

3D CUBE Flex MRI Sequence versus 2D MRI Sequences for the Imaging of the Cervical Spine

Theodore Jerdee¹, Amelie M. Lutz¹, and Garry E. Gold^{1,2}

¹Radiology, Stanford University, Stanford, CA, United States, ²School of Bioengineering, Stanford University, Stanford, CA, United States

Purpose: To compare image quality, visibility of clinically relevant anatomic structures, and diagnostic confidence on images obtained of the cervical spine with a 3D CUBE Flex MRI sequence and conventional 2D MRI sequences.

Methods: CUBE flex is a 3D fast spin echo sequence with two-point

fat/water separation that produces water-weighted, fat-weighted, and combined images. Images were acquired with isotropic resolution to allow reconstruction of multi-planar reformations.

Ten patients referred for pain underwent conventional cervical spine MRI and one additional sagittal CUBE flex sequence under IRB approval. Two experienced musculoskeletal radiologists evaluated the image quality, visibility of intervertebral disks, bone marrow, nerve roots, facet joints, and spinal canal in a total of 60 cervical spine segments and provided their diagnostic confidence for each segment on a 1 to 5 scale, 1=poor and 5=excellent¹. In addition, sagittal oblique reformats of the CUBE sequences were evaluated for image quality and visibility of disks and nerve roots as well as diagnostic confidence. All CUBE and conventional MRI studies were analyzed in random order separated by a two week interval.

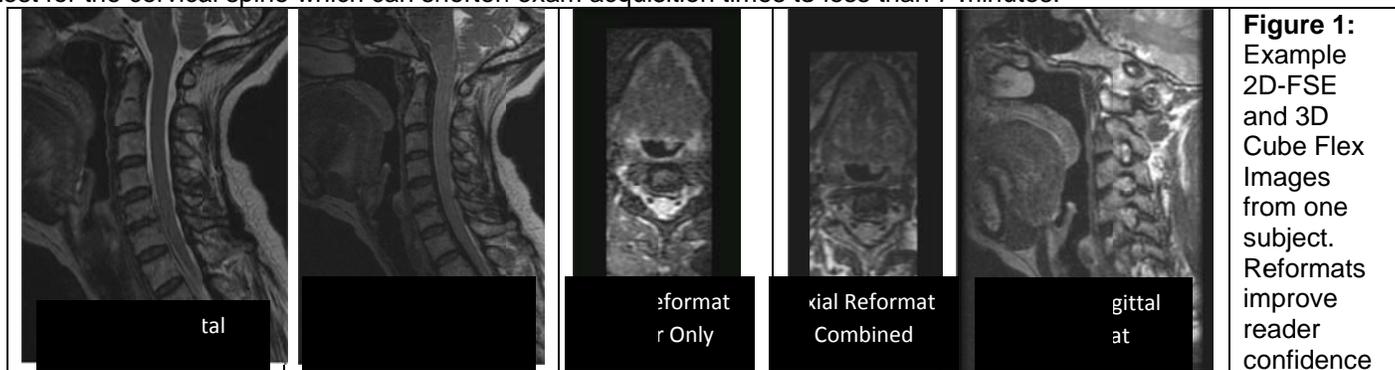
Results: Image acquisition time, sequences acquired, and parameters for 3D Cube Flex are shown in Table 1. Image feature grades for both reads are shown in Table 2. The additional sagittal oblique images improved diagnostic confidence of the readers by at least one grade in 82% of segments for CUBE sequences (Figure 1). Overall, diagnostic confidence for CUBE was significantly higher when sagittal oblique reformations were used (Wilcoxon rank test, $p = 0.001$).

Discussion: Replacing conventional 2D MRI sequences with 3D MRI sequences that allow for high resolution multi-planar reformations may improve work-flow by substantially shortening overall acquisition time. This study showed that image quality, visibility of relevant anatomic structures, and diagnostic confidence using sagittal CUBE flex sequences of the cervical spine with axial reformations was acceptable to excellent in all evaluated segments. In addition, the ability to create sagittal oblique reformats further increased reader confidence on CUBE flex images.

Conclusion: With further optimization, CUBE flex sequences may have the potential to serve as a stand-alone imaging test for the cervical spine which can shorten exam acquisition times to less than 7 minutes.

Conventional Sequences	Sagittal 3D Cube Flex
Sagittal T2 2D-FSE	TR/TE 2000/100 ms
Sagittal T1 2D-FSE	Field of view: 24 cm
Sagittal STIR 2D-FSE	Matrix 224x224
Axial T2 2D-FSE	Slice: 0.8 mm
Axial 2D-GRE	Axial, oblique Sagittal reformats
Total Scan Time: 23 min	Total Scan Time: 6 min

Image feature on 60 spinal segments for 2 readers	Conventional 2D MRI Good /Excellent		3D Cube Flex Good/Excellent	
	Reader 1	Reader 1	Reader 1	Reader 2
Overall Image quality	90%	100%	88%	77%
Disk visibility	97%	97%	98%	90%
Nerve root visibility	92%	92%	98%	73%
Facet joint visibility	87%	87%	88%	75%
Spinal canal visibility	83%	83%	70%	73%
Bone marrow visibility	54%	54%	98%	99%
Diagnostic confidence	92%	92%	100%	100%



References: 1. Meindl T., Wirth S., Weckbach S., Dietrich O., Reiser M., Schoenberg S.O. Magnetic resonance imaging of the cervical spine: comparison of 2D T2-weighted turbo spin echo, 2D T2*weighted gradient-recalled echo and 3D T2-weighted variable flip-angle turbo spin echo sequences Eur Radiol (2009) 19: 713–721.

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