

# Transmural Changes in Fibre Helix Angle in Normal and Failing Canine Ventricles

Richard Clayton\*, Samia Abdalhamid, Ryan Bloor, Kanna Kotagiri, Georgios Kyprianou, Jaeson Lee, Amruta Mane and Robert White

Department of Computer Science, University of Sheffield, Sheffield, United Kingdom

**BACKGROUND:** Ventricular myocytes are arranged in fibres, and it is well known that the fibre orientation relative to the base-apex axis (the helix angle) varies across the ventricular wall. Fibre orientation is important for propagation of the action potential, and for mechanics. Diffusion tensor MRI (DT-MRI) images fibre orientation in the heart, and the aim of this study was to examine transmural helix angle in a group of normal and failing canine hearts imaged using DT-MRI by Patrick Helm and colleagues at Johns Hopkins University. **METHODS:** We included DT-MRI images of 6 normal canine hearts, and 4 canines with heart failure. We examined transverse slices close to the base, midway between apex and base, and close to the apex. In each slice we measured the helix angle at locations in the left ventricular (LV) free wall, the septum, and the right ventricular (RV) free wall. **RESULTS:** In the normal hearts, the helix angle across the LV free wall and septum changed smoothly from between 50 and 60 degrees in the epicardial layer (RV endocardium in the septum) to between -50 and -60 degrees in the LV endocardial layer. However, close to the epicardium and within an endocardial layer around 3 mm thick we observed abrupt changes in helix angle. Close to the insertion of the RV and the septum, fibre orientation was much more variable. In the failing hearts, the change in helix angle across the LV and RV free walls as well as the septum was much less well defined. **CONCLUSION:** The transmural change in helix angle is often characterised as smooth, with a total rotation of 120 degrees. Our findings are consistent with this, but show that the helix angle is more variable close to the ventricular endocardium, at the insertion of the RV, and in failing hearts.