CASE REPORT

Clinical Application for Fast Spin Echo 2D Water Fat Separation

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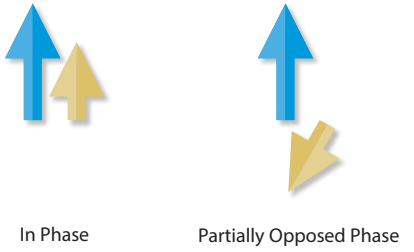
Fast Spin Echo 2D Water Fat Separation Sequence performed in the Neck Region

Fast Spin Echo (FSE) 2D Water Fat Separation (WFS) incorporates in the case of FSE, a shifted refocusing pulse is utilized for the different chemical components to be separated. Shifted or non-centering in this case means that the echo pulse is not always in the middle of TE times. Canon Medical incorporates a Two Point Method for water imaging a Partially Opposed Phase (POP) acquisition. Two-Point Method for water-fat imaging with POP acquisition. The asymmetry of water and fat signal vectors in POP method enables both separate water and fat which also identifies the chemical components.[1]

A phase correction TRW-S (Tree-Reweighted Message-Passing) Iterative Reconstruction Algorithm is utillized.[2] As shown in Figure 1-1, 2-Point Dixon FSE Sequence named WFS DIXON demonstrates both In Phase and Partial Out of Phase effects during data before the Iterative Reconstruction. Figure 1-2 demonstrates the Iterative Phase Calculation that utilizes both In Phase, Partial Out of Phase information, related to the belief of propagation, where the information is sent between neighboring voxels in the form of messages to generate the In Phase, Out of Phase, Water and Fat Image.[2] This 2-Point Dixon FSE Sequence (WFS DIXON) allows for Robust Fat Suppression in challenging body regions such as the Neck Region with in-homogeneities and increased susceptibilities.



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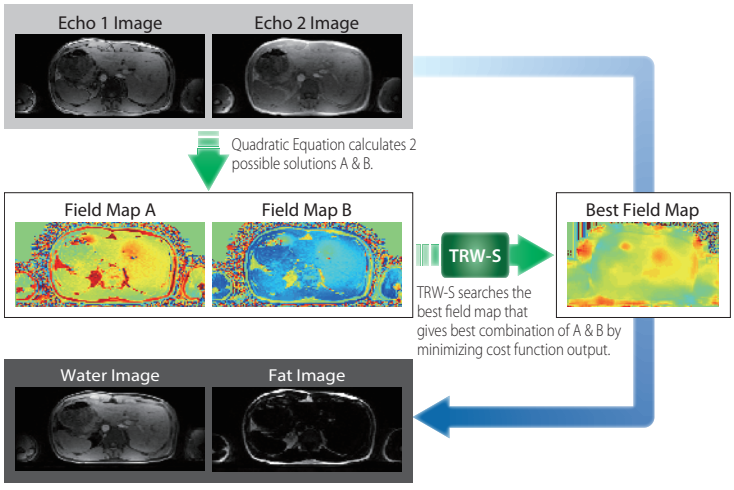
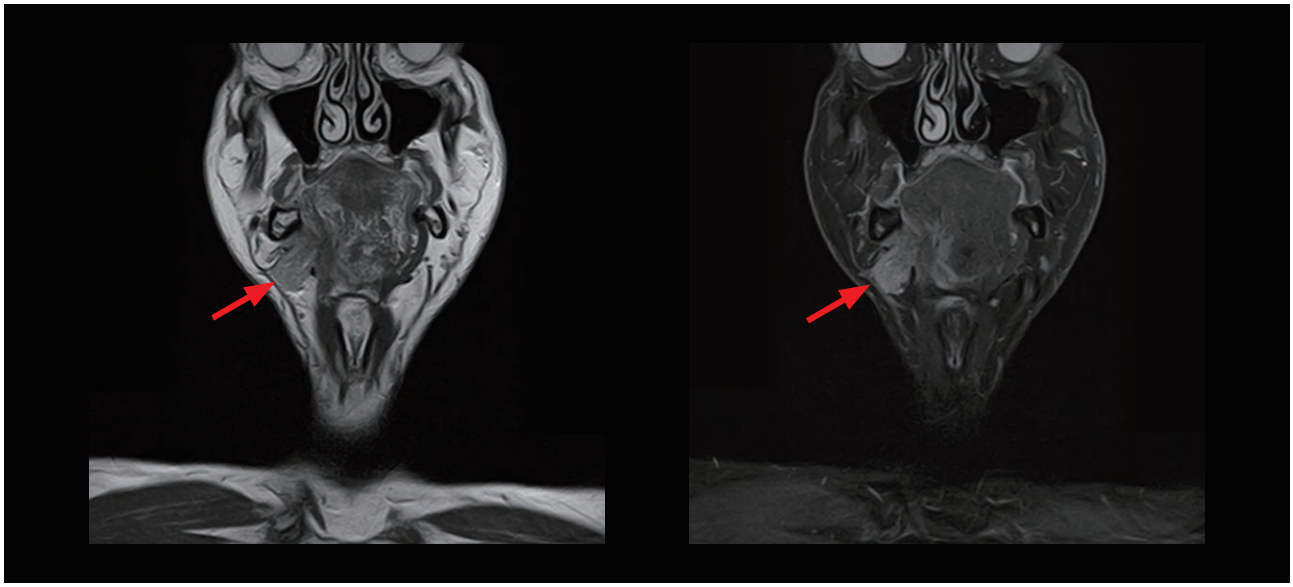


