



MiRTLE Medical, LLC.  
12-Lead ECG During MRI

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iCMR January 28, 2016

# 12-Lead ECG During MRI

- MiRTLE Medical, LLC.
  - Initial work October 2010
  - Founded December 2012, privately held
  - Majority owned by E-TROLZ, Inc.
- Intellectual Property
  - Brigham & Women's Hospital, Boston, MA
    - Acquiring patient physiological information during MRI scan
  - E-TROLZ, Inc.
    - Electrophysiological acquisition & signal processing device
- Product Development
  - Validation complete through third-generation prototype device
  - Building final design Beta device

# Experiments

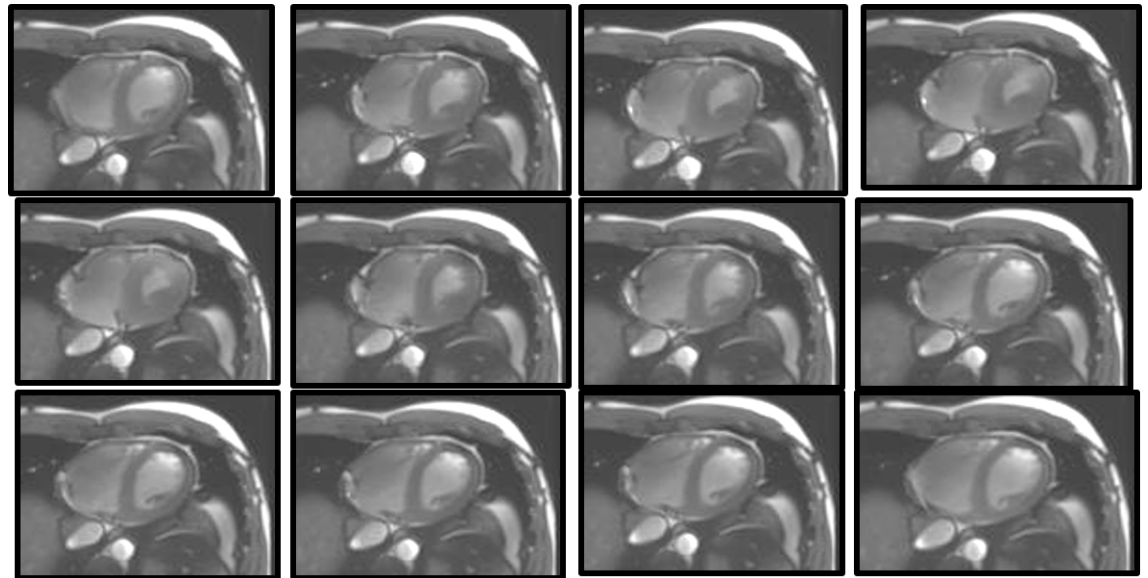
## Poster: 3T Cardiac Imaging with on-line 12-lead ECG monitoring

- 4 normal volunteers (32-57 years old) in a Siemens 3T Skyra using 16-channel cardiac array
- Imaging:
  - Breath-held volunteer ECG-triggered BB-TSE (TR/TE=2100ms/46ms, ETL=9, 192x256, 29x36, 5 mm sw, 14s/sl., 2 avg.) Prospectively triggered by 12-lead VCG
  - 25 frame/R-R breath-held volunteer ECG-triggered SSFP cine (TR/TE/flip=3.5ms/1.2ms/28deg, 26x32, 216x256, 5 mm sw, 10s/sl., 2 avg.). Retrospectively triggered by the 12-lead VCG
- Analysis Criteria:
  - Scan efficiency evaluation: fraction of QRS complexes detected
  - Image Quality (IQ) evaluation: IQ relative to imaging w/conventional 4-lead Siemens gating

