# Carotid Arterial Circumferential Strain Has a Greater Association to Vascular Aging than Conventional Carotid Arterial Stiffness.

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**Objective:** Arterial stiffness is closely related to the risks of CVD and increases with aging. Functional impairment of the arterial wall can occur before structural changes and can be detectable before CVD symptoms. The elastic properties of the carotid arterial wall during the cardiac cycle can be evaluated by either standard 2-dimensional (2D) ultrasound longitudinal or 2D ultrasound circumferential imaging of vascular deformation (Strain) using speckle tracking. The purpose of this study was to compare standard longitudinal scans with 2D circumferential ultrasound imaging of vascular tissue motion and Strain using speckle tracking with in young and old people.

**Methods:** Young and older adults had 2D ultrasound circumferential and longitudinal axis images of the common carotid artery recorded. Circumferential carotid strain (CS) and CS rate were obtained and analyzed via speckle tracking software. Following the strain analysis, the circumferential strain beta-stiffness (C- β) was calculated. Longitudinal beta-stiffness (L-β) was calculated and non-invasive blood pressure measurements obtained from carotid artery pressure measurements (carSBP, carDBP, carPP, carMAP) in a resting supine position using applanation tonometry.

**Results**: C- β was significantly higher than L-β, and the association with age was greater (r =.824 vs r =.547). Resting CS and CS rate were significantly higher in the young compared to the older group. See table below for descriptive characteristics.

**Conclusion**: Conventional longitudinal beta-stiffness does not explain as much of the age-dependent differences in the carotid artery compared with circumferential strain beta-stiffness by two-dimensional speckle tracking imaging. This is possible due to inclusion of the whole arterial wall motion and deformation that is observed in the circumferential strain image. Circumferential strain Beta-stiffness appears to provide additional information when comparing age-dependent changes in vascular stiffness. The ability of circumferential strain beta-stiffness to accurately predict the future risk of CVD independent of age still needs to be investigated.

| Variables | Young (n=13) | Older (n=16) |
|---|---|---|
| **Age (yrs) *** | 26 ± 1 | 62 ± 2 |
| **BMI (kg/m$^2$) *** | 24.1 ± 0.9 | 28.0 ± 1.3 |
| **Heart Rate (bpm)** | 57 ± 3 | 63 ± 2 |
| **carSBP (mmHg)** | 104 ± 4 | 116 ± 5 |
| **carDBP (mmHg) *** | 66 ± 2 | 73 ± 2 |
| **carMAP (mmHg) *** | 83 ± 2 | 91 ± 3 |
| **carPP (mmHg)** | 45 ± 2 | 52 ± 3 |
| **AC (mm$^2$/kPa) *** | 1.48 ± 0.20 | 0.96 ± 0.14 |
| **L-Systolic Diameter (mm) *** | 6.82 ± 0.22 | 7.79 ± 0.29 |
| **L-Diastolic Diameter (mm) *** | 6.15 ± 0.22 | 7.34 ± 0.29 |
| **L- β *** | 4.5 ± 0.4 | 8.8 ± 0.8 |
| **C-Systolic Diameter (mm) *** | 6.86 ± 0.10 | 7.66 ± 0.23 |
| **C-Diastolic Diameter (mm) *** | 6.24 ± 0.11 | 7.24 ± 0.22 |
| **C- β *** | 6.0 ± 0.6 | 16.7 ± 1.4 |
| **CS (PK%) *** | 8.3 ± 0.8 | 3.1 ± 0.3 |
| **CS Rate (PK 1/s) *** | 0.65 ± 0.06 | 0.25 ± 0.02 |
| **Radial Displacement (PK mm) *** | 0.27 ± 0.02 | 0.12 ± 0.01 |
| **Radial Velocity (cm/s) *** | 0.23 ± 0.02 | 0.10 ± 0.01 |

All Data are mean ± SEM, * Age Difference, p<0.05