


Second order motion compensated spin-echo diffusion tensor imaging of the human heart

Other Conference Item**Author(s):**

Stoeck, Christian ; Deuster, von Deuster, Constantin; Genet, Martin; Atkinson, David; Kozerke, Sebastian

Publication date:

2015

Permanent link:

<https://doi.org/10.3929/ethz-b-000100694>

Rights / license:

[Creative Commons Attribution 4.0 International](#)

Originally published in:

Journal of Cardiovascular Magnetic Resonance 17(S1), <https://doi.org/10.1186/1532-429X-17-S1-P81>

POSTER PRESENTATION

Open Access

Second order motion compensated spin-echo diffusion tensor imaging of the human heart

Christian T Stoeck^{1,2*}, Constantin von Deuster^{1,2}, Martin Genet¹, David Atkinson³, Sebastian Kozerke^{1,2}

From 18th Annual SCMR Scientific Sessions
Nice, France. 4-7 February 2015

Background

Stimulated echo acquisition mode (STEAM) [1] imaging has been used to probe myocardial microstructure *in vivo*. However STEAM imaging requires 2 R-R intervals, sophisticated respiratory navigator gating [2] and is subject to myocardial strain [3,4]. Spin-echo (SE) based single-shot diffusion weighted sequences present an appealing alternative [5,6]. In this work the sensitivity to bulk motion of cardiac SE diffusion tensor imaging is addressed by using second order motion compensated (MC) diffusion encoding.

Methods

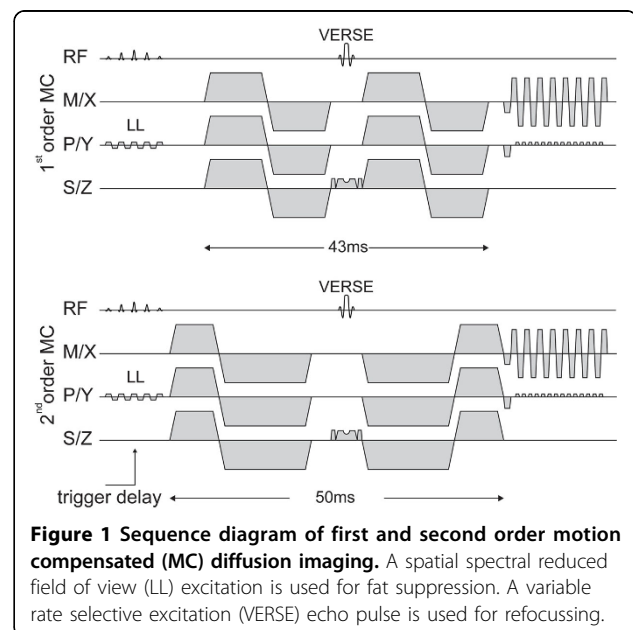
First and second order MC diffusion encoding gradients were incorporated into a cardiac triggered single-shot SE sequence (Figure 1). Imaging was performed on a 1.5T Philips Achieva system (Philips Healthcare, Best, The Netherlands) equipped with gradients delivering 80mT/m@100mT/m/ms. Five healthy volunteers were imaged with navigator-gating during free-breathing with the following parameters: resolution: 2.2×2.2mm², slice thickness: 6mm, local-look FOV: 230×98mm², TR/TE: 1R-R/83ms, two slices (apex/base). Fat suppression was incorporated by spectral-spatial excitation. Three orthogonal diffusion encoding directions ($b=450\text{s/mm}^2$, 8 averages) were applied at trigger delays ranging from 45ms to peak systole (steps of 10ms). Ten diffusion directions (10 averages, TR: 2R-R) were acquired in an additional session at 38%/47%/56%/66%/75% peak systole. The mean diffusivity (MD) was calculated as function of trigger delay and used as measure for the sensitivity to bulk motion. Helix angles were calculated upon tensor reconstruction.

Results

MD as function of trigger delay is shown in Figure 2a). Second order MC diffusion encoding yielded an applicable trigger delay range of 15-81% (apical) and 15-77% (basal) of peak systole. For first order MC, the corresponding trigger delay windows were only 30-57% (apical) and 27-56% (basal). Figure 2b) shows a time series of helix angle maps (basal) and the transmural angle histograms (apical/basal) c).

Conclusions

Second order motion compensated cardiac SE diffusion encoding significantly decreases the sensitivity to bulk motion compared to first order motion compensated diffusion gradients across the heart.