# Results & Conclusions

## Poster: 3T Cardiac Imaging with on-line 12-lead ECG monitoring

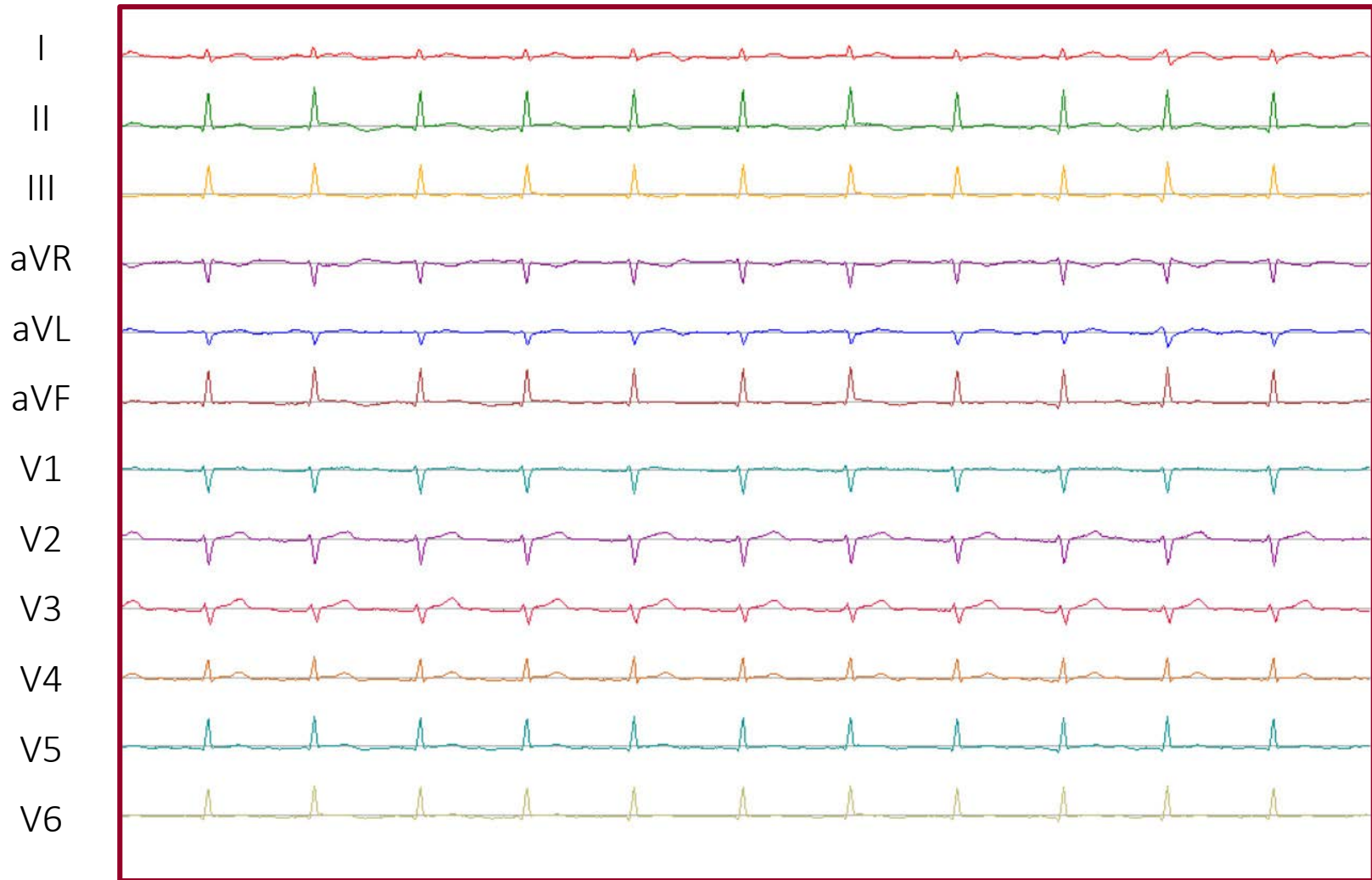
- MRI-Compatible 12-lead ECG system provided ECG traces without GIV for SSFP, GRE and TSE
- Triggering efficiency was better than that obtained with the Siemens 3-lead ECG for GRE and SSFP, and slightly lower for TSE
- Imaging IQ for these normal volunteers was equivalent to that obtained with the standard 3-lead Siemens gating



Cine SSFP images acquired with gating from 12-lead ECG system. 12 frames out of 25 frames are shown.

