parametrial invasion*

179 Parametrial invasion was assessed in 51 cases with laterality (total 102 sites). Parametrial
 180 invasion was present in 16 of 102 (16%) sites at surgical pathologic examination. Table 3 presents
 181 sensitivity, specificity, accuracy, PPV, and NPV of parametrial invasion, respectively, for cervical
 182 cancers of all pathological types, squamous cell carcinoma, and adenocarcinoma. In the evaluation of
 183 single sequences, results show that T2WI had higher or equal sensitivity compared to DWI and CE-
 184 T1WI. CE-T1WI had higher specificity compared to T2WI and DWI. Among all the sequences,
 185 combination of T2WI + DWI showed the best in sensitivity, accuracy and NPV in all pathologies, but
 186 CE-T1WI was still the best in specificity. Although only the specificity of reader 2 showed significant

difference from χ^2 test, the followed multiple tests showed no difference. The interreader agreement of the Likert scale was substantial on T2WI and moderate on DWI and CE-T1WI (weighted $\kappa = 0.77, 0.43, 0.47$).

The diagnostic performance for the assessment of parametrial invasion in SCC was lower than that in adenocarcinoma in all sequences.

Size measurement

Maximal tumor diameter at pathologic examination ranged from 7 to 74 mm (26.8 ± 14.7 mm). The tumor size assessment on MRI with pathology showed good correlation with $r = 0.63$ – 0.72 (Figure 3). The interreader agreement for the tumor size at MR imaging was almost perfect: ICC = 0.91, 0.95, and 0.85, respectively, in T2WI, DWI, and CE-T1WI.

The maximal diameter of adenocarcinoma was measured as 3.5–7.0 mm smaller by MRI than by the pathological specimen. The size of adenocarcinoma tended to be underestimated as more than SCC in comparison with pathological specimen (the median difference: -8.0 to -4.5 mm vs. -3.5 to +2.0 mm). Adenocarcinoma tended to be underestimated in terms of diameter compared with SCC ($p = .03, .09, .26$, respectively, in T2WI, DWI, and CE-T1WI for reader 1 and $p = .09, .15$, and $.11$ for reader 2) (Figure 4). Figure 5 shows an example of adenocarcinoma where there was a discrepancy between imaging evaluation and pathological diagnosis.

206 **DISCUSSION**

207 For this study, we explored the characteristics and accuracy of respective MR sequences for
208 tumor detection, assessment of parametrial invasion, and maximal tumor diameter for cervical cancer.
209 No significant difference was found for those tumor assessments among sequences for either reader.
210 Regarding parametrial invasion, T2WI had higher sensitivity and CE-T1WI had higher specificity. We
211 also investigated the influence of histological types on those factors, comparing SCC and
212 adenocarcinoma. Results show that adenocarcinoma tended to be measured as smaller than the
213 pathologic specimen, in comparison to SCC.

214 As for tumor detection, no significant difference was found among sequences. All tumors in
215 pT2a/b except for one coexisting with LEGH were detected, but 67–88% in pT1b2 (AJCC) and less
216 than 50% in pT1b1. The low detection rate in pT1b1 might be subtle tumor invasion of less than 5
217 mm: thin, flat plaque extension at the surface of the cervix might result in difficulty for visualization
218 using a radiologic modality (17). The sensitivity for small tumors equal to or less than 1 cm³ was
219 reported as 44% (95% CI: 24.4–65.1) (18). Our results of low detection for pT1b1 tumor might
220 therefore be within an acceptable range. Adenocarcinoma was detected less frequently than SCC in
221 pT1b1, perhaps because of the difference of tumor depths. The tumor median depth was 6 mm (3–11
222 mm range) in SCC and 4 mm (1.8–9 mm range) in adenocarcinoma. Another possible cause might be
223 the signal intensity on DWI in adenocarcinoma, which is lower than that of SCC, causing difficulty in
224 tumor detection (13). Of the eight cases of SCC IB2, four cases were judged to be undetectable by one

or more readers. After reviewing the images, two of the cases could be pointed out by combining the clinical information, but the other two cases were difficult to point out because of the lack of contrast between the normal cervical stroma and the tumor even when viewed retrospectively.