1-2)

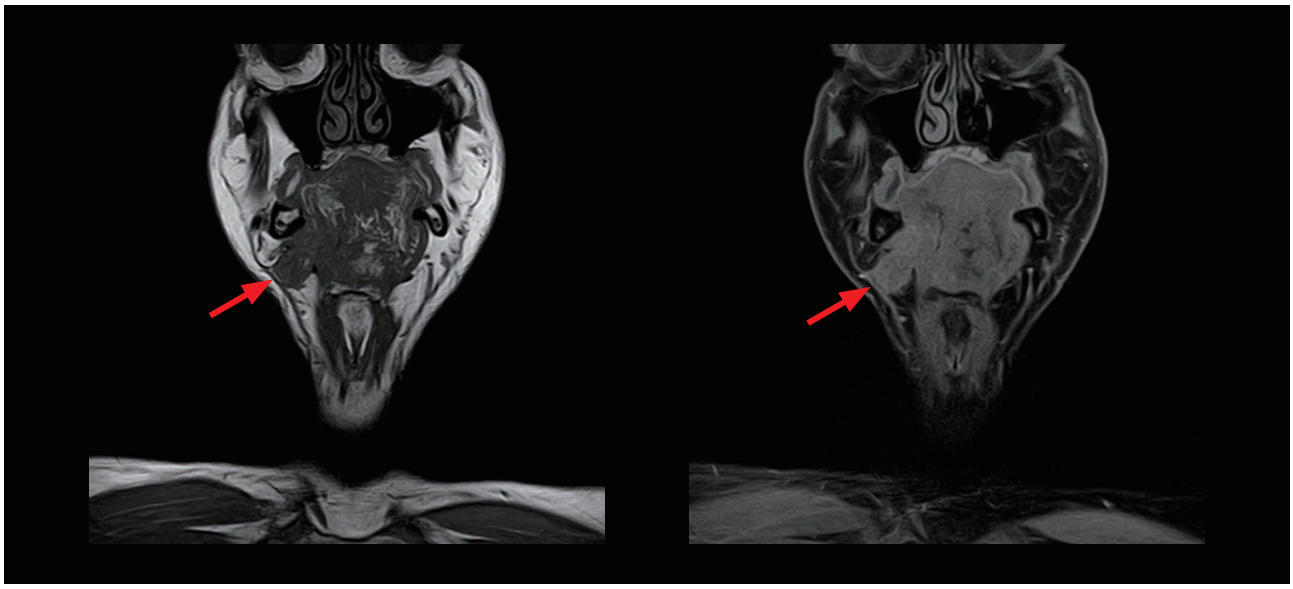
Figure 1. Canon Medical's 2-Point Dixon: WFS DIXON
1-1) 2-Point Dixon FSE Sequence
1-2) Reconstruction

