3D brachial plexus imaging: comparison between STIR and Two Point Dixon technique

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Target Audience: Radiologists, scientists and engineers who have an interest in Brachial Plexus imaging

Purpose: MR neurography is an important non-invasive method to know the 3D structure of brachial plexus[1]. Although fat signal is higher than nerve signal in the neck region, homogeneous fat suppression is difficult because of B0 inhomogeneity. 3D T2 Fast Spin Echo (FSE) with STIR (Short Tau Inversion Recovery) is often used for homogenous fat saturation in the literature[1]. However, STIR normally reduces signal intensity of nerve. Two Point Dixon[2] is a fat/water separation method in B0 inhomogeneous region. STIR and Two Point Dixon were compared in this study.

Methods: *Fat Suppression:* Two Point Dixon compensates B0 inhomogeneity in the post processing and separate fat and water signal depending on the chemical shift between in-phase and opposite phase echoes. To shorten scanning time, two echoes were acquired between a set of refocus RF pulses of FSE. Data acquisition window must be short enough and Band Width (BW) was set to 125 kHz. For STIR, non-slice selective adiabatic inversion recovery pulse was used. The null point of fat signal was set to TI=250ms.

Vessel lumen Saturation: Subclavian artery runs near the brachial plexus and lumen signal can be a high background signal. The arterial lumen signal was saturated with Diffusion preparation pulse[3]. This preparation pulse was always turned on in this study. The b-value was 26 s/mm^2. Pulse duration (22 ms) of this preparation pulse was included in the calculation of TE.

Volunteer scan: Three healthy subjects were scanned. IRB approval and written informed consent were obtained for human scanning. The nerve to noise, fat or muscle ratio were measured with STIR and Two Point Dixon. Because the nerve signal of the thin brachial plexus is difficult to measure, it was measured at a spinal cord. Noise was defined as the standard deviation of the spinal cord signal. Investigational version of Variable Refocus Flip Angle 3D FSE[4] (Cube) was used for data acquisition. Protocol was as follows; TE/ETL/BW/Time were 76/120/62.5/2:57 (STIR) or 91/100/125/3:31 (Two Point Dixon), respectively. Resolution is 1.4mm in all axes. Coronal plane, TR 2000, parallel imaging acceleration factor 2, Head Neck Spine coil Brachial Plexus mode, MR750 3.0T (GE Healthcare).

Results: Subject images are shown in Fig.1. The nerve to noise, fat and muscle ratio are in Fig. 2. Noise is relatively lower in Two Point Dixon cases and STIR (Fig.2.1).The nerve to fat ratio exceeds 2.0 in all Two Point Dixon cases (Fig.2.2). Fat signal was relatively higher in Two Point Dixon cases than STIR cases. This is because water signal in fat tissue is not saturated in Two Point Dixon case. However fat saturation was homogeneous in both cases and Fat signal does not influence the depiction of nerve. The nerve to muscle ration exceeds 2.5 in all cases (Fig.2.3). Vessel lumen signals were not depicted. Nerve signal could be separated from these background signals in both methods.

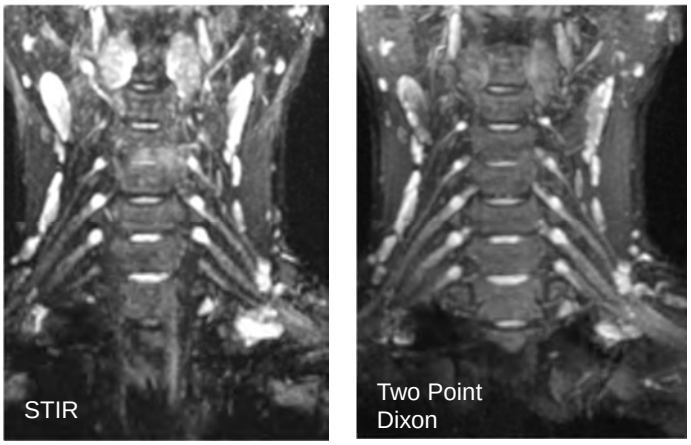

Fig. 1: 3D brachial plexus image with STIR (left) and Two Point Dixon (right)

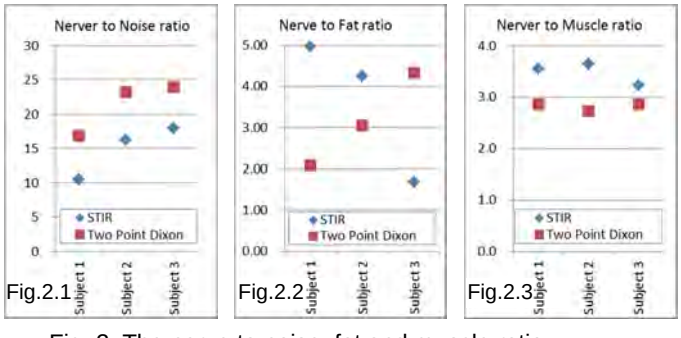

Fig. 2: The nerve to noise, fat and muscle ratio (from left to right)

Discussion/Conclusion: Fat suppression is good enough with both STIR and Two Point Dixon. Because STIR suppresses muscle more that nerve, the nerve to muscle ratio is higher than Two Point Dixon. However the nerve to noise ratio is higher in Two Point Dixon. This results in smooth connectivity of the nerve. The Two Point Dixon method could improve the 3D brachial plexus image.

References:

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