Regarding parametrial invasion, no significant difference was found among the three sequences examined for our study. However, higher sensitivity and NPV was found on combination of T2WI + DWI. Higher specificity and PPV were indicated on CE-T1WI for reader 2. These results imply that the absence of parametrial invasion on combination of T2WI + DWI suggests the true negative; its presence on CE-T1WI might be the true positive. Thomeer et al. reported from their meta-analysis that MRI had significantly better sensitivity and comparable specificity to that of clinical evaluation (Sn, 84% vs. 40%; Sp, 92% vs. 93%). They inferred high sensitivity as the most important characteristic of MRI (19). In our study, combination of T2WI + DWI showed the best sensitivity. One reason was assumed to be that oblique-axial was taken only in T2WI. These high diagnostic values using sequence without contrast agent might benefit patients with contraindications for MR contrast agents. Our results for sensitivity (23.1–75%) were lower than those reported earlier, which showed the pooled sensitivity and specificity, respectively, as 74–84% and 92–94% (19–22). One reason is that all the included cases showed subtle invasion because CCRT/RT or neoadjuvant chemotherapy was performed for cases with apparent parametrial invasion on clinical examination or MRI. The possibility exists that changes of surgical methods over time has led to differences in the results. Results of superior detection of parametrial invasion in adenocarcinoma compared with SCC are also

244 explained with the same reason, i.e., at our institution, considering radiation resistance, radical surgery
245 tends to be selected for adenocarcinoma even in FIGO IIB, whereas CCRT/RT or NACT is usually
246 selected for SCC in FIGO IIB (and IB3). In this study cohort, all SCC pT2b cases ($n=5$) were with
247 subtle pathological parametrial invasion. The presence of verification bias was also described in earlier
248 reports of metanalysis. This bias is now difficult to avoid because surgery alone is not a standard
249 treatment for advanced cervical cancer at present (19).

250 The size of the tumor measured on MRI was found to have good correlation ($r = 0.71-0.79$)
251 with tumor size on pathology. No significant difference was found among MR sequences. From this
252 result, the decision of T1b tumor in new FIGO stage by MR imaging can be made for any sequences.
253 Our results are comparable to those of several earlier studies (23–27). Additionally, we found that the
254 diameter measured by MRI tends to be smaller than that by pathology in adenocarcinoma. Actually,
255 accurate pathologic measurement of the depth of invasion in some tumors can be quite challenging. It
256 is often problematic in early endocervical adenocarcinoma (28–30). No report of a radiological study
257 has indicated that SCC and adenocarcinoma differs in the degree of distinction between the tumor and
258 the normal part. Only for gastric type adenocarcinoma has it been known that gastric type
259 adenocarcinoma sometimes shows an unclear margin reflecting highly infiltrating characteristics of
260 the tumor and causing underestimation of the tumor extent (31). Recognizing that adenocarcinoma
261 might be measured as smaller than actual size compared with SCC is now of clinical importance,
262 because the tumor size is a key staging factor, especially for fertility-preserving surgery.

263 This study has several limitations. First, it was a retrospective analysis of a small population
264 at a single institute. Second, only patients who had undergone surgery without neoadjuvant
265 chemotherapy were included. Patients who had received radiation therapy or neoadjuvant
266 chemotherapy were excluded from this study because of the lack of standard reference, which might
267 cause verification bias, especially for those with SCC. Third, both radiologists in our study had
268 expertise in gynecologic cancer imaging. For that reason, our results might not be broadly
269 generalizable.

270 In conclusion, no significant difference was found among T2WI, DWI, and CE-T1WI for
271 tumor detection, assessing parametrial invasion or tumor size. Cervical cancer staging by MR imaging
272 was found to have no significant difference among these three sequences. In addition, adenocarcinoma
273 was prone to be measured as smaller than the pathologic specimen in comparison with SCC.

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Figure 1. Exemplary case of diagnostic discrepancy between MRI sequences

A, Axial T2WI. The tumor was recognized as a slightly high signal intensity area locating at the surface of the cervix extruding into vaginal cavity. Vagina fornix at left-posterior side was irregular. Then the parametrial invasion was suspected at this point. B, On DWI, the tumor delineation was clear. Tumor is observed as confined within cervix fornix. The tumor size was apparently smaller than T2WI. C, CE-T1WI also show clear delineation of the tumor and the tumor seemed to not invade into parametrium. After operation, slight parametrial invasion was recognized at pathological examination.

Figure 2. Schema showing patient inclusion

Figure 3. Correlation of the maximal tumor diameter between those measured using MRI and pathology

The horizontal axis shows the tumor diameter measured by pathology. The vertical axis shows the tumor diameter measured by MR imaging in each sequence. The tumor size assessment showed good correlation with $r = 0.63\text{--}0.72$

Figure 4. Comparison between SCC and adenocarcinoma for the tumor size difference

Box-plots show the difference of the maximum tumor diameter measured using MRI and by pathological examination, respectively, for squamous cell carcinoma (SCC) and adenocarcinoma (AC).

371 AC was measured smaller in MRI than in pathology, compared with SCC. The median difference
372 measured using MRI and using pathology is shown below the graph.

