

Assessment of reproducibility in Whole-Heart Magnetic Resonance Coronary Angiography

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Target Audience: Physicians, MR technologists

Introduction and Purpose: Whole-Heart Magnetic Resonance Coronary Angiography (WH MRCA) [1] is a very useful and safe diagnostic tool for screening for coronary artery disease. It can be visualized dedicated coronary arteries of a whole entire heart. Further improvements in respiratory motion correction using navigator technology [2] and electrocardiographic (ECG) gating using vector ECG triggering [3] allow free-breathing high resolution WH MRCA with effective suppression of motion artifacts. However, to our knowledge, there are no studies demonstrating the reproducibility of WH MRCA. Therefore, the purpose of this study was to ascertain the reproducibility of WH MRCA in clinical setting on health checkups.

Methods: All studies were performed using a commercial 1.5-T scanner (Toshiba, Tochigi, Japan) with a 16-channel phased-array coil, with two rows of elements used to cover the heart. The WH MRCA scans were performed using an SSFP sequence with fat suppression, T2 preparation and real-time motion correction (RMC) to compensate for respiratory motion. Imaging parameters were: TR/TE/FA = 4.3 ms/2.2 ms/120° and spatial resolution = 1.5 x 1.5 x 1.5 mm³. The 3D imaging slab was positioned for the typical whole-heart coverage (75-90 slices). 2D parallel imaging was applied with factors of 2.1 in the phase and 1.4 in the slice directions. A total of 38 cases of cardiovascular screening were performed twice with a mean interval of 1.6 years; we compared the visible vessel length, vessel sharpness, vessel diameter and image quality. The MRCA data was transferred to a workstation (AZE Ltd., Tokyo, Japan) to make Curved MPR and the image quality was assessed using a 4-grade scale (1 = poor, 2 = moderate, 3 = good, 4 = excellent) by an experienced observer using randomized image pairs. Paired t-test was used on vessel length, vessel sharpness, and vessel diameter. Reproducibility of the image quality was analyzed using Bland-Altman analysis.

Results and Discussion: All 38 cases were successful in the original and repeated WH MRCA scans. Vessel length (RCA p=0.70, LAD P=0.71, LCX p=0.44), vessel diameter (RCA p=0.41, LAD P=0.35, LCX p=0.85), and vessel sharpness (RCA p=0.62, LAD P=0.22, LCX p=0.50) were not significantly differences between two scans. The image quality between the original and repeated scans was similar, and there was a high degree of inter-scan agreement for all three arteries using Bland -Altman analysis. The reproducibility of the original and repeated scans was consistent and only a few cases had a slight difference in image score of 2, which seems caused by respiration artifacts.

Conclusion: WH MRCA allows visualization of long continuous segments of coronary arteries and appears to be a highly reproducible technique for assessment of coronary arteries.

References

- [1] Weber OM, Martin AJ, Higgins CB. Magn Reson Med. 2003; 50: 1223-8.
 [2] Stuber M, Botnar RM, Danias PG, et al; Radiology 1999; 212: 579-87. [3]Fischer SE, Wickline SA, Lorenz CH. Magn Reson Med.1999; 42: 361-70..

Table 1. Mean and standard deviation of vessel length, diameter, sharpness and image quality score between the original and repeated scans

	original scan			repeated scan		
	RCA	LAD	LCX	RCA	LAD	LCX
vessel length (mm)	153.3 ± 34.2	135.1 ± 25.5	94.6 ± 39.4	154.4 ± 36.0	134.2 ± 23.7	97.8 ± 31.0
vessel diameter(mm)	3.41 ± 0.62	3.19 ± 0.53	2.84 ± 0.51	3.35 ± 0.75	3.11 ± 0.52	2.83 ± 0.59
vessel sharpness	0.72 ± 0.12	0.76 ± 0.12	0.83 ± 0.15	0.73 ± 0.11	0.74 ± 0.15	0.82 ± 0.12
visual score	3.44 ± 0.75	3.21 ± 0.77	3.15 ± 0.78	3.26 ± 0.88	2.79 ± 0.70	2.92 ± 0.81

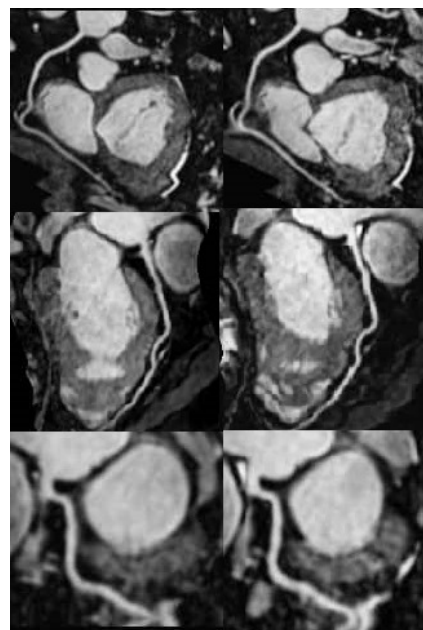


Figure 1. The typical reformatted image of RCA, LAD,LCX (a) the original and (b) repeated scans

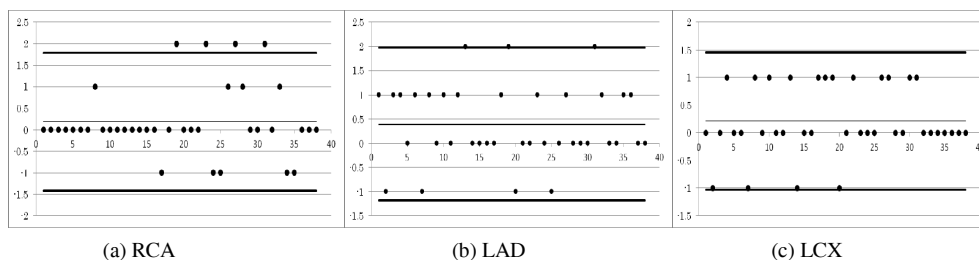


Figure 2. The agreement of the image quality in (a) RCA, (b) LAD, and (c) LCX between the original and repeated scans by Bland -Altman Methods