# MiRTLE Realtime Operation

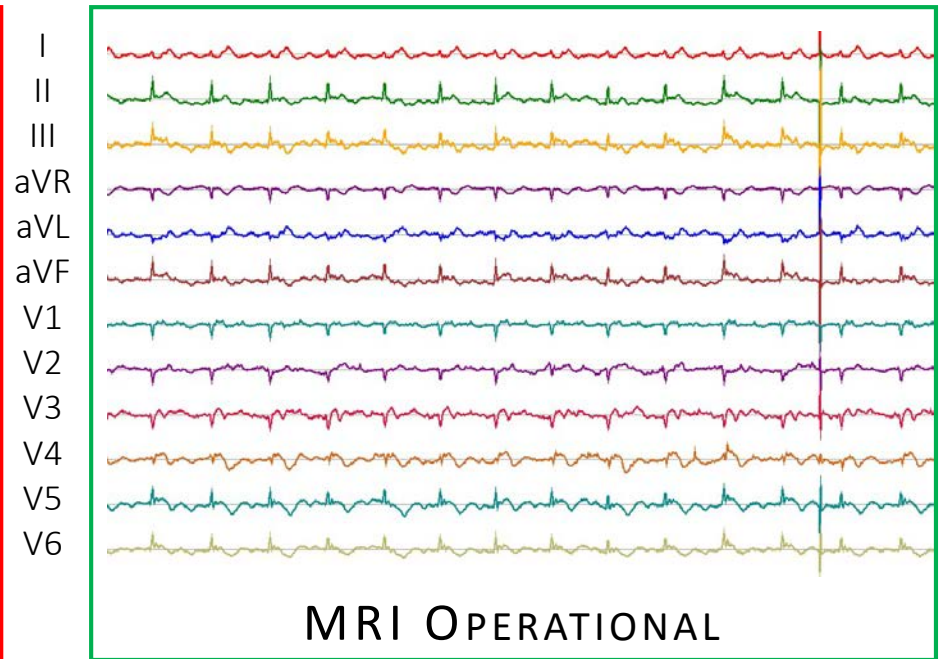
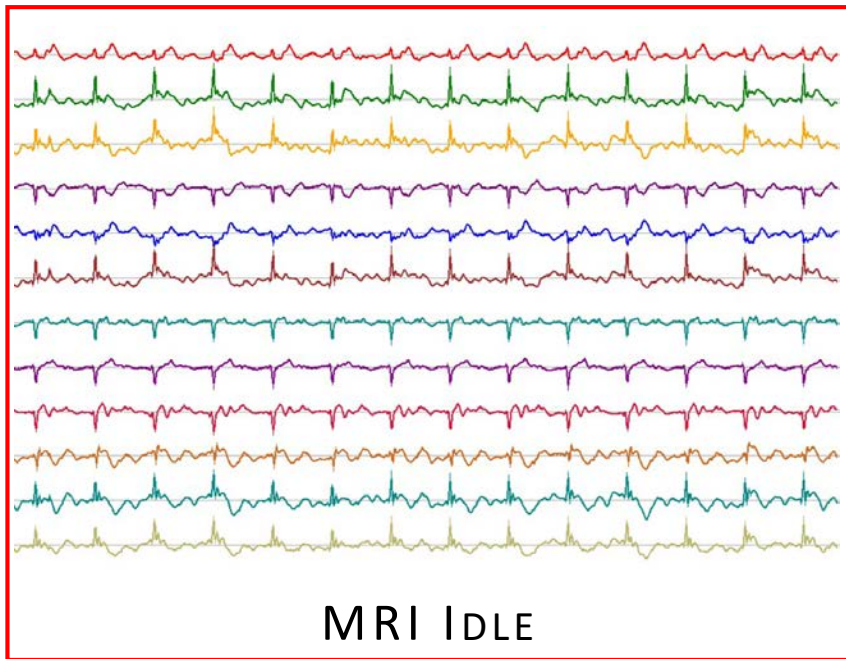
Subject 3 - 38 year old male - SSFP - Skyra 221L-3T