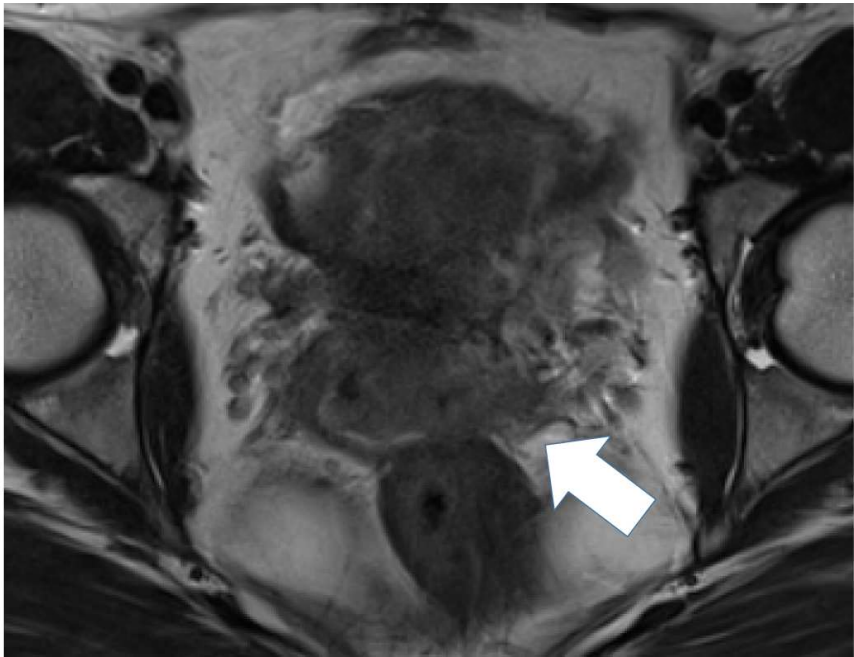
373

374 **Figure 5. The case of adenocarcinoma where there was a discrepancy between imaging**
375 **evaluation and pathological diagnosis.**

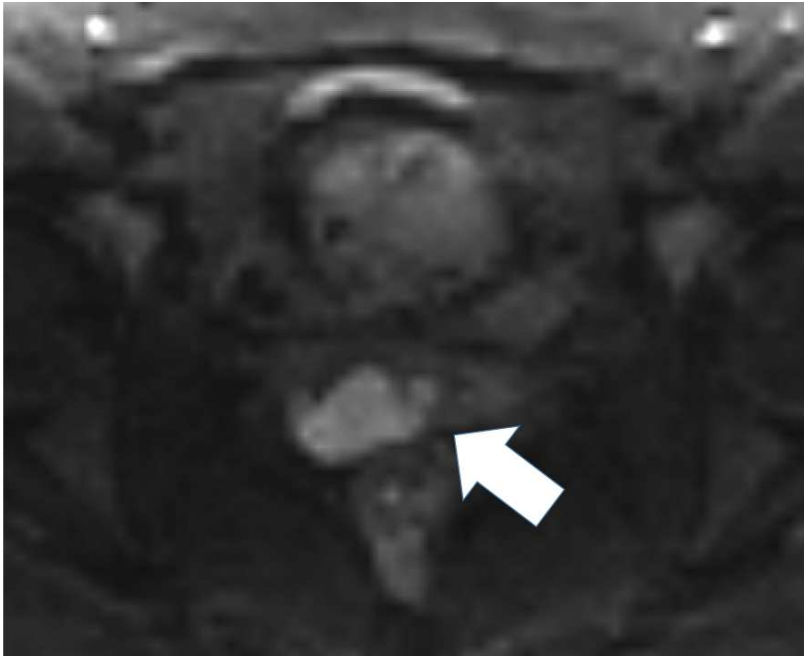
376 The tumor exists from external orifice to internal orifice, in 6-12 o'clock direction. The tumor was
377 measured as 19, 27, 17 mm (T2WI, DWI, CE-T1WI, respectively) for reader1, 19, 26, 22 mm for
378 reader 2 in maximum diameter, resulting in 33 mm for pathologic evaluation.

