Interstudy and intraobserver reproducibility of high-resolution MRI in evaluating basilar atherosclerotic plaque at 3Tesla

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Target audience: Researchers and clinicians who are interested in MRI of in vivo intracranial atherosclerotic plaque.

Purpose: Intracranial artery atherosclerosis is increasingly being recognized as a major cause of stroke worldwide, and patients with intracranial steno-occlusive disease have an augmented risk of vascular events[1]. Several imaging modalities, including digital subtraction angiography, computed tomography angiography, and magnetic resonance imaging (MRI), are used to assess intracranial atherosclerosis. However, dark blood high-resolution MRI (HRMRI) superiors to other techniques in delineating the wall of the basilar artery (BA) because it is noninvasive and radiation-free[2].To our knowledge, the scan and rescan reproducibility of quantification of BA plaque has not reported. Therefore, the purpose of the present study is to evaluate the interscan and intraobserver reproducibility of BA plaque employing dark blood HRMRI at 3Tesla.

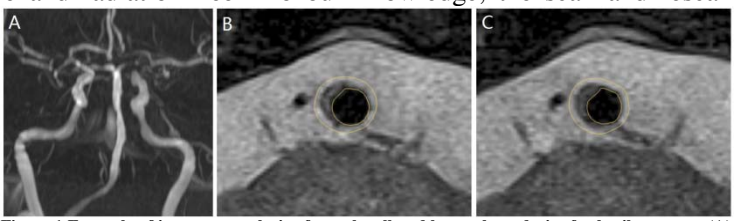

Figure 1 Example of interscan analysis of vessel wall and lumen boundaries for basilar artery. (A) 3D (TOF) (Scan-1); (B) 2D T2W TS) (Scan-1); (C) 2D T2W TSE (Scan-2).

Materials and methods: ***Subjects*** Ten patients (eight males and two females, 54-67 years old, mean age = 61 years) with >30% stenosis as identified by conventional MRA were recruited. After the first scan, the patient was got out from the scanner and the coil was removed, then the patient was repositioned for the second scan. ***MRI protocol*** Cross-sectional imaging was performed on a 3T MR system (Skyra, Siemens medical solution, Germany) using a standard phased-array head coil. Two protocols were used: 3D time of flight (TOF) images were obtained with TR/TE = 21/3.4 ms, FOV = 180×200 mm^2, matrix = 330×384, thickness = 0.7 mm, and average = 1; parameters for 2 dimensional T2 weighted turbo spin echo (T2W TSE) were TR/TE = 2890/46 ms, FOV = 100×100 mm^2, matrix = 256×256, thickness =2 mm, ETL = 20, and averages = 2. The total time of two scan sessions was approximately 25 minutes. ***Image analysis*** Both two scan session series were reviewed by an experienced observer, and 92 (Scan-1, 46; Scan-2, 46) cross-sectional T2W images with basilar atherosclerotic plaque were included in the final analysis. Vessel area and lumen area were traced manually by the observer (Figure 1). The wall area (plaque area) was calculated by subtracting the lumen area from the vessel area. To test the intraobserver variability, the observer measured BA plaque (Scan-1) twice during two different time points that were separated by a 2-week interval to avoid any recall bias. ***Statistical analysis*** Agreement between repeated measurements (interscan and intraobserver reproducibility) was quantified through intraclass correlation coeffient (ICC) and Bland-Altman plots. The mean differences between repeated measurements against the mean value of repeated scans were also analyzed.

Table 1 Interscan and intraobserver reproducibility for basilar artery.

	Interscan		Intraobserver	
	ICC (95% CI)	Mean difference	ICC (95% CI)	Mean difference
Total vessel area	0.960	-0.30 (1.80)	0.995	0.18 (0.66)
Lumen area	0.942	0.11 (1.11)	0.966	0.01 (0.87)
Wall area (mm^2)	0.972	-0.41 (1.92)	0.992	0.16 (1.05)

ICC: intraclass correlation coefficient; CI:confidence interval; SD: standard deviation

Results: The interscan and intraobserver reproducibility were presented in Table 1. The ICC for vessel, lumen and wall areas were excellent and ranging from 0.942 to 0.972 for interscan and 0.966 to 0.995 for intraobserver, respectively. The differences between the vessel, lumen and wall area measurements and the mean value of repeated scans and intraobserver measurements were presented in Bland-Altman plots, including limits of agreement (Figures 2, 3). However, the intraobserver measurements have better reproducibility than the interscan.

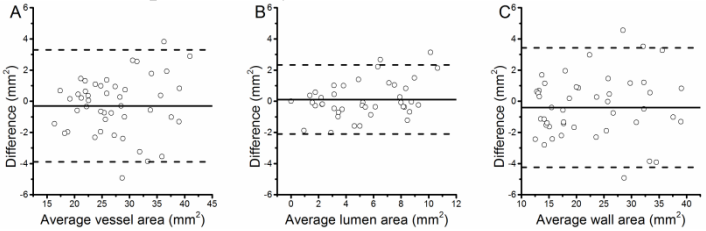

Figure 2 Bland-Altman plots of interscan reproducibility for vessel area (A), lumen area (B), and wall area (C) of basilar artery plaque. Dashed lines represent the limits of agreement.

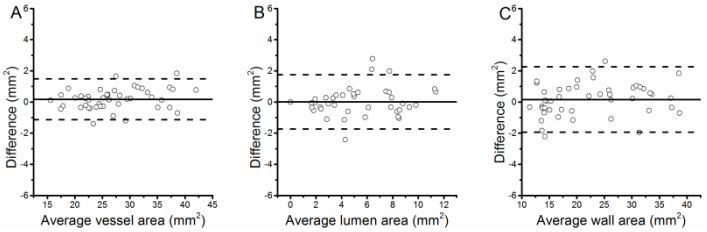

Figure 3 Bland-Altman plots of intraobserver reproducibility for vessel area (A), lumen area (B), and wall area (C) of basilar artery plaque. Dashed lines represent the limits of agreement.

Discussion: The present study showed that an excellent interscan and intraobserver reproducibility for quantifying the basilar atherosclerotic plaque, which is important for longitudinal and serial examination in clinical practice and research applications. In addition, the serial evaluation may be particularly useful to assess the time course of basilar atherosclerosis and it can serve as an endpoint to monitor the effect of interventional strategies on basilar atherosclerotic disease[3].

Conclusion: High field BA plaque imaging demonstrated excellent interscan and intraobserver reproducibility. The results proved that HRMRI is a reliable tool for clinical studies focused on the natural history and therapy of atherosclerosis.

References: 1. Turan TN, et al. Stroke. 2010;41(8); 2. Ma N, et al. AJNR. 2011;32(2); 3. Kroner ESJ, et al. EJR. 2013;82(4).