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ABSTRACT

BACKGROUND AND PURPOSE: Deep learning (DL)-based reconstruction enables improving the quality of MR images acquired with a short scan time. We aimed to prospectively compare the image quality and diagnostic performance in evaluating cervical degenerative spine diseases and myelopathy between conventional cervical MRI and accelerated cervical MRI with a commercially available vendor-neutral DL-based reconstruction.

MATERIALS AND METHODS: Fifty patients with degenerative cervical spine disease or myelopathy underwent both conventional cervical MRI and accelerated cervical MRI by using a DL-based reconstruction operating within the DICOM domain. The images were evaluated both quantitatively, based on SNR and contrast-to-noise ratio (CNR), and qualitatively, by using a 5-point scoring system for the overall image quality and clarity of anatomic structures on sagittal T1WI, sagittal contrast-enhanced (CE) T1WI, and axial/sagittal T2WI. Four radiologists assessed the sensitivity and specificity of the 2 protocols for detecting degenerative diseases and myelopathy.

RESULTS: The DL-based protocol reduced MRI acquisition time by 47%–48% compared with the conventional protocol. DL-reconstructed images demonstrated a higher SNR on sagittal T1WI ($P = .046$) and a higher CNR on sagittal T2WI ($P = .03$) than conventional images. The SNR on sagittal T2WI and the CNR on sagittal T1WI did not significantly differ ($P > .05$). DL-reconstructed images had better overall image quality on sagittal T1WI ($P < .001$), sagittal T2WI (Dixon in-phase or TSE) ($P < .001$), and sagittal T2WI (Dixon water-only) ($P = .013$) and similar image quality on axial T2WI and sagittal CE T1WI ($P > .05$). DL-reconstructed images had better clarity of anatomic structures (P values were $< .001$ for all structures, except for the neural foramen [$P = .024$]). DL-reconstructed images had a higher sensitivity for detecting neural foraminal stenosis ($P = .005$) and similar sensitivities for diagnosing other degenerative spinal diseases and myelopathy ($P > .05$). The specificities for diagnosing degenerative spinal diseases and myelopathy did not differ between the 2 images ($P > .05$).

CONCLUSIONS: The accelerated cervical MRI reconstructed with a vendor-neutral DL-based reconstruction algorithm did not compromise image quality and had higher or similar diagnostic performance for diagnosing cervical degenerative spine diseases and myelopathy compared with the conventional protocol.

ABBREVIATIONS: CE = contrast-enhanced; CNR = contrast-to-noise ratio; DL = deep learning; HIVD = herniated intervertebral disc

MRI is a clinically important imaging technique that provides high spatial resolution and soft tissue contrast without radiation exposure. However, long data acquisition times in a narrow and uncomfortable space reduce the satisfaction of patients, especially in cases of spinal diseases or movement disorders, and cause motion artifacts due to the patients' movement.

MRI signals, instead of being composed of direct image information, are collections of data in the spatial frequency domain known as *k*-space, and the scan time is closely related to the amount of data obtained. Full sampling of data enables the acquisition of relatively accurate images but requires a long data

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SUMMARY

PREVIOUS LITERATURE: While previous studies have demonstrated that the use of deep learning reconstruction for accelerated protocols does not compromise image quality or diagnostic accuracy compared with conventional protocols, its utility for the evaluation of cervical degenerative spine diseases and myelopathy remains unknown.

KEY FINDINGS: In this prospective study, we found that the accelerated cervical MRI reconstructed with a commercially available deep learning–based reconstruction algorithm operating within the DICOM domain did not compromise image quality and had higher or similar diagnostic performance for diagnosing cervical degenerative spine diseases and myelopathy compared with the conventional protocol.

KNOWLEDGE ADVANCEMENT: These findings highlight that a vendor-neutral deep learning–based reconstruction algorithm can be a promising solution to reduce the scan time for cervical MRI without compromising image quality or diagnostic accuracy for various pathologies.

acquisition time. Partial acquisition of data shortens the scan time but increases image artifacts and noise. Therefore, research on reconstructing high-quality MR images from undersampled data has been actively conducted.

For decades, techniques such as parallel imaging and compressed sensing have been used to reduce the data acquisition time but have reached limitations in terms of the acceleration rate and computational time.[1-4] Recently, improving the image quality of accelerated MR images by using deep learning (DL)-based reconstruction has been a topic of research interest. Previous studies have demonstrated that the use of DL reconstruction for accelerated protocols does not compromise image quality or diagnostic accuracy compared with conventional protocols.[5-13] Among them, only a few studies analyzed cervical spinal MRI and were limited to the evaluation of spinal stenosis.[10,13]

Several MRI manufacturers have introduced various DL-based image reconstruction software integrated directly into their image acquisition pipelines, either in the raw data or *k*-space domains.[14] Some have pursued an alternative approach by developing models that operate within the DICOM domain, aiming to enhance model generalizability. SwiftMR, a vendor-neutral image reconstruction software developed by AIRS Medical, uses DL-based reconstruction to reduce noise and artifacts in DICOM MR images; therefore, it enables improving the image quality of MR images acquired with a short scan time at any MRI scanner. The purpose of this study was to prospectively compare the image quality and diagnostic performance in evaluating cervical degenerative spine diseases and myelopathy between conventional MRI and accelerated cervical MRI with a commercially available vendor-neutral DL-based reconstruction.