Figure 1

A



B



C

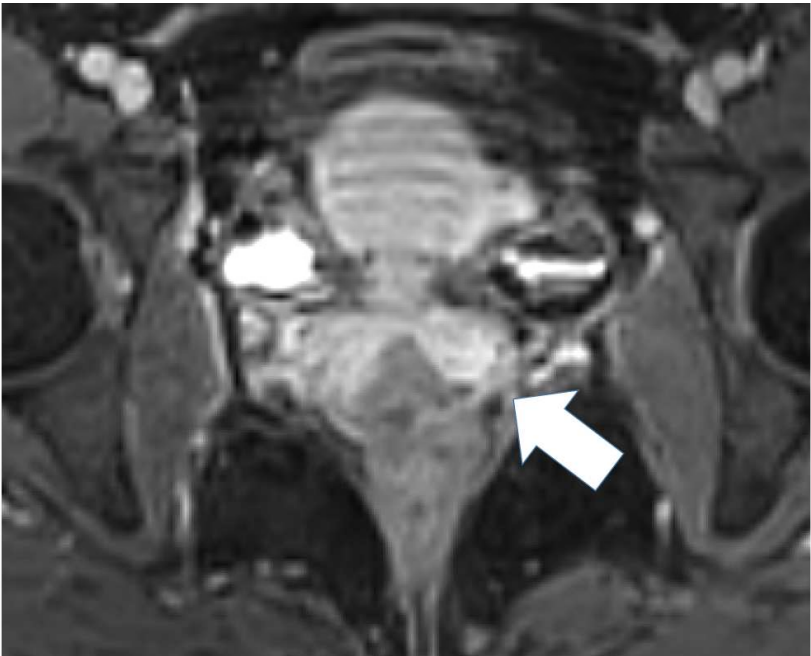


Figure 2

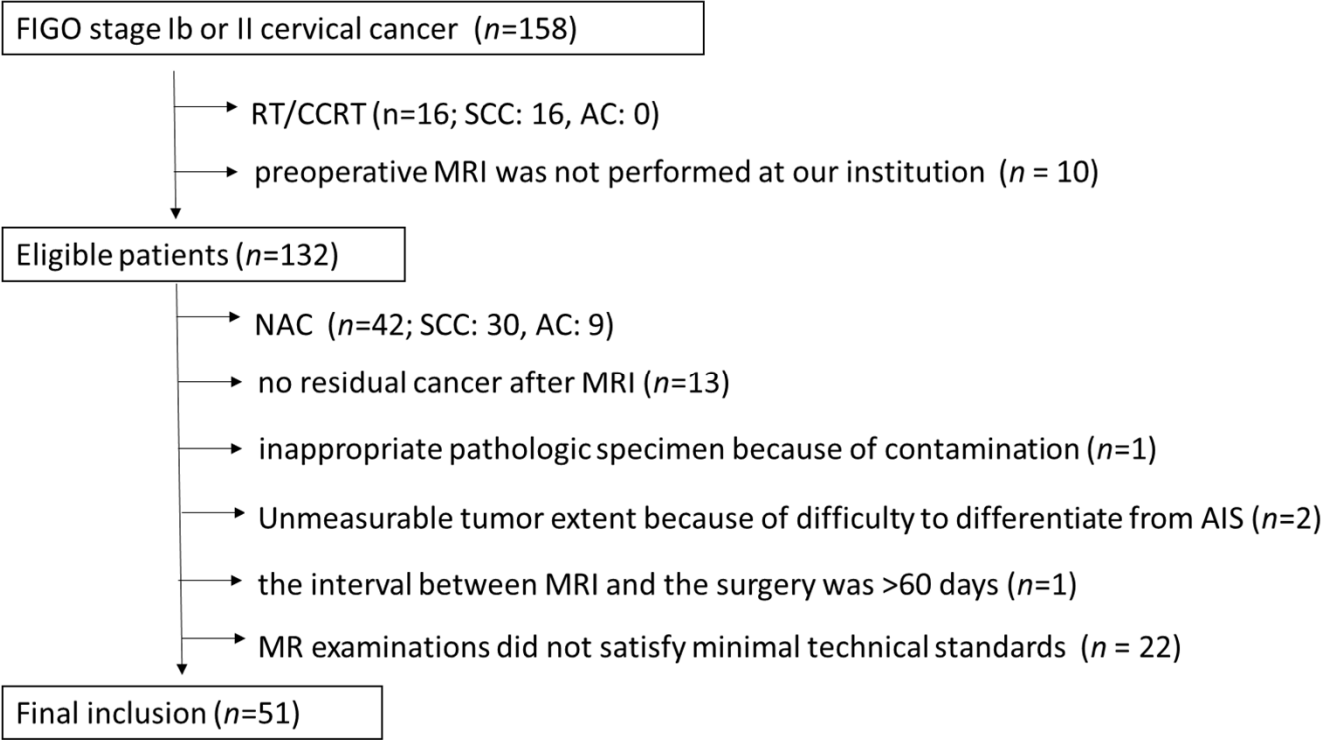
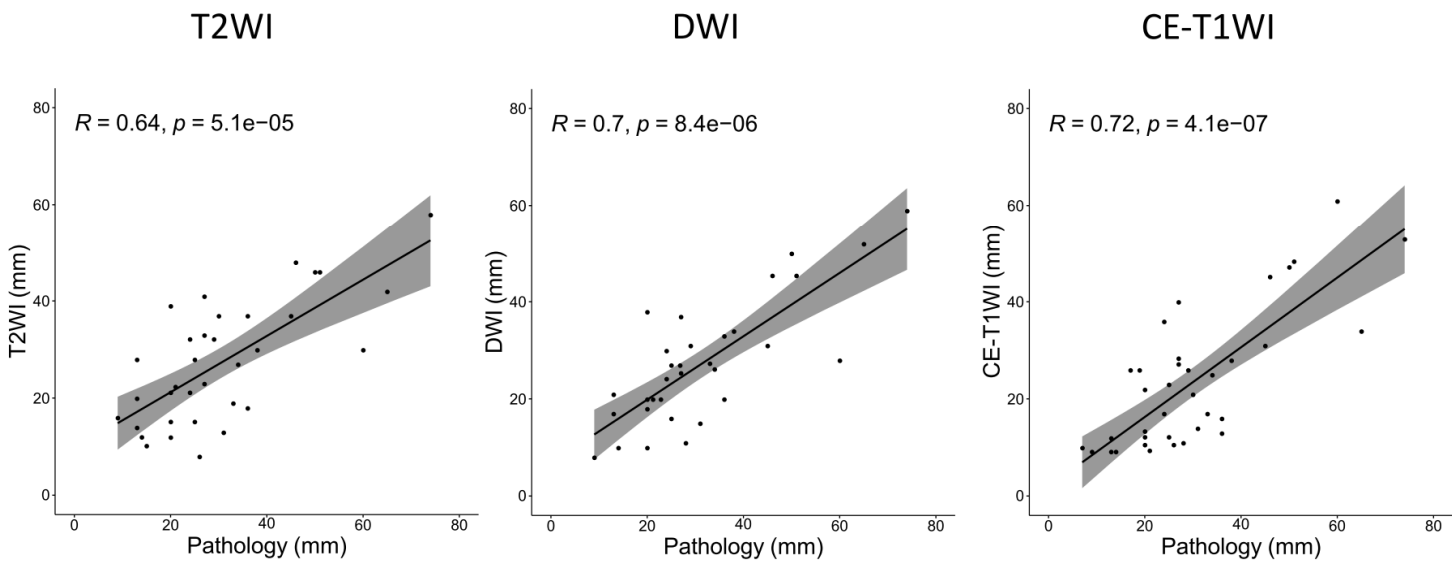