Figure 2 demonstrates T2 FSE Sequence (WFS DIXON), acquired as part of routine MR Soft Tissue Neck examination on a 57-Year-Old male patient complaining of difficulty swallowing while eating and swelling from lymphadenopathy. One advantage of the Dixon is the ability to create four different type of images (In Phase, Out of Phase, Water Image and Fat Image) within one acquisition reducing the entire examination scan time by half. WFS DIXON FSE Sequence (Figure 2-1) demonstrates inflammatory lesion with the In Phase T2 Weighted image, while utilizing Water Image to further differentiate edema surrounding the inflammatory lesion due to the homogenous fat suppression (Figure 2-2). This sequence can be acquired in any imaging plane and Tissue contrast weighting. (Figure 3) T1 weighted image in the coronal plane demonstrating both In Phase (Figure 3-1) and Water (Figure 3-2) Images.



2-1) 2-2)

Figure 2. WFS DIXON FSE Sequence image
2-1) T2 Weighted In Phase image, Spatial 3.0 x 1.0 x 0.9 mm, Scan time 4 min 52 sec, 30 slices.
2-2) T2 Weighted Water image, Spatial 3.0 x 1.0 x 0.9 mm, Scan time 4 min 52 sec, 30 slices.

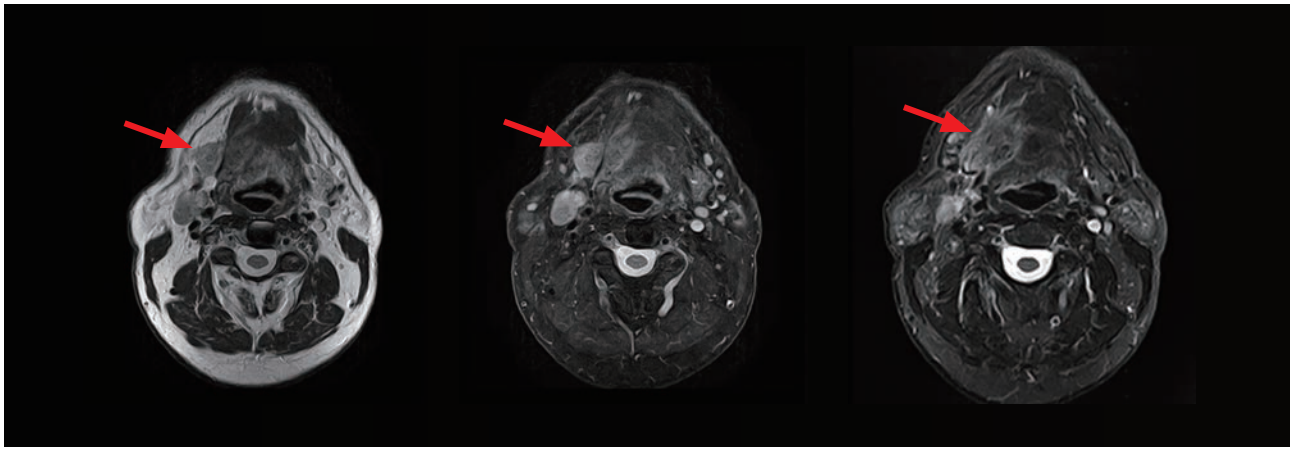


3-1) 3-2)

Figure 3. T1 weighted image in the coronal plane
3-1) T1 Weighted In Phase image, Spatial 3.0 x 1.0 x 0.8 mm, Scan time 4 min 42 sec, 30 slices.
3-2) T1 Weighted Water image, Spatial 3.0 x 1.0 x 0.8 mm, Scan time 4 min 42 sec, 30 slices.