¹Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Full list of author information is available at the end of the article

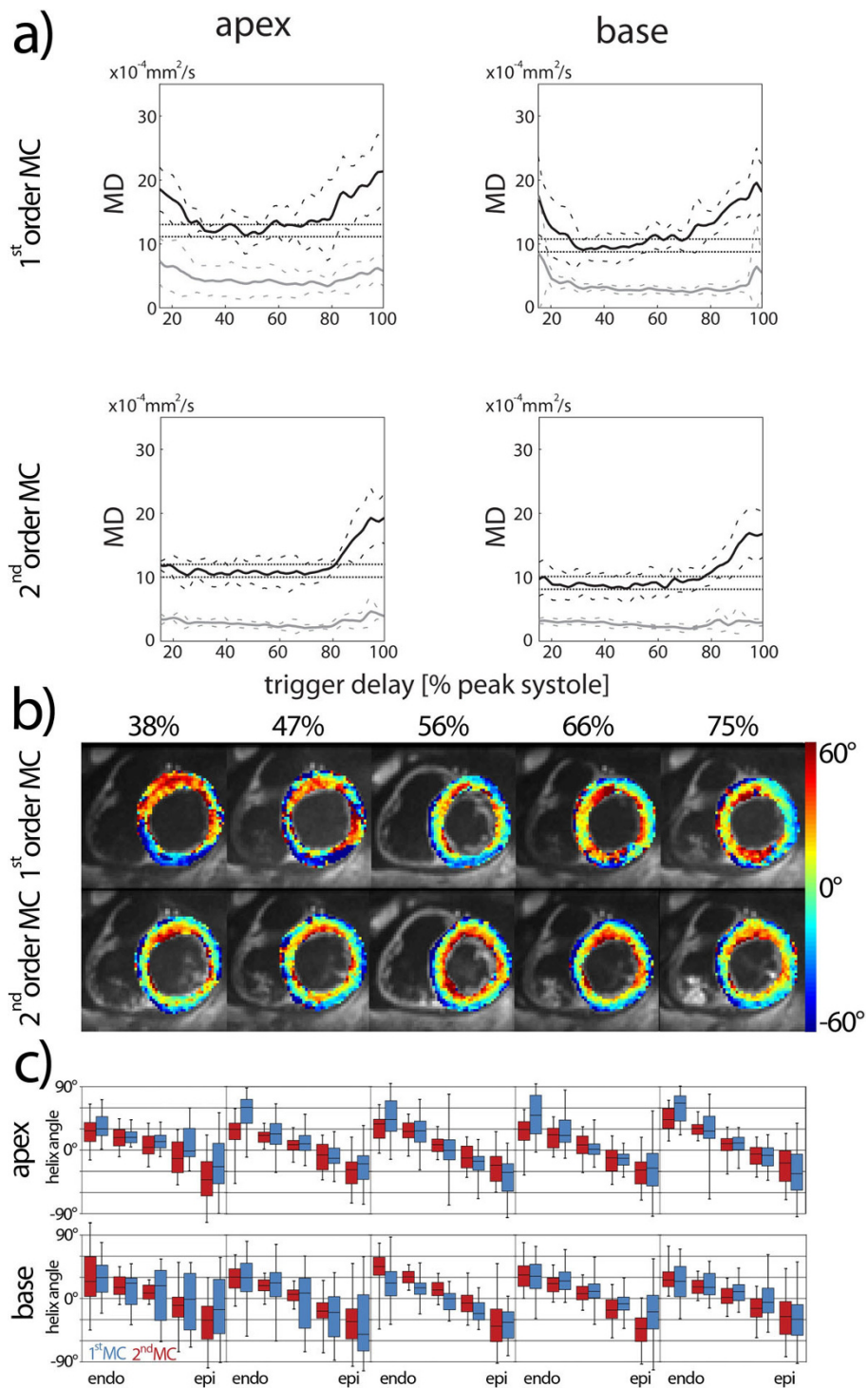


Figure 2 a) Mean diffusivity (MD) for first and second order motion compensated (MC) diffusion encoding as function of trigger delay. Black lines represent the mean MD across the myocardium and gray the corresponding standard deviation. Solid lines represent the average across volunteers, dashed lines the corresponding standard deviation. The horizontal dashed lines indicate a range of minimum MD and $2.05 \times 10^{-4} \text{ mm}^2/\text{s}$ above. b) Example helix angle maps at basal level (top) for different trigger delays (% peak systole) and first as well as second order motion compensated (MC) diffusion encoding. c) Transmurals helix angle histograms for apex and base. The box represents the 50% percentile and error bars the 90% percentile across the myocardium at different transmural depths.

Funding

Swiss National Science Foundation, grant #CR3213_132671/1, EU FP7 Marie-Curie fellowship to MG, UK EPSRC, grant EP/I018700/1.

Authors' details

¹Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland. ²Imaging Sciences and Biomedical Engineering, King's College London, London, UK. ³Centre for Medical Imaging, University College London, London, UK.

Published: 3 February 2015

References

1. Edelman , et al: *MRM* 1994.
2. Nielles-Vallespin , et al: *MRM* 2013.
3. Reese , et al: *MRM* 1995.
4. Stoeck , et al: *PLoS ONE* 2014.
5. Gamper , et al: *MRM* 2007.
6. Nguyen , et al: *MRM* 2013.

doi:10.1186/1532-429X-17-S1-P81

Cite this article as: Stoeck et al.: Second order motion compensated spin-echo diffusion tensor imaging of the human heart. *Journal of Cardiovascular Magnetic Resonance* 2015 **17**(Suppl 1):P81.

Submit your next manuscript to BioMed Central and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