Figure 3

A

Reader 1



B

Reader 2

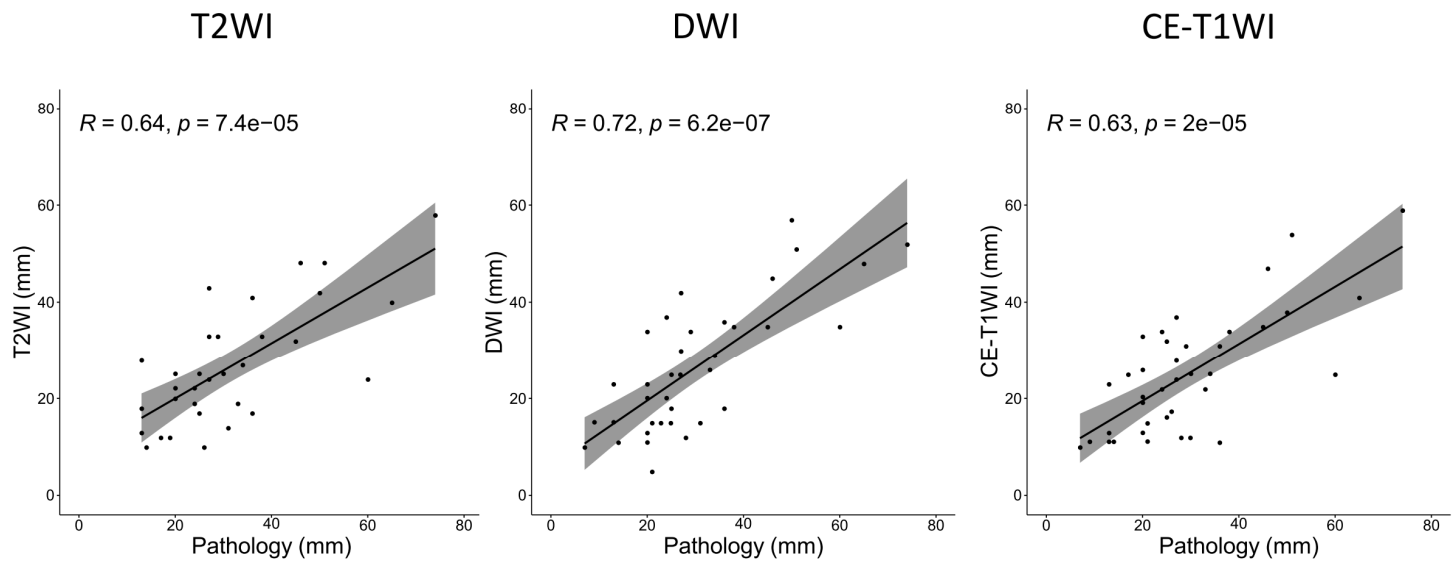


Figure 4

