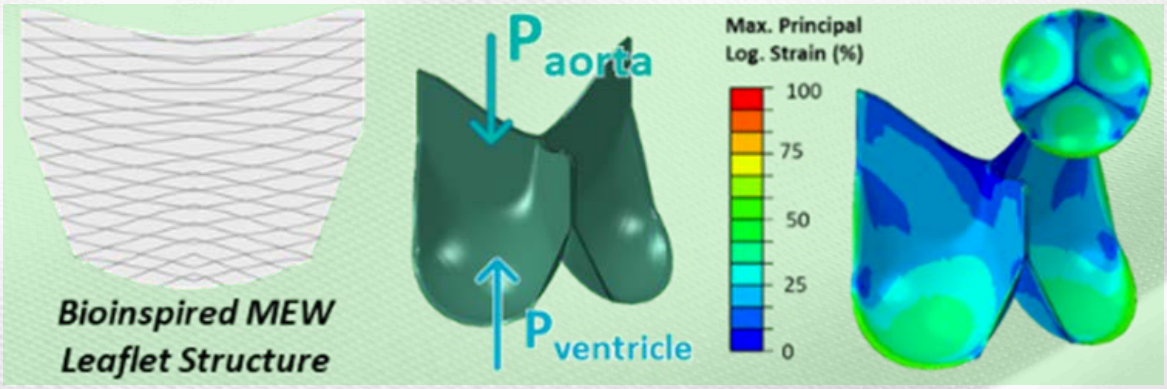
Aortic stenosis (AS) affects about 4% of people over 70 and has a 50% chance of mortality within 2 years when left untreated. Bioprosthetic heart valves are used to treat AS and can be delivered through minimally invasive surgery but their lifespan is often compromised by the long-term performance of the heart valve leaflet material. This is due to both structural damage and/or calcification in the leaflets.

Prof. Lally's research group has been working with Boston Scientific in Galway for nearly a decade to better understand the mechanisms of structural damage and calcification in bovine and porcine pericardium, the main materials used in commercial bioprosthetic heart valve leaflets. To-date this industry-academic collaboration has co-funded three Research Ireland PhD students, two postdoctoral positions and a research assistant position. Using experimental and computational approaches, the research work has identified the complex relationship between leaflet material damage and calcification and established a non-destructive laser-based method of screening these leaflet materials to improve their long-term performance.

Boston Scientific Aortic Heart Valve

In addition, Prof. Lally and her team have developed a novel in-silico framework for creating 3D-printed, bioinspired polymer leaflets with a composite fibre-embedded structure which have the potential to have superior durability to pericardial leaflets. Informed by imaging and mechanical characterisation of native porcine aortic leaflets, they have created a novel preclinical design tool to inform and optimise material selection and leaflet structure for different valve leaflet shapes and varying clinical cases. This work has the potential to inform the design of bioinspired polymer heart valves that can outperform current commercial devices and improve patient outcomes.



Computational models of fibre embedded bioinspired polymeric heart valve leaflets to establish the optimum fibre structure to be printed using melt electrowriting (MEW) 3D printing techniques

This collaboration with Boston Scientific in Galway has also resulted in a new collaboration with Boston Scientific in Clonmel supported by the SFI AMBER centre, with the aim of creating in-silico and bench-top models for the design and optimisation of a suite of 'smart' urological medical devices. To-date, Boston Scientific co-funding to Prof Lally's group has generated over €2 million in direct funding.