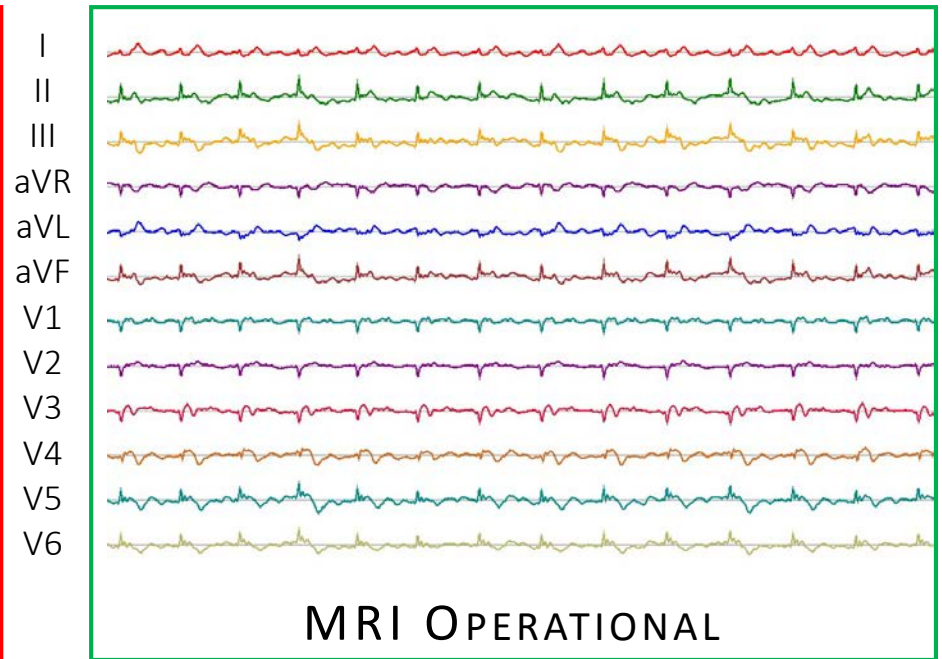
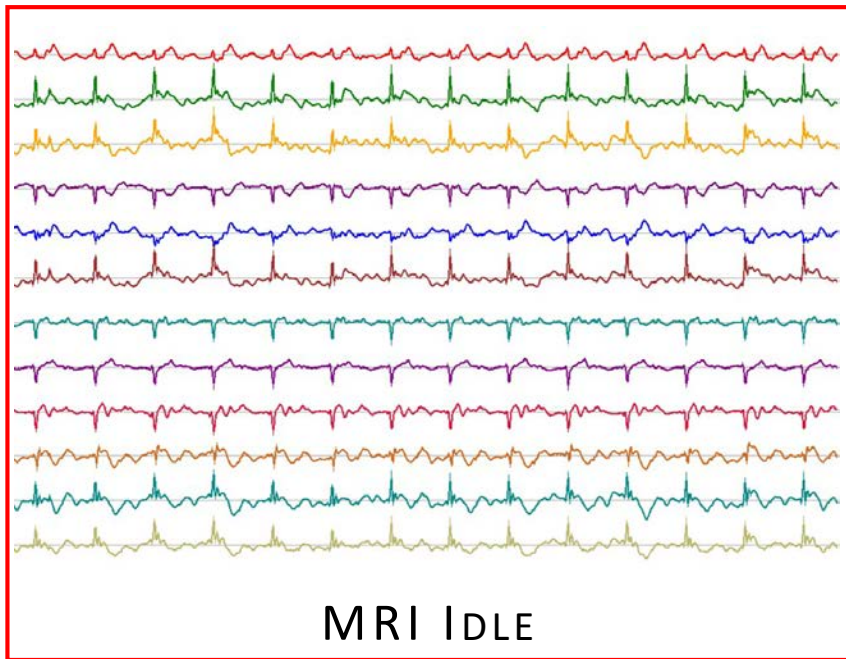
# MiRTLE ECG Performance