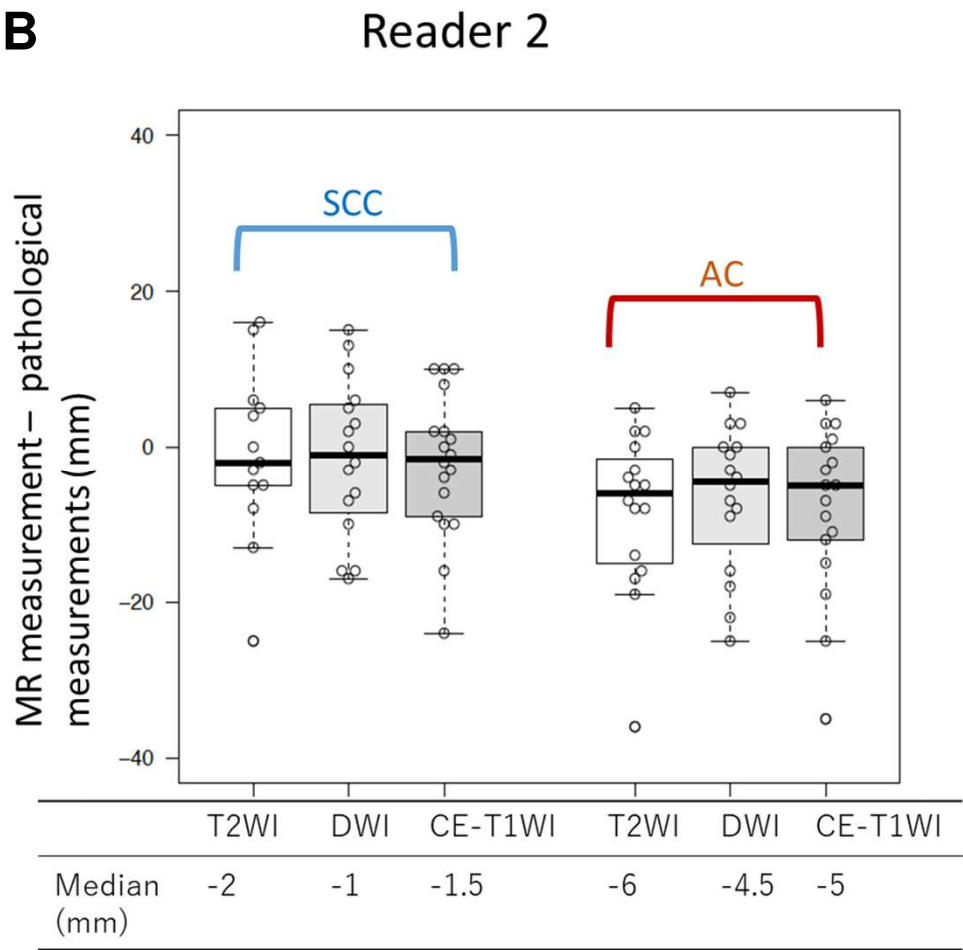
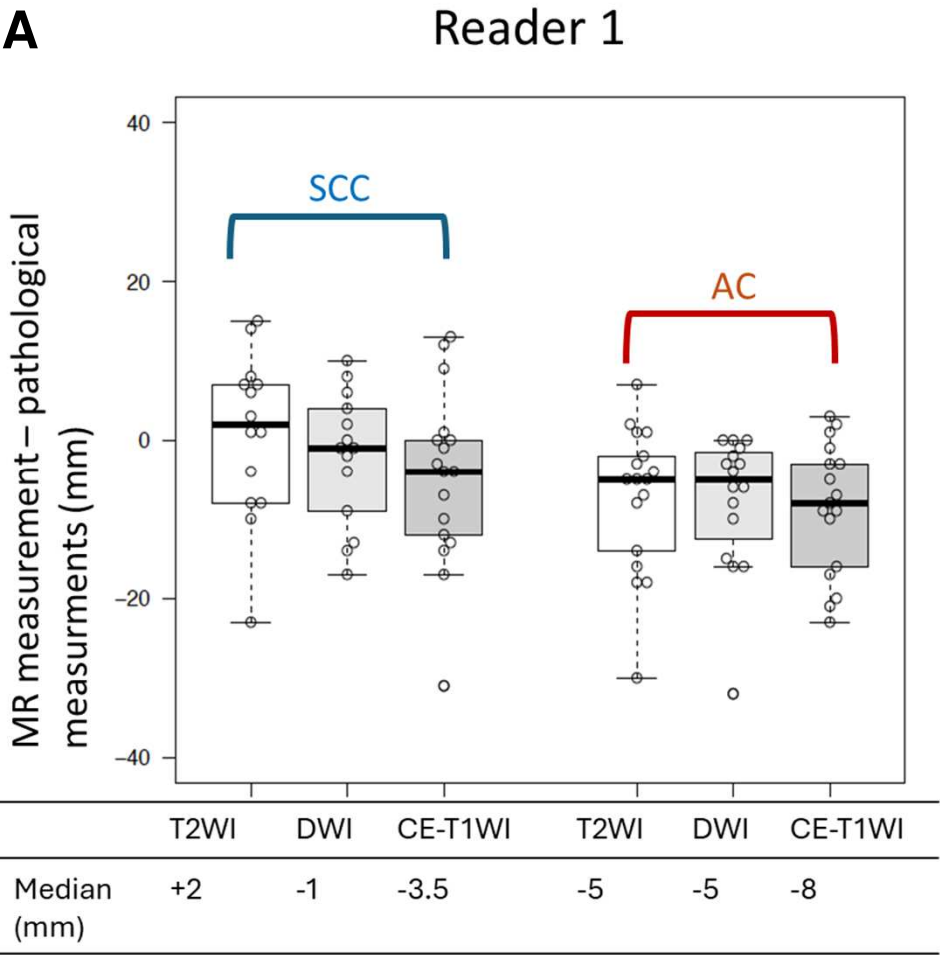


