

Correlation of 3T-MRI Carotid Artery Wall Volume and B-mode Ultrasound Intima-Media Thickness measurements

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Introduction Cardiovascular MRI permits non-invasive, serial in vivo measurement of carotid arterial wall volume (AWV), arterial Wall-Outer Wall ratio (WOW) and Arterial Wall Thickness (AWT). We compared 3T-MRI AWV measurements with carotid ultrasound Intima-Media Thickness (CIMT) by describing the correlation between both measures.

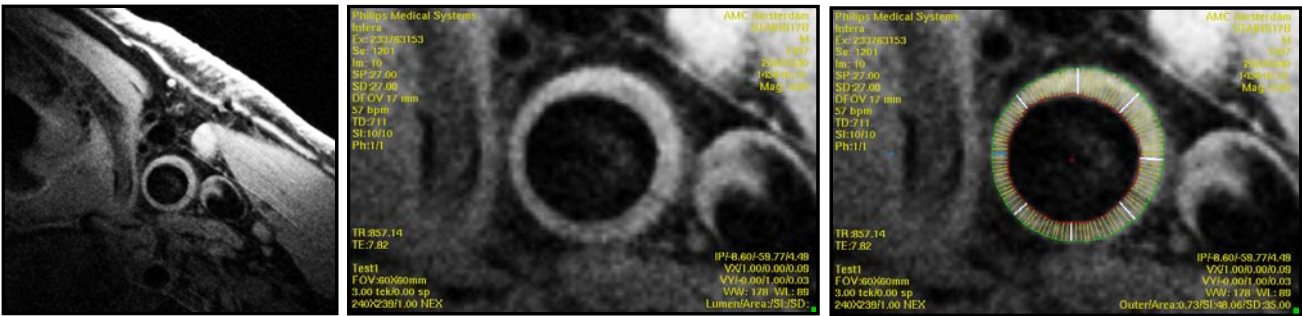


Figure 1. T1-weighted image of the common carotid artery. An overview is shown on the left. The middle image has zoomed in on the carotid artery. Delineation of the lumen and the outer wall contour is shown on the right.

Methods 3T-MRI and B-mode ultrasound scans were done in the common carotid arteries of 30 healthy volunteers (aged 42, SD 16). 15 subjects were younger than 30 years and 15 subjects were between 50 and 70 years. All subjects were imaged three times on different days. Axial T1-weighted TSE image stacks were acquired at end-diastole using a 5 cm single-element microcoil (Philips, Hamburg, Germany). Sequence parameters were: slice thickness 3 mm, imaging matrix size 240, FOV of 60 x 60 mm, non-interpolated pixel size 0.25 x 0.25 mm, reconstruction matrix 240, TE 9 ms, TR according to the subjects heart rate. Active fat suppression (SPAIR) was applied together with a double inversion black blood prepulse. Image analysis was done with semiautomatic software that delineates the carotid lumen volume and the outer carotid vessel volume (VesselMass, Leiden). IMT measurements were performed using a standardized imaging protocol and a Sequoia 512 scanner equipped with an 8L5 transducers (Acuson-Siemens, Erlangen, Germany).

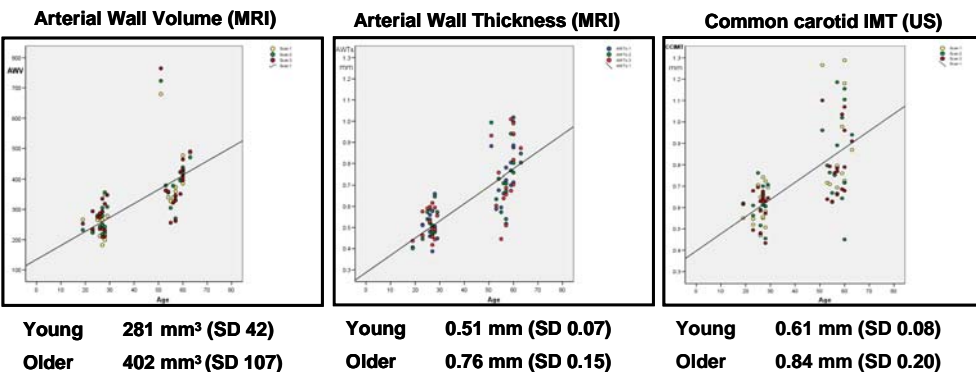


Figure 2. The left panel shows Arterial Wall Volume (MRI) set out against age. The middle panel shows Arterial Wall Thickness (MRI) set out against age. The right panel shows Common Carotid Intima-Media Thickness set out against age. Values are shown for the initial scan and both repeat scans.

Results Mean values of the initial and repeat 3T-MRI scans were: AWV 331.6 (SD 106.0) mm³, WOW 0.308 (SD 0.562), AWT 0.6306 (SD 0.1458) mm. Ultrasound CIMT was 0.7237 (SD 0.1800) mm. The Pearson correlation coefficient was 0.71 (p=0.01) for AWV and CIMT, 0.78 (p=0.01) for WOW and CIMT and 0.77 (p=0.01) for AWT and CIMT. For 3T-MRI measurements the average per subject paired mean differences were: AWV 4.2 (SD 29.0) mm³, WOW 0.015 (SD 0.124), AWT 0.014 (SD 0.070) mm. The intraclass correlation coefficients were: AWV 0.963 (95% CI 0.933 - 0.981, p<0.001, Fig. 3), WOW 0.938 (95% CI 0.891-0.968, p<0.001), AWT 0.882 (95% CI 0.798 - 0.938, p<0.001).

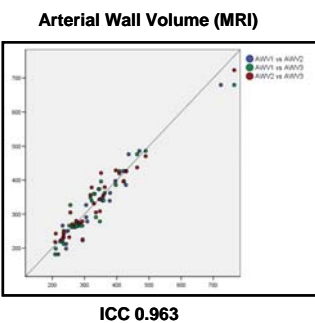


Figure 3 The Arterial Wall Volume measurements of the initial scan and the repeat scans are set out against each other.

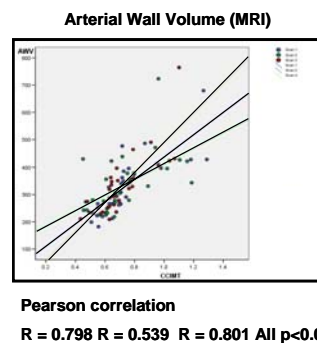


Figure 4 The 3T-MRI Arterial Wall Volume measurements of the initial scan and the repeat scans are set out against the common carotid Intima-Media Thickness of each scan session.

Conclusion 3T-MRI AWV, WOW and AWT measurements of the carotid artery are highly reproducible and significantly correlated with B-mode ultrasound CIMT in healthy volunteers. Moreover, the absolute values of 3T-MRI AWT are in accordance with US CIMT measurements. This suggests that 3T-MRI T1-weighted images of the carotid artery measures Intima-Media Thickness.