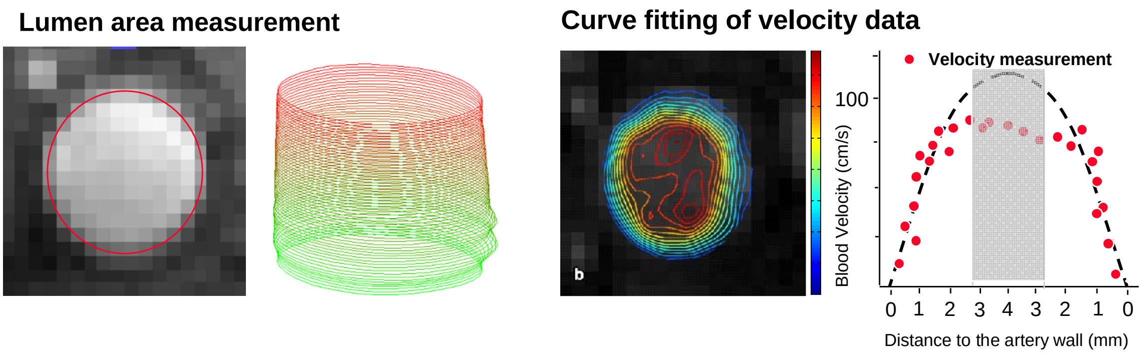
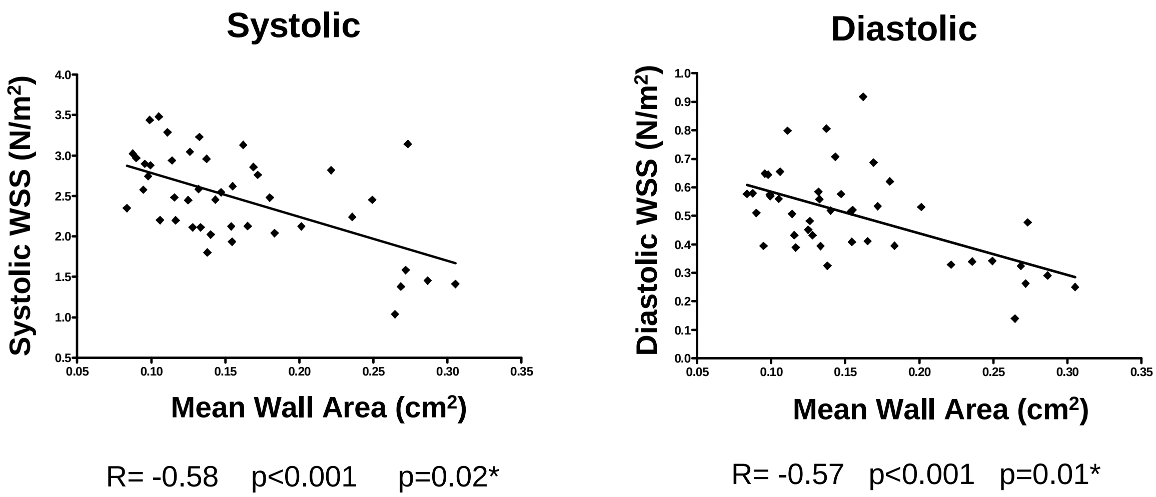
# 3.0 Tesla MRI Common Carotid Wall Shear Stress Measurements: Correlations with Common Carotid Arterial Wall Thickness.

**R. Duivenvoorden[1], E. de Groot[2], E. van Bavel[3], R. Amri[2], E. Stroes[4], J. Lameris[5], J. Kastelein[2], and A. J. Nederveen[5]**
[1]Vascular Medicine, Academic Medical Center, Amsterdam, Netherlands, [2]Vascular Medicine, Academic Medical Center, [3]Medical Physics, Academic Medical Center, [4]Academic Medical Center, [5]Radiology, Academic Medical Center

**Introduction** Wall Shear Stress (WSS) is an important determinant of endothelial function and phenotype. Low WSS is associated with atherogenesis. WSS can be well quantified with MRI. One of the aims of our 3.0 Tesla MRI studies was to quantify common carotid WSS and investigate relationships of WSS with other arterial lumen and wall parameters. In this abstract we describe the relationship between common carotid WSS and carotid wall thickness expressed as Mean Wall Area (MWA).




**Methods** In each of the 45 subjects of the study (age range 18 to 78; average 42 (SD 16) years) three 3.0 Tesla MRI common carotid arterial scans were performed on a Philips Intera scanner. Subject scans were done on different days. Axial gradient echo Phase-Contrast images were acquired over 60 phases per heartbeat (retrospective gating), using a 5 cm single-element microcoil (Philips). Sequence parameters: slice thickness 3 mm, non-interpolated pixel size 0.625 x 0.625 mm, velocity encoding 150 cm/s. WSS was calculated as follows: WSS = μ·WSR, where μ is the blood viscosity (3.2 Pa·s) and WSR is the blood velocity gradient at the artery wall. WSR was assessed by determining the slope of the velocities close to the artery wall using second order curve fitting of the velocity profile, excluding the center. 3.0 Tesla MRI axial T1-weighted TSE image stacks were acquired at late diastole for MWA measurements. Sequence parameters: slice thickness 3 mm, non-interpolated pixel size 0.25 x 0.25 mm, TE 11 ms and TR according to heart rate, active fat suppression (SPAIR) and a double inversion black blood prepulse.




* Adjustment for age, sex, SBP, DBP, BMI, lumen area, peak velocity.

**Results** Mean values were: systolic WSS 2.47 (SD 0.58) N/m$^2$, diastolic WSS 0.50 (SD 0.16) N/m$^2$, MWA 13.1 (SD 4.2) mm$^2$. Systolic and diastolic WSS were inversly associated with MWA (Spearman's rho -0.58 ($p<0.001$) and -0.57 ($p<0.001$) respectively, which remained significant after adjustment for age, sex, BMI, lumen area, peak systolic flow, systolic blood pressure and diastolic blood pressure.

**Conclusion** WSS derived from 3.0 Tesla MRI datasets can be quantified non-invasively in common carotid arteries. Both systolic and diastolic WSS have strong correlations with common carotid artery wall thickness, a surrogate endpoint for atherosclerosis and cardiovascular disease. WSS may therefore be a promising new functional parameter for evaluation of cardiovascular disease risk and drug efficacy.