Figure 5

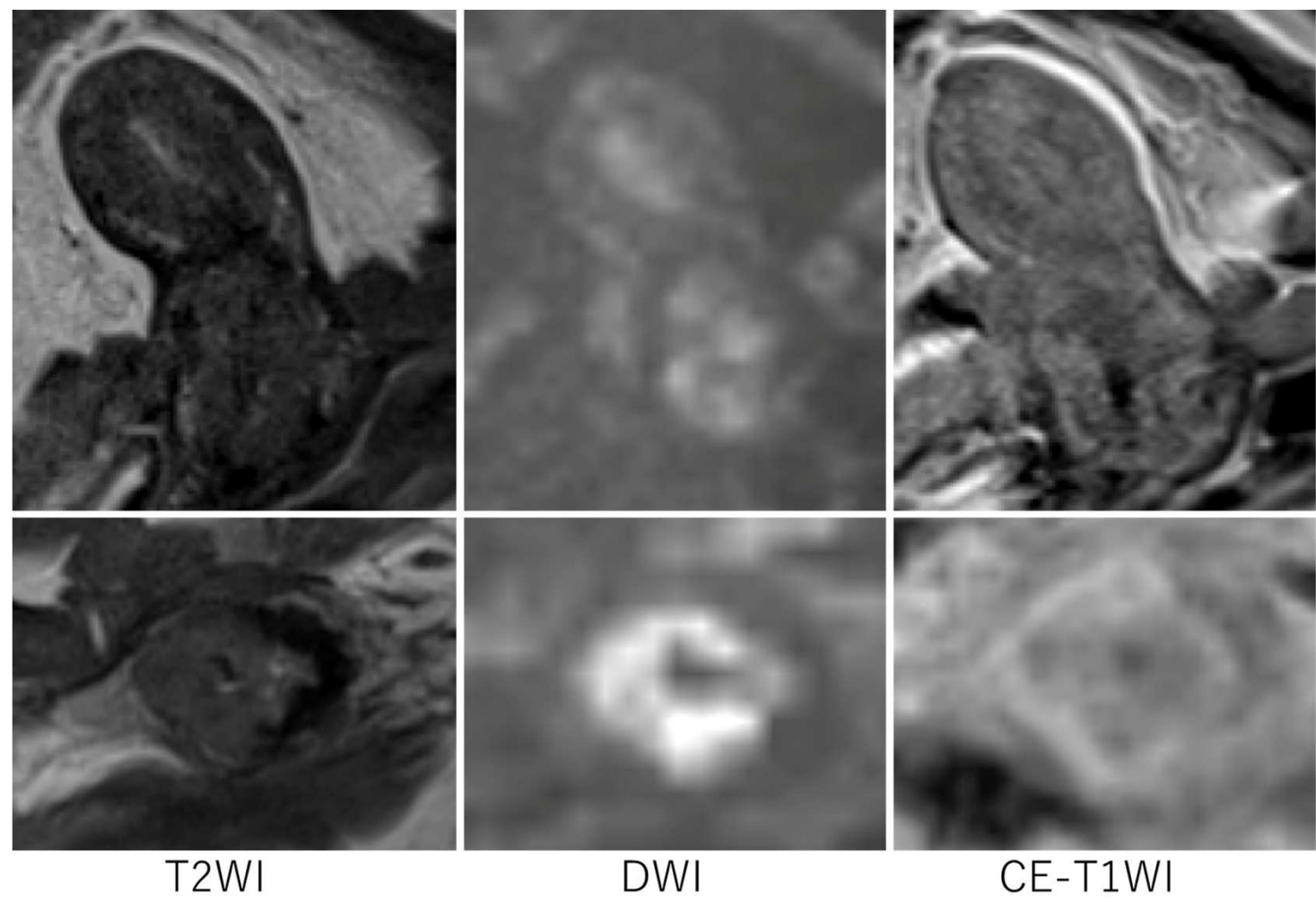


Table 1 Patient characteristics

Number of patients	N = 51	
Age (y)	46.7 ± 12.1 (mean±SD)	
Stage*		
	pT1b	38
	1b1	14
	1b2	24
	1b3	0
	pT2a	1
	pT2b	12
Histology**		
	Squamous cell carcinoma	21
	Non-keratinizing type	15
	keratinizing type	5
	Papillary	1
	Adenocarcinoma	26
	Endocervical, usual type	15
	gastric type	8 (3 were w/ LEGH)
	Signet ring cell type	1
	admixed with small cell	1
	neuroendocrine differentiation	
	poorly differentiated with neuroendocrine feature	1
	Others	4
	Small cell carcinoma	3
	Glassy cell carcinoma	1
Days between preoperative MRI and surgery	27 (range: 1–56)	
Cone biopsy or LEEP before MRI	3	
MRI field strength		
	3T	50
	1.5T	1

* Pathological T stage was assigned according to The American Joint Committee on Cancer (AJCC) TNM classification.

** Histological classification was assigned according to WHO 2014.

LEGH, Lobular Endocervical Glandular Hyperplasia; MRI, Magnetic Resonance Imaging; LEEP, Loop Electrosurgical Excision Procedure; T, Tesla

Table 2 Tumor Detection rate

		Reader 1				Reader 2				
	T2WI	DWI	CE-T1WI	<i>p</i>	T2WI+DWI	T2WI	DWI	CE-T1WI	<i>p</i>	T2WI+DWI
										I
All pathologies*	(%)									
pT1b1	43	21	50	.51	43	36	42	50	.74	38
pT1b2	75	71	83	.84	88	67	83	88	.17	88
pT2a	100	100	100	1	100	100	100	100	1	100
T2b	100	92	100	.37	100	92	92	100	.59	92
SCC	(%)									
pT1b1	57	50	71	.75	57	57	60	71	.85	57
pT1b2	71	86	100	.31	88	50	100	100	.01	100
pT2b	100	100	100	1	100	100	100	100	1	100
Adenocarcinoma	(%)									
