

Intravascular Ultrasound and Magnetic Resonance Imaging of  
Atherosclerosis and Assessment of Endothelial Function

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**THESIS RELATED ABSTRACTS**

**Frost L**, Richardson J, Carbone A, Puri R, Nelson A, Sidhartha S, Worthley M, Worthley S. Geometric Accuracy of Mechanical and Phased-Array Intravascular Ultrasound Catheters: A Phantom Study. *60<sup>th</sup> Scientific Sessions of the Cardiac Society of Australia and New Zealand*. Brisbane 2012. <http://dx.doi.org/10.1016/j.hlc.2012.05.510>

**Frost L**, Richardson J, Carbone A, Bertaso A, Puri R, Nelson A, Sidhartha S, Worthley M, Worthley S. Rabbit Aortic Vasodilation Assessment by 1.5T Magnetic Resonance Imaging and Intravascular Ultrasound. *60<sup>th</sup> Scientific Sessions of the Cardiac Society of Australia and New Zealand*. Brisbane 2012. <http://dx.doi.org/10.1016/j.hlc.2012.05.587>

**Frost L**, Richardson J, Carbone A, Worthley M, Worthley S. Progressive Endothelial Dysfunction is Related to Plaque Burden in an Experimental Model of Atherosclerosis. *University of Adelaide, Faculty of Health Science Postgraduate Research Conference* (2013).

Sidhartha S, Puri R, **Frost L**, Kataoka Y, Carbone A, Willoughby S, Nelson A, Nicholls S, Worthley S, Worthley M. The Impact of Lumen Size and Microvascular Resistance on Fourier-Domain Optical Coherence Tomography (FD-OCT) Coronary Measurements. *International Journal of Cardiology*. (2014) 174:210-211

**Frost L**, Carbone A, Worthley M, Worthely S. In-vivo and In-vitro Variability in Cross Sectional Measurements with IVUS Catheters. *University of Adelaide, Faculty of Health Science Postgraduate Research Conference* (2014).

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**COMMON ABBREVIATIONS**

<b>ACh</b>	Acetylcholine
<b>CAD</b>	Coronary Artery Disease
<b>CSA</b>	Cross Sectional Area
<b>CVD</b>	Cardiovascular Disease
<b>ECG</b>	Electrocardiogram
<b>ED</b>	End Diastole
<b>EEM</b>	External Elastic Membrane
<b>eNOS</b>	Endothelial Nitric Oxide Synthase
<b>FLASH</b>	Fast Low Angle Shot
<b>FOV</b>	Field of View
<b>GTN</b>	Glyceryl Trinitrate
<b>ICC</b>	Intra Class Coefficient
<b>IVUS</b>	Intravascular Ultrasound
<b>MHz</b>	Megahertz
<b>MIP</b>	Maximum Intensity Projection
<b>MRI/MR</b>	Magnetic Resonance Imaging/Magnetic Resonance
<b>NC</b>	Necrotic Core
<b>NO</b>	Nitric Oxide



<b>NURD</b>	Non Uniform Rotational Distortion
<b>NZW</b>	New Zealand White
<b>PAV</b>	Percentage Atheroma Volume
<b>PDW</b>	Proton Density Weighted
<b>RF</b>	Radio Frequency
<b>ROI</b>	Region of Interest
<b>SNR</b>	Signal to Noise Ration
<b>T</b>	Tesla
<b>TCFA</b>	Thin-Cap Fibroatheroma
<b>TM</b>	Tissue Map
<b>TOF</b>	Time of Flight
<b>VH</b>	Virtual Histology
<b>VSM</b>	Vascular Smooth Muscle
<b>VWA</b>	Vessel Wall Area

## **THESIS SYNOPSIS**

In this thesis we aimed to investigate the application of IVUS and MRI in assessing plaque and endothelial function in the experimental rabbit model of atherosclerosis.

The first experimental chapter focussed on validating the accuracy and reproducibility of mechanical and phased-array IVUS catheter designs in an in-vivo and ex-vivo setting.

The second experimental chapter sought to investigate the plaque characterisation technologies of iMAP and VH-IVUS. This was the first time that the two systems had been compared head to head in the experimental rabbit model. The results provided significant and systematic variability in plaque composition analysis with both systems.

The third experimental chapter describes an in-vivo investigation between serial endothelial function and vascular remodelling. We have documented that progressive endothelial dysfunction occurs with increasing plaque burden and observed that vascular remodelling in the rabbit experimental model occurs in a way analogous to clinical positive remodelling.

In the fourth experimental chapter we described a novel MRI application for the assessment of endothelial function. The MRI endothelial function results were compared against those obtained using IVUS. We have shown MRI to be a viable non-invasive modality for assessing luminal CSA changes in very small calibre vessels in response to vasoactive drugs.

The final experimental chapter describes the comparison between MRI and IVUS serial quantifying plaque burden. We concluded that MRI is a feasible non-invasive alternative for imaging atherosclerosis in the experimental rabbit model.