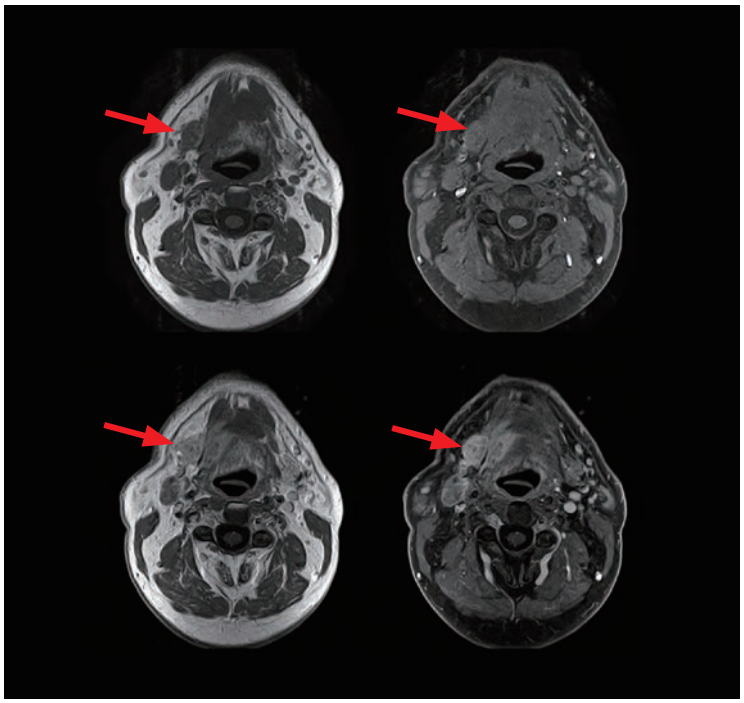
Figure 4 demonstrates the benefit of acquiring the WFS DIXON FSE Sequence versus a Standard T2 STIR sequence. The benefit of the WFS DIXON FSE Sequence creates both In Phase (Figure 4-1) and Water (Figure 4-2) Images with higher SNR and spatial resolution versus the T2 STIR (Figure 4-3) Image. Furthermore, acquiring both In Phase and Water Image overall saves time in comparison to the T2 STIR overall reducing examination times.

Figure 5 demonstrates Pre and Post contrast T1 WFS DIXON FSE Sequence images. All the images demonstrate robust homogeneity and Fat Suppression throughout the entire slice volume. Again, this technique allows for both In Phase and Water Images acquired and displayed reducing overall examination times while maintain image quality and demonstrating the enhancement of the inflammatory lesion.



4-1) 4-2) 4-3)

Figure 4. WFS DIXON FSE Sequence versus a Standard T2 STIR sequence
4-1) T2 Weighted In Phase image, Spatial 4.0 x 0.8 x 0.7 mm, Scan time 4 min 16 sec, 32 slices.
4-2) T2 Weighted Water image, Spatial 4.0 x 0.8 x 0.7 mm, Scan time 4 min 16 sec, 32 slices.
4-3) T2 STIR image, Spatial 4.0 x 1.1 x 1.0 mm, Scan time 3 min 48 sec, 32 slices.



5-1) 5-2)

5-3) 5-4)

Figure 5. Pre-and-Post Contrast T1 WFS DIXON FSE Sequence images
5-1) Pre contrast T1 Weighted In Phase image, Spatial 4.0 x 0.8 x 0.8 mm, Scan time 3 min 46 sec, 30 slices.
5-2) Pre contrast T1 Weighted Water image, Spatial 4.0 x 0.8 x 0.8 mm, Scan time 3 min 46 sec, 30 slices.
5-3) Post contrast T1 Weighted In Phase image, Spatial 4.0 x 0.8 x 0.8 mm, Scan time 3 min 46 sec, 30 slices.
5-4) Post contrast T1 Weighted Water image, Spatial 4.0 x 0.8 x 0.8 mm, Scan time 3 min 46 sec, 30 slices.

