AORTIC VALVE MORPHOLOGY DICTATES REGION-SPECIFIC FIBER ARCHITECTURE IN HUMAN ASCENDING THORACIC AORTIC ANEURYSMS
Alkiviadis Tsamis1,5, Julie A. Phillippi1,2,5, Ryan G. Koch1, Jeffrey T. Krawiec1,5, Antonio D’Amore1,6, Simon C. Watkins4, William R. Wagner2, David A. Vorp1,2,3,5, Thomas G. Gleason2
1Bioengineering Department, University of Pittsburgh, USA; 2Cardiothoracic Surgery Department, University of Pittsburgh, USA; 3Surgery Department, University of Pittsburgh, USA; 4Center for Biologic Imaging, University of Pittsburgh, USA; 5McGowan Institute for Regenerative Medicine, University of Pittsburgh, USA; 6Fondazione Ri.MED, Italy

Introduction
Recent studies from our group revealed reduced undulation of collagen fibers in the medial-intimal half [Tsamis, 2012] and decreased delamination strength [Pasta, 2012] of ascending thoracic aortic aneurysm (ATAA) in patients with bicuspid aortic valve (BAV) when compared with patients with tricuspid aortic valve (TAV) suggesting a role in predisposed initiation of dissection. We hypothesize that aortic valve morphology dictates regional anomalies in the fiber micro-architecture of the ATAA tissue. To test the hypothesis, the goal of the current study was to characterize the fiber micro-architecture in three circumferential (CIRC) regions of ATAA wall relative to the aortic valve cusps (left (L), right (R), and non-coronary (N)).

Methods
Human aorta intact rings from BAV (n=4) and TAV ATAA (n=4) were cut in three CIRC regions labelled L, R and N, corresponding to their location with respect to the left, right and non-coronary sinus of the TAV, respectively. The samples were fixed and then imaged with multi-photon microscopy in the medial LONG-RAD and CIRC-RAD planes. Images were processed [D’Amore, 2010] to characterize the elastin and collagen micro-architecture.

Results
Two-way ANOVA showed that in the medial LONG-RAD plane of region N only, the elastin amplitude of angular undulation (AAU) and RAD% were lower, and the LONG% and orientation (OI) were higher in BAV compared to TAV ATAA (Fig. 1), indicating that elastin fibers in this plane and region of BAV ATAA are less wavy and more aligned in LONG direction. Fibers were more aligned in LONG axis with increasing age (data not shown).

Discussion
The results agree with [Tsamis, 2012], where fibers in the medial-intimal half were less undulated about LONG axis in BAV than TAV ATAA. Spatial differences in medial micro-architecture of BAV ATAA may depend on age and contribute to reduced delamination strength or initiation of dissection in ATAA.

References
Tsamis et al, BMES 2012.