MATERIALS AND METHODS

This prospective study was approved by the institutional review board of Seoul National University Hospital (IRB No. 2103–174-1207). Written informed consent was obtained from all participants. The study was conducted according to Standards for Reporting of Diagnostic Accuracy Studies guidelines.[15]

Participants

Patients who visited Seoul National University Hospital and underwent cervical spine MRI between July 2022 and September 2023 were prospectively enrolled. Inclusion criteria were as follows: the patients 1) were aged 18 years or older, 2) had neck pain, weakness, numbness, or tingling sensation, and 3) required cervical spinal MRI for further evaluation due to suspected degenerative cervical spinal disease or cervical myelopathy. Exclusion criteria were as follows: 1) withdrawal of consent, 2) contraindications to MRI, and 3) limited MR image quality.

MRI Examination

MRI was performed by using 1.5T scanners (Ingenia; Philips Healthcare). Each patient underwent examination based on 1 of 2 protocols, determined by their medical conditions: either the herniated intervertebral disc (HIVD) protocol or the myelopathy protocol. The HIVD protocol included sagittal T1WI, sagittal T2WI, and axial T2WI. The myelopathy protocol included sagittal T1WI, sagittal T2WI (Dixon), axial T2WI, and sagittal contrast-enhanced (CE) T1WI. All participants underwent conventional spin-echo cervical spine MRI followed by accelerated cervical spine MRI on the same day. The accelerated MRI was performed with preset accelerated scan parameters and reconstructed by using a DL-based algorithm, while conventional MRI was postprocessed by vendor-supplied reconstruction without a DL algorithm. For the myelopathy protocol, a gadolinium-based contrast agent bolus (gadobutrol [Gadovist; Bayer Schering Pharma] at a dose of 0.1 mmol/kg of body weight) was manually injected via the intravenous route at the right median antecubital vein. The details of the parameters used in this study are provided in the Supplemental Data.

DL-Based Reconstruction Technique

The DL-based MR image reconstruction technique utilized in this study is a commercially available software, SwiftMR v2.0.1.0 (AIRS Medical). The algorithm utilized a modified U-Net architecture, consisting of 18 convolutional blocks, 4 max-pooling layers, 4 up-sampling layers, 4 feature concatenations, and 3 convolutional layers arranged in a cascading manner to reinforce data consistency. This DL system exclusively operates in the image domain, utilizing undersampled images as input to reconstruct output images.

The model was trained with 31,865 sets and internally validated with 3540 sets of 2D and 3D DICOM images of various body parts. The MR images used for algorithm development and

internal validation were collected serially from multiple hospitals in South Korea over a predefined period and were entirely separate from the MR images collected for this study. This model utilized Adam, a stochastic optimization method, as an optimizer with 20 epochs, a batch size of 4, and a learning rate of 10^{-3} (decaying to 10^{-4}).[16] The training was performed by using 4 NVIDIA Tesla V100 graphics processing units (GPUs) with 32 GB of memory (NVIDIA Corporation).

Quantitative Image Quality Evaluation

In this study, the SNR and contrast-to-noise ratio (CNR) were calculated as indicators of quantitative image quality. ROIs were placed at the C3–C4 intervertebral disc, C3 bone marrow, and background on the sagittal T1WI of each acquisition with care not to include edges. The SNR and CNR were calculated for both the conventional and accelerated protocols by using the following formula: $SNR = SI_{C3\text{-}4\ disc}/SD$, $CNR = |(SI_{C3\text{-}4\ disc} - SI_{C3\ bone\ marrow})|/SD$, where $SI_{C3\text{-}4\ disc}$ and $SI_{C3\ BM}$ are signal intensities of the C3–C4 intervertebral disc and C3 bone marrow, respectively, and SD is the standard deviation of the background noise.[17]

Qualitative Image Quality Evaluation

Four radiologists (4, 4, 10, and 10 years of experience in radiology) participated as independent readers for qualitative evaluation of image quality and diagnostic performance in detecting degenerative cervical spine disease and myelopathy. Before the initiation of the actual reading, the readers were instructed on the evaluation criteria with 3 sample MRI examinations to improve the study objective. Both the conventional and accelerated cervical MRI were performed on 50 patients, resulting in a total of 100 MRI studies distributed to readers over 2 sessions. Only 1 MRI of each patient was included in 1 session, and an interval of more than 4 weeks was placed between the 2 sessions to minimize the influence of images from the previous session on the next session. Fifty MRI studies composed of a mixture of conventional and DL-reconstructed images were presented in a randomized crossover manner at each session to readers who were blinded to the imaging protocols and patient information.

