

## Cartesian Self-Gated Cine MRI: Initial Clinical Experience

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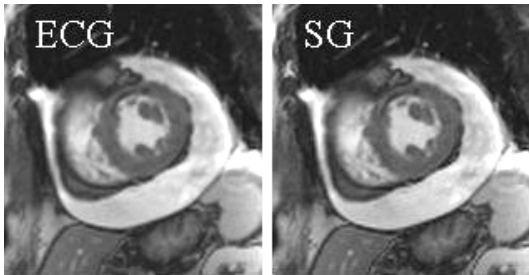
**Introduction:** ECG-gating requires additional patient preparation time, is susceptible to RF and magnetic interference, and is ineffective in a significant percentage of patients<sup>1</sup>. More recently, self-gating techniques have been described using either radial<sup>2</sup> or conventional Cartesian<sup>3</sup> k-space sampling to potentially eliminate the need for external physiological signal monitoring. Self-gated cine with Cartesian sampling avoids the streak artifacts of radial imaging, and was recently shown to have equivalent image quality to ECG gated cine in a sample of healthy volunteers<sup>3</sup>. The purpose of this study is to demonstrate the effectiveness of the self-gated cine sequence in a sample of patients referred for clinical cardiac MRI exams.

**Methods:** *The sequence:* This technique is a modified retrospectively gated TrueFISP cine sequence that acquires a short second echo after the readout and phase gradients have rewound. The peak amplitude of the second echo varies in proportion to the average signal in the image, which is expected to change in synchrony with the cardiac cycle. A band-pass filter (0.2 Hz - 10 Hz pass-band) is applied to the echo-peak information to remove noise, and a peak-detection algorithm determines the trigger times.

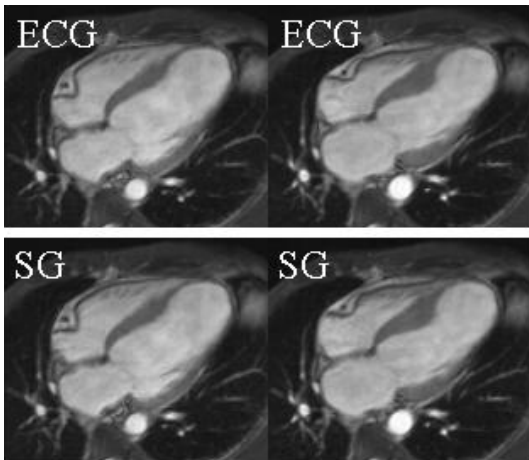
*Experimental Setup:* Three to five slices, including short and long-axis views, were obtained in 11 patients (7 female, 4 male, 21-92 years [mean 56 years]) for a total of 50 measurements. ECG and self-gated image series were retrospectively reconstructed from each measurement, resulting in 100 series. Indications for cardiac MR were variable, ranging from pulmonary vein mapping to viability studies. Imaging was performed using a 1.5T MAGNETOM Avanto (Siemens, Erlangen, Germany) with a 12-element body array coil. Breath-held acquisitions were performed using the following parameters: 263mm \* 350mm FOV, 135 phase-encoding lines, 16 phases, 3.42 ms TR, 59.7 ms temporal resolution, 6 mm slice thickness, and a 1000 Hz/pixel bandwidth. Short axis series (n=50) were evaluated to quantify left ventricular single-plane ejection fractions in a blinded fashion. All 100 series were evaluated for overall image quality (1-4 scale) and degree of artifact (0-3 scale) by two independent, blinded reviewers. All data were analyzed using a two-tailed paired t-test with statistical significance set at the 5% level.

**Results:** Quantitative results showed that there was no statistically significant difference between the calculated ejection fractions of the ECG-gated and self-gated acquisitions (p-value=0.12). Qualitative evaluations were analyzed by pooling the data of the two reviewers. Both gating techniques received overall image quality scores between "good" (3) and "excellent" (4) and artifact scores between "none" (0) and "minimal" (1).

**Conclusion:** Self-gated cine TrueFISP sequences, using a conventional Cartesian sampling scheme, showed no difference from ECG-gated sequences in quantifying single-plane ejection fractions in a sample of patients referred for clinical cardiac MR. While the qualitative scores were slightly worse for self-gating, the overall image quality was good to excellent and artifacts were minimal. Of note, one patient in this series had a clinically calculated left ventricular ejection fraction (LVEF) of 20%, but no quantitative or qualitative differences after analysis. This promising self-gating technique has many advantages to ECG-gating and needs to be assessed in a larger population of patients with significantly depressed cardiac function.



**Figure 1 (above).** End-diastolic, short-axis images comparing ECG-gating and self-gating sequences in a patient referred for pulmonary vein mapping prior to radiofrequency ablation of atrial fibrillation.



### References

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2. Larson A, et al. Self-Gated Cardiac Cine MRI. *Magn Res Med* 2004; 51:93-102.
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	Mean single-plane ejection fraction	Mean overall image quality score	Mean artifact score
ECG-gating	53.24 (n=25)	3.66 (n=50)	0.58 (n=50)
Self-gating	53.83 (n=25)	3.52 (n=50)	0.72 (n=50)
<b>Result</b>	<b>p-value=0.12</b>	<b>both "good" to "excellent"</b>	<b>both "none" to "minimal"</b>

**Table 1.** Results of data analysis. The differences in ejection fractions and overall image quality were not statistically significant (p>0.05). Qualitatively, ECG-gated and self-gated images were given nearly the same reviews.

**Figure 2 (left).** End-diastolic (left) and end-systolic (right), long-axis images comparing ECG-gating and self-gating sequences in a patient with aneurysmal dilatation of the left ventricular apex. Clinically calculated LVEF was 20%.