Subject 3 - 38 year old male - SSFP - Skyra 221L-3T



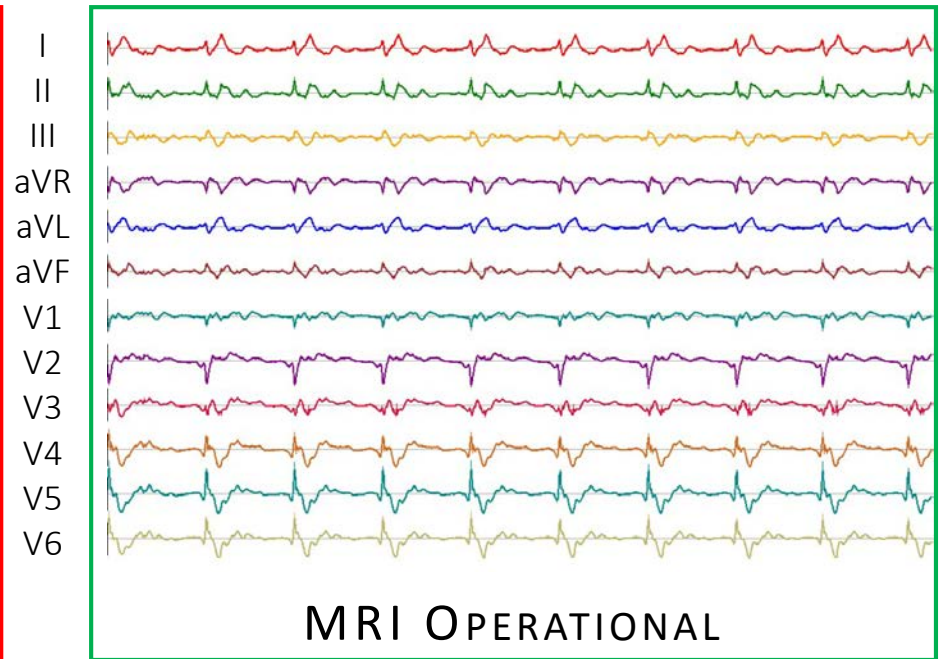
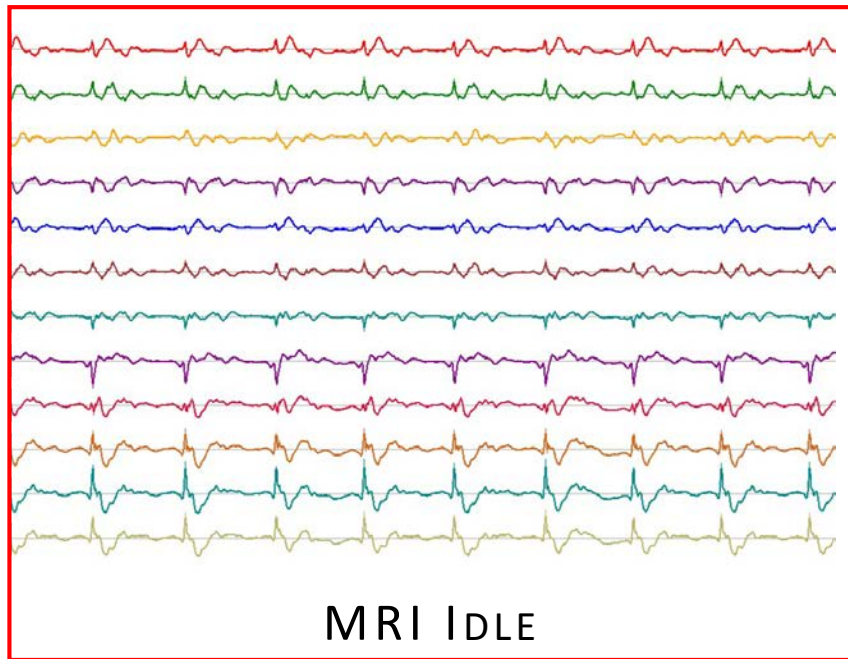
# MiRTLE ECG Performance