To evaluate the image quality, the readers first assessed how well each anatomic structure was delineated on a 5-point scale (1: not visible, 2: barely visible, 3: adequately visible, 4: good visibility, and 5: excellent visibility) by using the following MRI sequences: sagittal T1WI and T2WI for the bone marrow, endplates, and intervertebral discs; sagittal T2WI and axial T2WI for the CSF space, spinal cord, and facet joints; and axial T2WI for the neural foramina and paraspinal muscles.[18] For each MRI sequence, overall image quality was evaluated on a 5-point scale (1: not acceptable or no diagnostic value, 2: very limited diagnostic value, 3: acceptable for most diagnoses, 4: good for most diagnoses, 5: optimal).[18] The degree of artifacts was evaluated for each on a 4-point scale (1: massive artifacts, 2: significant artifacts, 3: minimal artifacts, 4: no artifacts).[18]

Diagnostic Performance for Cervical Spinal Diseases

To analyze the diagnostic performance for degenerative cervical spine diseases and myelopathy, the readers were instructed to evaluate the presence of disc abnormality (herniation or bulging), central canal stenosis, neural foraminal stenosis, and spinal instability (spondylolisthesis or retrolisthesis) at each intervertebral level and the presence of myelopathy. The severity of central canal stenosis was also assessed according to a previously published guideline.[19] With regard to myelopathy, the presence or absence of contrast enhancement was evaluated for patients scanned with the myelopathy protocol.

For the reference standards, 2 senior neuroradiologists (S.H.C. and R.-E.Y. with 20 and 12 years of experience in radiology, respectively) independently assessed all MRI studies. The 2 senior neuroradiologists referred to both the conventional MRI and clinical information of each patient and disagreements were resolved by consensus.

Statistical Analysis

All statistical analyses were performed by using R statistical software, and P values $< .05$ were considered statistically significant. A post hoc power calculation indicated that a sample size of 50 had 93% power to detect an effect size of 0.5 in sagittal T1 and T2 SNR by using a 2-sided paired t test with a significance level of 0.05 based on the effect size, which was calculated by using the mean and SD values in a previous study.[20] The paired t test was used to compare quantitative assessments between the conventional and DL-reconstructed images. Qualitative image quality was compared by using the Wilcoxon signed-rank test for each reader's data and by using the generalized estimating equation for all readers' data to account for within-subject correlation. Detection performance for degenerative cervical spinal diseases and myelopathy was analyzed by using the generalized estimating equation for both each reader's data and all readers' data.

RESULTS

Demographic Characteristics

A total of 51 consecutive patients were initially enrolled, but 1 patient was subsequently excluded due to withdrawal of consent. Eventually, 50 patients (mean age ± standard deviation, 57 years ± 17; 23 men, 27 women) underwent MRI examinations. Among them, 30 patients diagnosed with or suspected to have degenerative cervical spinal disease underwent MRI examinations by using the HIVD protocol, and 20 patients diagnosed with or suspected to have cervical myelopathy underwent MRI examinations with the myelopathy protocol (Fig 1). Within the group imaged with the myelopathy protocol, 45% had multiple sclerosis, 25% had neuromyelitis optica spectrum disorder, and 30% had either other diseases or were undiagnosed.

For the 50 patients, a total of 300 intervertebral levels and 360 neural foramina were assessed. Among these patients, 47% (171/300), 12% (37/300), and 8% (23/300) were positive for disc abnormality, spinal stenosis, and spinal instability, respectively. Twenty-four percent (86/360) of the patients had positive findings for neural foraminal stenosis. Additionally, 24% (12/50) and 10% (2/20) of the patients were positive for T2 hyperintense cord lesions and CE cord lesions, respectively. More detailed demographic characteristics and radiologic diagnoses are provided in the Supplemental Data.