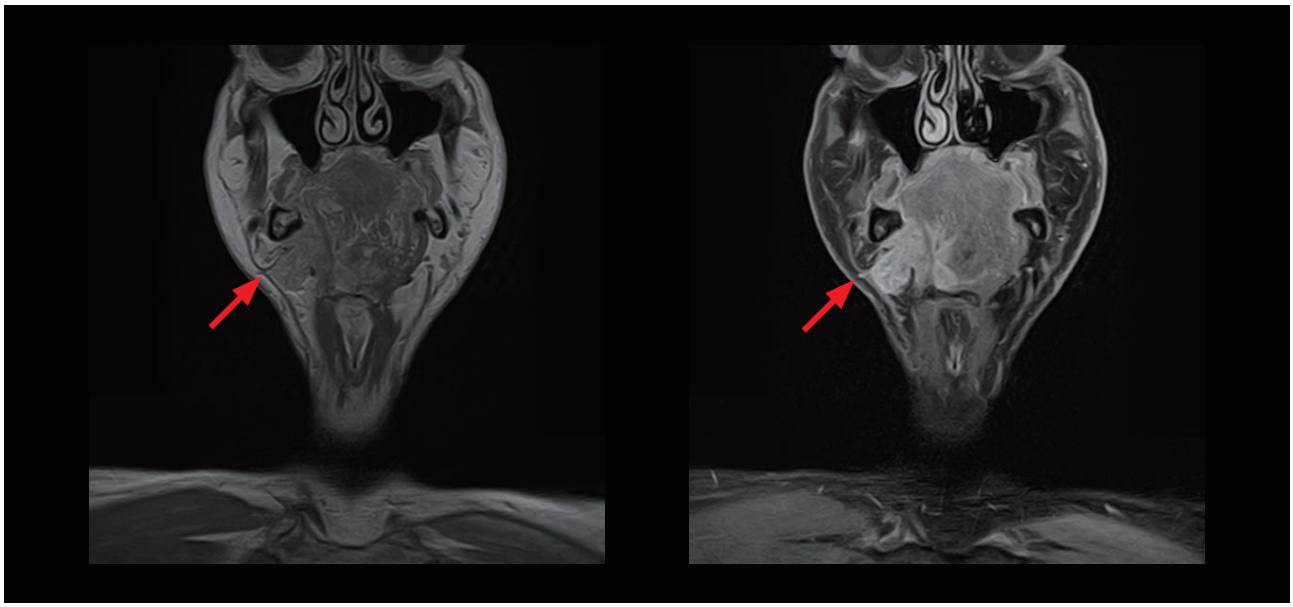
Figure 6 demonstrates the enhancement of the inflammatory lesion while maintaining SNR and homogenous Fat Suppression for the In Phase (Figure 6-1) and Water (Figure 6-2) Images.

Conclusion

This WFS DIXON FSE Sequence overall makes scanning easier and consistent from patient to patient while maintaining high image quality and homogenous Fat Suppression. Moreover, this sequence delivers a technique that reduces overall examination times in traditionally challenging body regions.

Reference

1. Qing-San Xiang: Two-Point Water-Fat Imaging With Partially-Opposed-Phase (POP) Acquisition: An Asymmetric Dixon Method. Magnetic Resonance in Medicine 56:572-584 (2006)
2. Johan Berglund, Hakan Ahlstrom, Lars Johansson, Joel Kullberg: Two-point Dixon Method With Flexible Echo Times. Magnetic Resonance in Medicine 65:994-1004 (2011)



6-1) 6-2)

Figure 6.
6-1) Post contrast T1 Weighted In Phase image, Spatial 4.0 x 1.0 x 0.8 mm, Scan time 3 min 46 sec, 30 slices.
6-2) Post contrast T1 Weighted Water image, Spatial 4.0 x 1.0 x 0.8 mm, Scan time 3 min 46 sec, 30 slices.

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