pT1b1	29	14	29	.77	29	14	29	29	.77	17
pT1b2	92	83	85	.81	92	77	69	85	.65	77
pT2a	100	100	100	1	100	100	100	100	1	100
pT2b	100	83	100	.38	100	83	83	100	.38	83

* Pathological T stage was assigned according to The American Joint Committee on Cancer (AJCC) TNM classification.

T2WI, T2 Weighted Imaging; DWI, Diffusion Weighted Imaging; CE-T1WI, Contrast enhanced T1 Weighted Imaging

Table 3 MR Imaging Assessment for Parametrial Invasion of Cervical Cancer

Reader 1						Reader 2				
	T2WI	DWI	CE-T1WI	<i>p</i>	T2WI+DWI	T2WI	DWI	CE-T1WI	<i>p</i>	T2WI+DWI
All pathologies (%)										
Sensitivity	62.5	40	23.1	.1	75.0	66.7	60	46.7	.35	66.7
Specificity	87.9	86.3	96.8	.12	93.7	86.3	91.2	98.4	.05*	95.1
Accuracy	82.4	76.5	84	.48	89.9	81.8	84.7	88.5	.53	89.5
PPV	58.8	46.2	60	.76	75.0	58.8	64.3	87.5	.36	76.9
NPV	89.5	83.6	85.7	.66	93.7	89.8	89.7	88.6	.97	92.1
SCC (%)										
Sensitivity	33.3	16.7	25	.8	33.3	33.3	33.3	33.3	1	33.3
Specificity	77.3	86.4	92.6	.31	88.5	75	83.3	96.7	.08	92.9
Accuracy	67.9	71.4	83.9	.33	78.1	65.4	73.3	86.1	.15	82.4
PPV	28.6	25	33.3	.97	40.0	28.6	33.3	66.7	.5	50
NPV	81	78.9	89.3	.57	85.2	78.9	83.3	87.9	.69	86.7
Adenocarcinoma (%)										
Sensitivity	77.8	62.5	25	.08	100	100	87.5	62.5	.12	100
Specificity	93.5	88.5	100	.18	96.9	92.3	96.2	100	.31	96.2
Accuracy	90	82.4	84.2	.61	97.6	94.1	94.1	92.1	.92	97.1
PPV	77.8	62.5	100	.52	90	80	87.5	100	.55	88.9
NPV	93.5	88.5	83.3	.43	100	100	96.2	90.9	.28	100

T2WI, T2 Weighted Imaging; DWI, Diffusion Weighted Imaging; CE-T1WI, Contrast enhanced T1 Weighted Imaging, * : $p < .05$