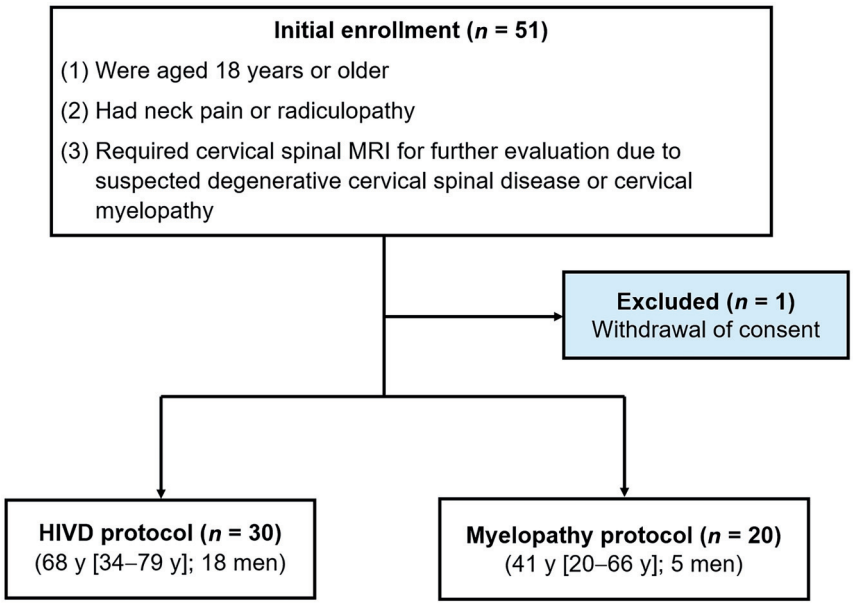

FIG 1. Flow chart for study population selection.

Table 1: Comparison of SNRs and CNRs of conventional and DL-reconstructed images

	Conventional	DL	*P* Value
SNR			
Sagittal T1WI	812.5 ± 1101.7	1500.9 ± 2914.8	.046
Sagittal T2WI	396.6 ± 1275.9	1307.5 ± 4952.7	.10
CNR			
Sagittal T1WI	315.2 ± 469.5	404.7 ± 591.8	.09
Sagittal T2WI	791.7 ± 1548.1	2540.5 ± 6509.4	.03

Note:—Unless otherwise specified, data are means ± SDs.

Table 2: Average scores for the overall image quality and presence of artifacts

	Conventional	DL	*P* Value
Overall image quality[a]			
Sagittal T1WI	3.9 ± 0.9	4.5 ± 0.7	< .001
Sagittal T2WI [DIXON IP or TSE]	4.0 ± 0.9	4.4 ± 0.7	< .001
Sagittal T2WI [DIXON water-only]	3.8 ± 0.8	4.1 ± 0.7	.013
Axial T2WI	4.0 ± 0.9	4.1 ± 0.8	.39
Sagittal CE T1WI	4.1 ± 0.9	4.0 ± 0.8	.89
Presence of artifacts[b]			
Sagittal T1WI	3.6 ± 0.6	3.9 ± 0.6	< .001
Sagittal T2WI [DIXON IP or TSE]	3.4 ± 0.6	3.5 ± 0.8	.27
Sagittal T2WI [DIXON water-only]	3.2 ± 0.7	3.2 ± 0.9	.78
Axial T2WI	3.1 ± 0.7	3.1 ± 0.9	.49
Sagittal CE T1WI	3.6 ± 0.5	3.3 ± 0.9	.012

Note:—Data are means ± SDs. IP indicates in-phase.
[a] Higher value means better overall image quality.
[b] Higher value means smaller number of artifacts on the image.

MRI Acquisition Time

In the HIVD protocol, the total acquisition time was 791 seconds for the conventional MRI and 381 seconds for the accelerated MRI, resulting in a 47% reduction in MRI scan time. For the myelopathy protocol, the total acquisition time was 688 seconds for the conventional MRI and 355 seconds for the accelerated MRI examination, resulting in a 48% reduction in MRI scan time. Acquisition times for all MRI sequences are presented in the Supplemental Data.

Quantitative Image Quality Evaluation

The SNRs and CNRs of both the conventional and DL-reconstructed images are summarized in Table 1. As compared with the conventional images, the DL-reconstructed images demonstrated a higher SNR on sagittal T1WI ($P = .046$) and a higher CNR on sagittal T2WI ($P = .03$). The SNR on sagittal T2WI and CNR on sagittal T1WI did not differ significantly between the 2 images ($P = .10$ and .09, respectively).