Subject 3 - 38 year old male - TSE - Skyra 221L-3T



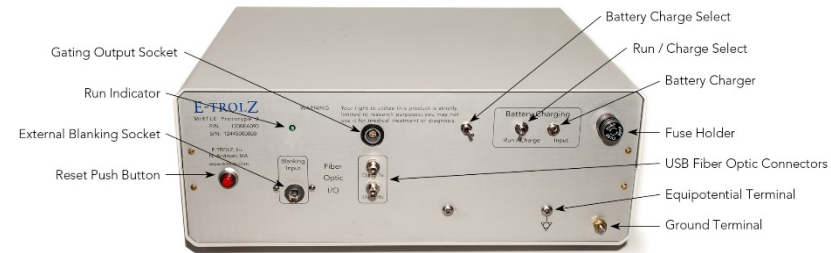
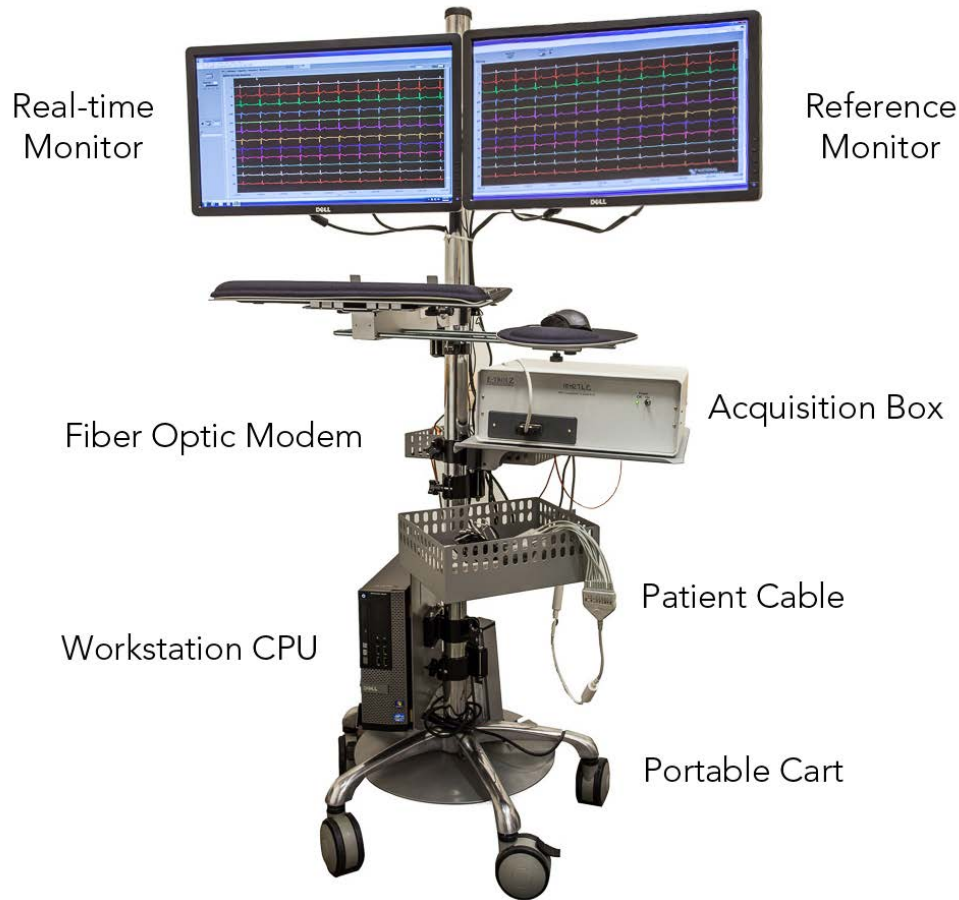
# MiRTLE ECG Performance

Subject 2 - 35 year old male - GRE - Skyra 221L-3T





# MiRTLE Device – IRB Use Version



# Device Road Map

		Development		Commercial Product	
Feature	Device Version	IRB Use	Clinical Trial	Diagnostic Device	Interventional Device
		Now	Q3'2016	2018	2018
ECG 12-Lead, diagnostic grade		✓	✓	✓	✓
Patient safety system including cable		✓	✓	✓	✓
Beat detection at 3T scanner gating		✓	✓	✓	✓
Defibrillation protection		✓	✓	✓	✓
Diagnostic quality ECG during scan		✓	✓	✓	✓
SSFP, GRE, TSE, EPI sequences cleansed		3 of 4	✓	✓	✓
MHD real-time removal			✓	✓	✓
Dual imaging modalities with uninterrupted monitoring – Wireless			✓	✓	✓
Stroke volume estimation			✓		✓
Continuous comparison with baseline ECG morphology			✓		✓
SPO2, Dual Invasive Blood Pressure			✓		✓
CardioLab, Sensis Interfaces			✓		✓



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