Fast Multiparametric 3D Spine MRI: Color Me Dixon!

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Purpose

Optimize single and multi-station 3D Dixon[1] spine MRI; and develop multiparametric color encoding techniques to facilitate interpretation of the information rich opposed-phase (OP), in-phase (IP), and derived fat (F) and water (W) series.

Methods

Composed multi-station (head to tail) and single large FOV volumetric sagittal Dixon series were acquired at 3T (TR 4.1-4.2 ms, TEs 1.2 -1.4 and 2.4 -2.6 ms) on 48 -128 channel systems, maximizing available array coils to optimize S/N. Novel multiparametric color encoding programs were created in Matlab to combine OP, IP, and W series so that tissues containing only W signal (e.g. brain, cord, discs) appear gray scale, F appears yellow (red + green), tissues or "Indian ink artifact" containing both W and F appear red-magenta, and tissues exhibiting significant T2*decay appear cyan-green. To achieve this in RGB color space; IP, OP, and W series were respectively assigned to the red (R), green (G), and blue (B) channels. To achieve this in Cielab (L*a*b*) color space, designed to more closely parallel human perception, we set: L = IP + OP, a = (IP -OP)/ (IP =OP), and b = (IP + OP – 2W) / (IP + OP). Sagittal color composites and subsequent coronal and axial reformats were generated from near mm^3 isotropic volumes. (Fig 1)

Results

Rapid high-resolution volumetric Dixon imaging of the spine and other structures was achieved at 3T, with short echo times, high BW, and short acquisition times mitigating motion and susceptibility artifact. Even in the presence of metallic ACD&F hardware (T2* effects appreciated as cyan-green), fat water separation was true and adjacent disc pathology well appreciated. Both RGB and L*a*b* color composites behaved similarly, were intuitive (e.g. yellow marrow – Y, red marrow – R), and facilitated interpretation. (Fig 1)

Conclusion

Multiparametric color-encoded fast Dixon spine imaging demonstrates significant promise and warrants further systematic investigation.

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References

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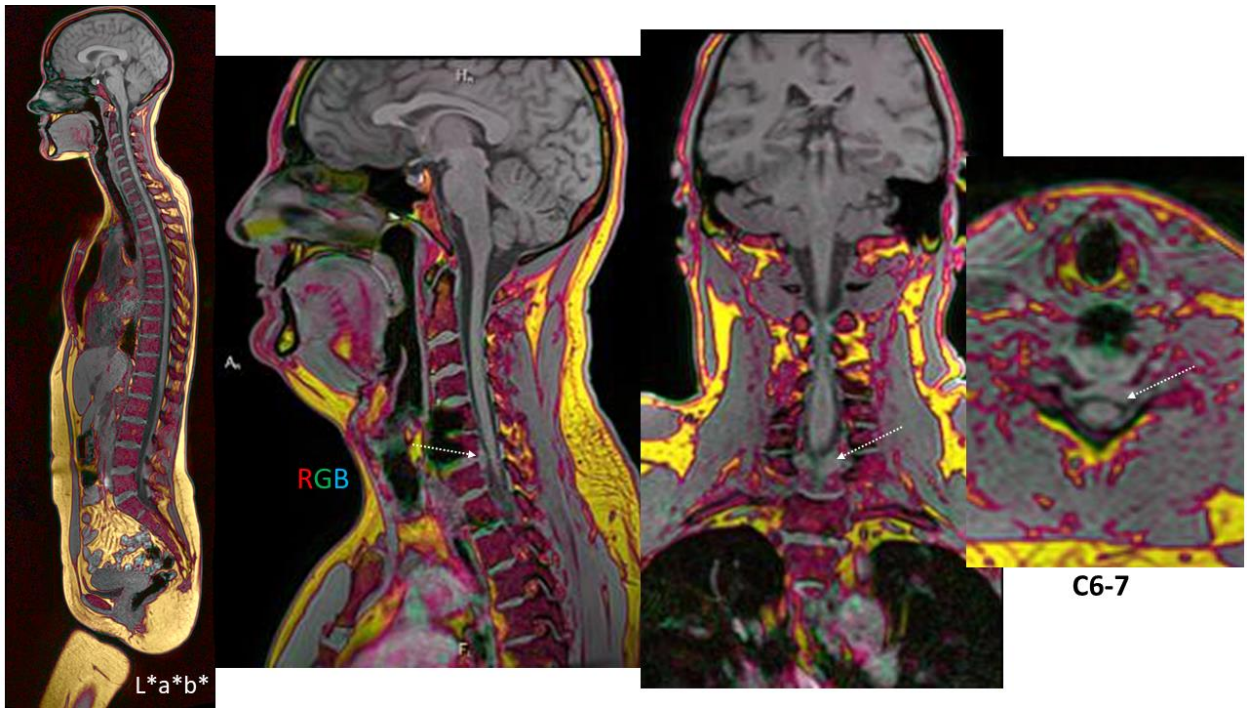

Figure 1