Qualitative Image Quality Evaluation

The DL-reconstructed images had higher average scores for the overall image quality on sagittal T1WI (mean difference, 0.56 [0.47, 0.65]; $P < .001$), sagittal T2WI (Dixon in-phase or TSE) (mean difference, 0.36 [0.26, 0.46]; $P < .001$), and sagittal T2WI (Dixon water-only) (mean difference, 0.31 [0.07, 0.56]; $P = .013$) and similar scores on axial T2WI (mean difference, 0.06 [−0.07, 0.19]; $P = .39$) and sagittal CE T1WI (mean difference, −0.01 [−0.19, 0.17]; $P = .89$) as compared with the conventional images (Table 2, Supplemental Data). As compared with the conventional protocol, the degree of artifacts was lower on sagittal T1WI (mean difference, 0.31 [0.19, 0.42]; $P < .001$), similar on sagittal T2WI (Dixon in-phase or TSE) (mean difference, 0.08 [−0.06, 0.22]; $P = .27$), sagittal T2WI (Dixon water-only) (mean difference, 0.04 [−0.22, 0.30]; $P = .78$), and axial T2WI (mean difference, −0.04 [−0.14, 0.07]; $P = .49$), but higher on sagittal CE T1WI (mean difference, −0.25 [−0.45, −0.05]; $P = .012$) of the accelerated protocol with DL reconstruction (Table 2, Supplemental Data). False-negative rates due to artifacts ranged from 0.01 to 0.13 (disc abnormality, 0.02; central canal stenosis, 0.01; neural foraminal stenosis, 0.03; spondylolisthesis, 0.03; T2 hyperintense cord lesions, 0.10; CE cord lesions, 0.13) (Supplemental Data). False-positive rates due to artifacts ranged from 0 to 0.05 (disc abnormality, 0.01; central canal stenosis, 0; neural foraminal stenosis, 0.01; spondylolisthesis, 0; T2 hyperintense cord lesions, 0.05; CE cord lesions, 0) (Supplemental Data). All anatomic structures were more clearly delineated on the DL-reconstructed images than on the

