Magnetic resonance Neurography (MRN) of brachial plexus at 1.5 T: Comparative evaluation of 3D SHINKEI versus DWIBS, our initial experience

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Target Audience: Neuro-Radiologists, MR Physicists, MR-Technologists

Purpose:

Magnetic resonance neurography (MRN) is a technique commonly used for evaluating abnormal conditions of peripheral nerves[1]. One of the recently developed MRN techniques is the 3D nerve-SHeath signal increased with INKed rest-tissue RARE Imaging or 3D SHINKEI[2]. Although this SHINKEI based MRN technique has been previously applied to produce good quality MRN results in terms of image resolution and blood flow suppression, it is noteworthy that all the previous works on SHINKEI-MRN were performed only at 3T by taking the advantage of achievable high SNR at 3T. Moreover, comparative study of this sequence has not been performed with other established MRN techniques like MRN based on diffusion weighted imaging with background suppressions (DWIBS). In this study, we evaluated the image quality of SHINKEI based MRN of brachial plexus at the routine clinical MRI scanning field of 1.5T and compared it with DWIBS based neurography.

Methods:

The SHINKEI technique combines an improved motion sensitized driven equilibrium (iMSDE) preparation pulse set for signal suppression from flowing blood and a spectral attenuated inversion recovery (SPAIR) fat-suppression pre-pulse that suppresses the fat signal followed by T2 weighted 3D-TSE acquisition. In our study 3D-SHINKEI technique was optimized at 1.5T to enable the proper nerve-sheath depiction in full length of brachial plexus. All our experiments were conducted at 1.5 T whole bodies MRI scanner (Achieva, Philips Healthcare, The Netherlands) using a 16 channel NeuroVascular coil, and the brachial plexus of five healthy volunteers were examined in this study. Our study was approved by the Institute ethical committee. SHINKEI data sets were acquired using pencil-beam volume shim with TR of 2500 ms, effective TE of 127 ms, voxel-size of 1.2 x 1.2, iMSDE Venc was set to 1cm/s with preparation duration of 50ms and the NSA was kept at 1. The DWIBS data sets were acquired with actual TR of 11.2 sec, actual TE of 80 ms, voxel size of 2.02 x 2.08 x 2.00 mm, b-factor was kept at 600 m^2/s and the NSA was kept at 20. Finally the image quality of SNINKEI based MRN and DWIBS based MRN at 1.5T were scored by two radiologists blind to each other.

Results:

Representative images of SHINKEI based MRN and DWIBS based Neuroghrapy are presented in the figure1. This study also scores comparative image quality of the tracking of brachial plexus from the roots originating from the C5 through T1. Summary of image quality in terms of visualization of different anatomical sections of brachial plexus is presented in the table 1.

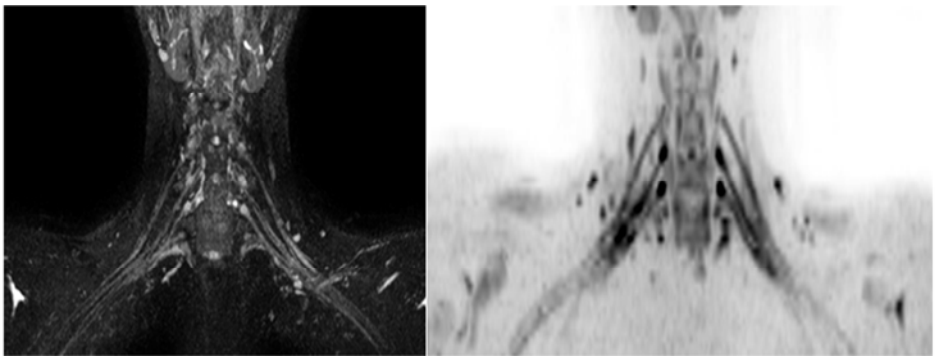

Figure 1: A comparative view of the brachial plexus at 1.5T -- 3D SHINKEI (L) and DWIBS based MRN (R)

	SCORE (1-4,low-high)	
	SHINKEI based MRN	DWIBS based MRN
Nerve Root Visualization	4.0±0	3.5±0.5
TRUNK Visualization	3.3±0.6	2.4±0.9
CORD visualization	2.4±1.0	1.2±0.4

Table-1: Summary of the quality of visualization of brachial plexus by SHINKEI based MRN and DWIBS based MRN

Discussion:

From our experiments, it is quite evident that DWIBS based MRN produces good view of the brachial plexus roots; however, the visualization of the trunk was just fair and the visibility of the cords was poor. On the other hand, our analysis indicated that the SHINKEI based MRN generates excellent anatomical visualization of the brachial plexus root and trunk sections with minimal variations between the volunteers; and the cord, however, was found to be fairly visible on SHINKEI based MRN. We have observed that the fat suppression with the 3D SHINKEI was non uniform in one of the volunteers leading to poor visibility of the cords -- the reason could be the sensitivity of this sequence to the achievable homogeneous B0 field in the challenging anatomy like head-neck area, thus making the exact positioning of volume shim very critical to generate good result.

Conclusion:

In this study, 3D SHINKEI was compared with the DWIBS based neurography. While DWIBS based MRN can produce good visualization of the nerve roots and a fair visualization of the trunk of brachial plexus, the cords were poorly visible. The 3D SHINKEI based MRN generates an excellent visualization of the nerve roots and trunks with fairly visible cords at 1.5T. Our ongoing work will include further improvement of SHINKEI based MRN at 1.5 T including use of B1 map based shimming to improve brachial plexus visualization.

References: [1] Chhabra, et al. Am J Roentgenol. 2011 Sep; 197(3):583–91. [2] Yoneyama et. Al. Proc. Intl. Soc. Mag. Reson. Med. 19 (2011)