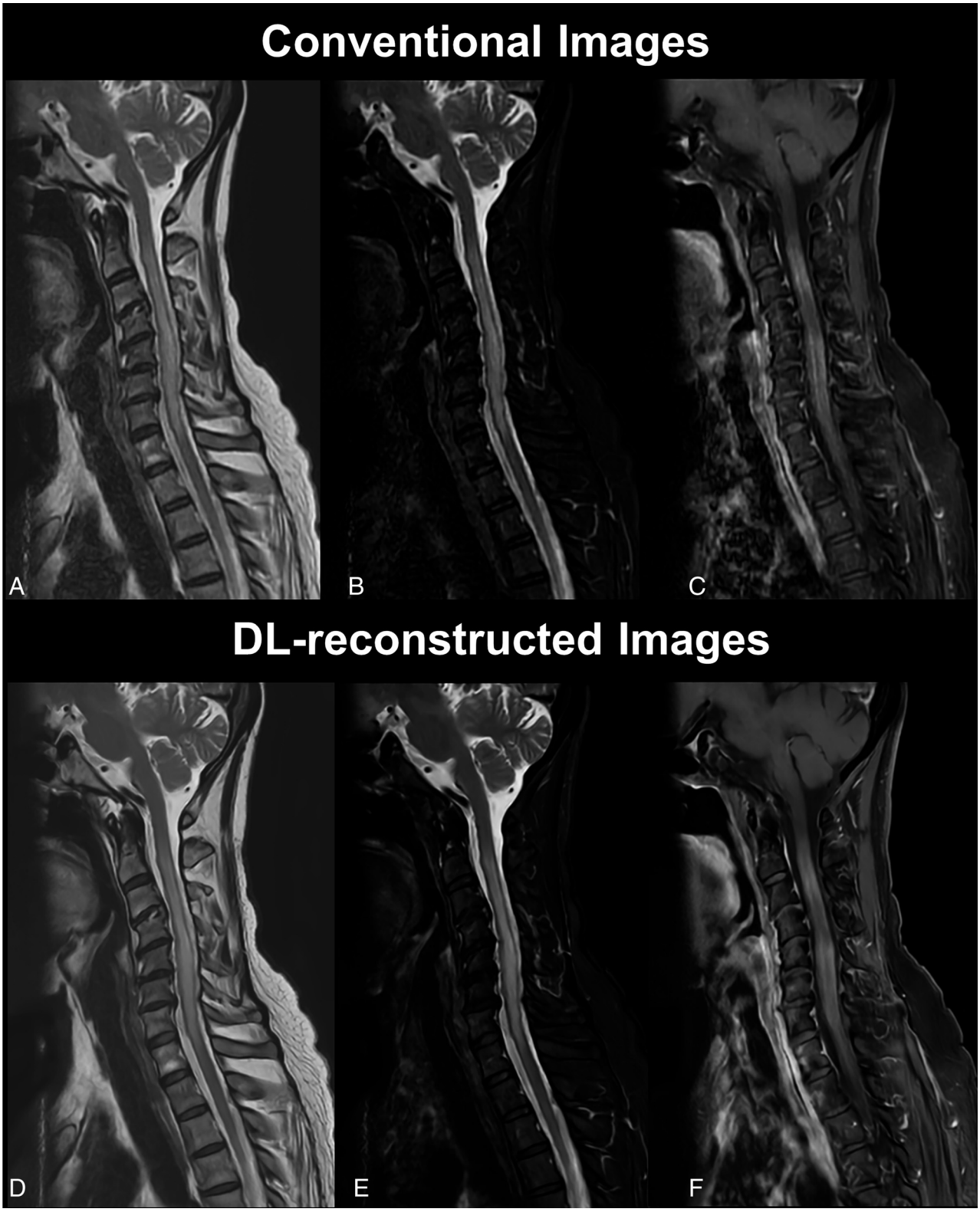

FIG 2. Sagittal T2WI DIXON in-phase (*A* and *D*), sagittal T2WI DIXON water-only (*B* and *E*), and sagittal CE T1WI (*C* and *F*) of a 66-year-old woman who underwent cervical MRI due to paraparesis. DL-reconstructed images (*D*–*F*) show similar overall image quality and level of artifacts as compared with conventional images (*A*–*C*). Longitudinally extensive T2 signal change at the C2–T1 spinal cord with multifocal intramedullary and leptomeningeal contrast enhancement are well depicted on the sagittal T2WI and CE T1WI of both protocols. Multilevel bulging discs at the C3–C7 level are also clearly visible on the sagittal T2WI of both protocols.

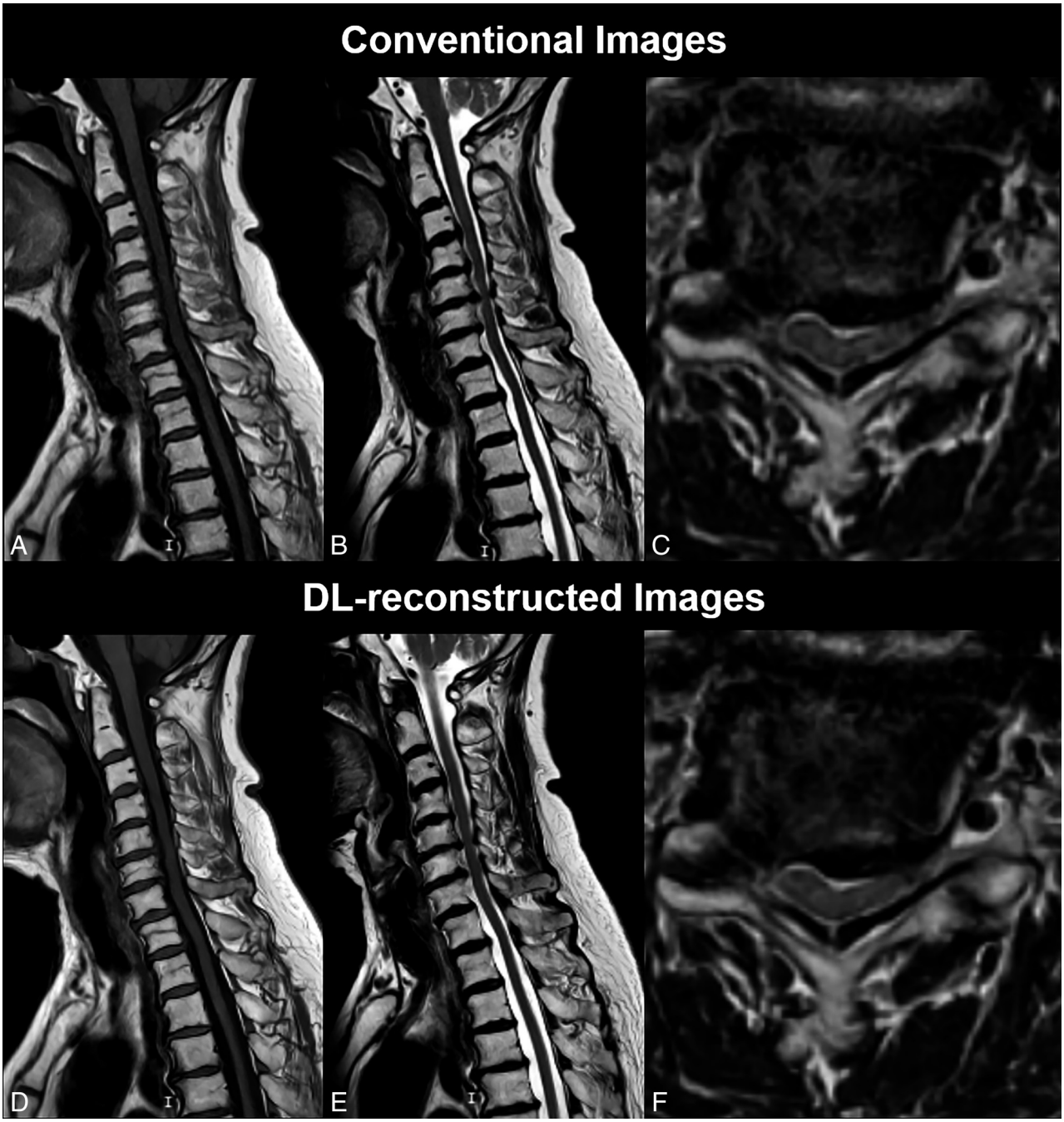

FIG 3. Sagittal T1WI (*A* and *D*), sagittal T2WI (*B* and *E*), and axial T2WI (*C* and *F*) of a 72-year-old woman who underwent cervical MRI due to a tingling sensation in both extremities. Moderate central canal stenosis at the C5–C6 levels is well visualized on the sagittal and axial T2WIs of both protocols.

conventional images (P values were $< .001$ for all structures, except for the neural foramen [$P = .024$]) (Supplemental Data).

Diagnostic Performance for Cervical Spinal Diseases

The sensitivities and specificities for the diagnosis of degenerative cervical spine diseases and myelopathy are shown in the Supplemental Data. The DL-reconstructed images had a higher average sensitivity for detecting neural foraminal stenosis than the conventional images (difference, 0.07 [0.02, 0.13]; $P = .005$). The average sensitivities for detecting disc abnormality (difference, 0.00 [−0.04, 0.04]; $P = .93$), central canal stenosis (difference, 0.06 [−0.02, 0.14]; $P = .13$), spinal instability (difference, 0.03 [−0.08, 0.15]; $P = .58$), T2 hyperintense cord lesion (difference, 0.00 [−0.18, 0.18]; $P > .99$), and CE cord lesion (difference, 0.25 [−0.44, 0.94]; $P = .48$) did not significantly differ between the conventional and DL-reconstructed images. The differences in average specificities for degenerative spinal diseases and myelopathy between the 2 images were all statistically nonsignificant ($P > .05$).

Conventional and DL-reconstructed images of representative cases with cervical myelopathy and degenerative spine diseases are shown in Fig 2–4.

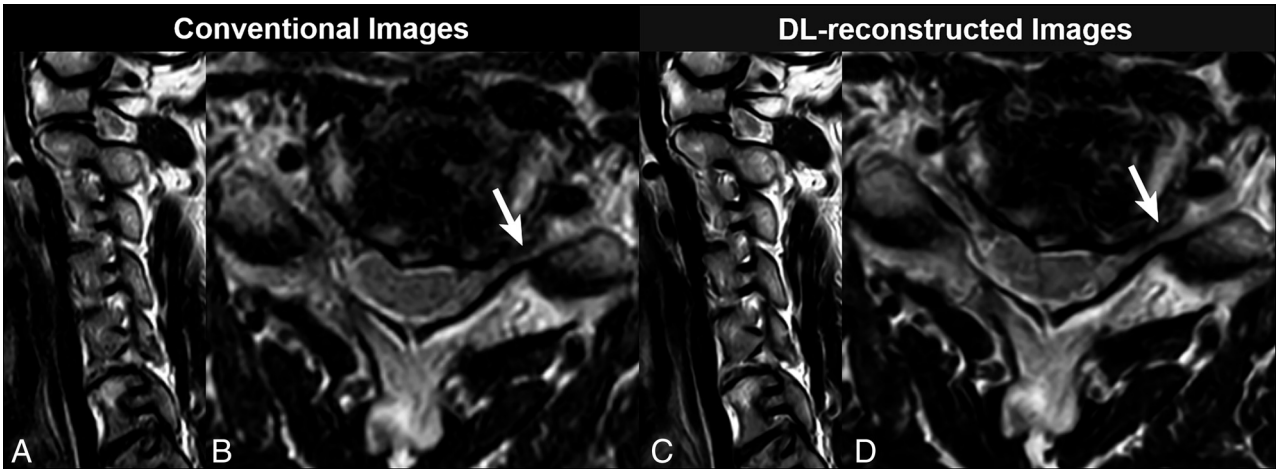

FIG 4. Sagittal T2WI (*A* and *C*) and axial T2WI (*B* and *D*) of a 65-year-old man who underwent cervical MRI due to the left upper extremity pain. Severe neural foraminal stenosis at the left C5–C6 level is correctly diagnosed on both conventional and DL-reconstructed images. Note that the bone cortex of the left uncovertebral joint is more conspicuous on the DL-reconstructed image (*D*, *arrow*) than on the conventional image (*B*, *arrow*).

DISCUSSION

Previous studies have shown that DL reconstruction for accelerated protocols does not compromise image quality or diagnostic performance compared with conventional protocols for brain and degenerative lumbar spine diseases.[20-22] We investigated the feasibility of using an accelerated cervical MRI protocol with DL-based image reconstruction for the diagnosis of degenerative cervical spine diseases and myelopathy. Key findings were as follows. As compared with the conventional protocol, 1) the DL-reconstructed protocol with a 47%− 48% reduction in scan time demonstrated higher or comparable SNR and CNR; 2) the DL-reconstructed protocol received higher or similar average scores for overall image quality and clarity of anatomic structures; and 3) the DL-reconstructed protocol had a higher sensitivity for detecting neural foraminal stenosis and comparable diagnostic performance for other degenerative cervical spinal diseases and myelopathy.

The accelerated cervical spine MRI protocol with DL-based image reconstruction demonstrated either superior or comparable overall image quality, as compared with the conventional protocol, in keeping with the results of previous studies.[20,22-24] However, the presence and severity of artifacts varied across different sequences. Specifically, while the DL-reconstructed protocol displayed lower or similar levels of artifacts, as compared with the conventional protocol, on most sequences, it exhibited more pronounced artifacts on sagittal CE T1WI. A retrospective analysis revealed that sagittal CE T1WI of the accelerated protocol was relatively susceptible to motion artifacts due to swallowing or patient movements in this study, likely because it was acquired later during the MRI examination. While DL reconstruction effectively reduces Gaussian noise, it may inadvertently exacerbate other artifacts.[25] DL-based reconstruction may have caused motion artifacts to become more pronounced in this study, potentially leading to variations in the interpretation of the sequences among readers. Nonetheless, reducing the scan time to approximately 50% of the conventional protocol would decrease the chance of motion artifacts occurring in the accelerated protocol. In terms of the clarity of anatomic structures, the DL-reconstructed images were generally superior to the conventional images in delineating major structures evaluated on cervical spine MRI. In particular, it is noteworthy that the clarity of the spinal cord in cervical spine MRI improved when the accelerated protocol with DL reconstruction was used.

Application of the DL reconstruction technique to accelerated protocols aims to maintain the image quality and diagnostic performance of radiologists while reducing MRI acquisition time. A previous study comparing accelerated lumbar MRI with DL reconstruction and conventional MRI in patients with degenerative lumbar spine disease showed no difference in sensitivity or specificity for the detection of central canal or neural foraminal stenosis between the 2 protocols.[20] Another study investigating the diagnostic quality of accelerated lumbar MRI with DL reconstruction also found no statistically significant difference between the 2 protocols.[22] With regard to cervical spine MRI, Seo et al[24] demonstrated that lesion detectability for degenerative disease in the accelerated protocol with DL reconstruction is at least as good as that in the conventional protocol. In particular, the inter-reader agreement for lesion detectability of neural foraminal stenosis was higher in the accelerated protocol with DL reconstruction. Kashiwagi et al[23] compared an ultrafast cervical spine MRI protocol by using DL reconstruction with a conventional protocol and reported interchangeability between the 2 protocols for the diagnosis of degenerative diseases, excluding endplate degeneration. Consistent with the previous studies, our findings suggest that the accelerated protocol with DL reconstruction does not degrade the diagnostic performance for degenerative diseases in terms of sensitivities and specificities as compared with the conventional protocol. Of note, the sensitivity for neural foraminal stenosis was higher on the DL-reconstructed images than on the conventional images. The superior sensitivity for detecting stenosis in small anatomic structures such as neural foramina might be attributed to the enhancement effect of the DL algorithm, which was trained by using high-resolution images. Furthermore, unlike the previous studies, we also compared the 2 protocols in terms of the diagnosis of spinal cord lesions to comprehensively cover major indications for cervical spine MRI and found that the

DL-reconstructed protocol showed comparable sensitivities and specificities for detecting T2 hyperintense cord lesions and CE cord lesions. Nonetheless, we found that, although the numbers were not high, some false-positive and false-negative diagnoses —particularly for cord lesions—still occurred in the DL-reconstructed images. Therefore, a comprehensive approach that considers both axial and sagittal imaging planes, along with their clinical context, is essential for accurate interpretation in routine practice.

There are several limitations to this study. First, this was a single-center study, which may limit the generalizability of the findings. Second, the study population was relatively small. In particular, due to the low prevalence of CE myelopathy, only a few patients had CE cord lesions, potentially affecting the statistical power of the analysis. Third, because of the nature of degenerative cervical spinal diseases and cervical myelopathy, there were no definitive ground truths for diagnosing the diseases. Nonetheless, we used reference standards established by 2 senior neuroradiologists who referred to both conventional MRI and clinical information of each patient during the diagnosis. Finally, this study did not consider incidental findings, such as bone tumors or soft tissue tumors, as indicators of diagnostic performance, which could have provided additional insights into the diagnostic utility of the protocols.

CONCLUSIONS

The vendor-neutral DL-based algorithm may offer a useful means for obtaining cervical MRI with reliable image quality and diagnostic performance for cervical degenerative spine diseases and myelopathy at reduced acquisition time.

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Disclosure forms provided by the authors are available with the full text and PDF of this article at www.ajnr.org.

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