UFS unveils polyurethane heart valve prototype

Apart from the difficulties in preventing and treating rheumatic fever in Africa, limited access to interventions, such as heart-valve replacement, remain a major challenge on the continent.

With over 1m cases of rheumatic heart disease in sub-Saharan Africa compared with 176,000 in China, 136,000 in Latin America, and only 33,000 in the industrialised world, the continent can be compared only with South and Central Asia with an estimate 736,000 cases, according to the World Heart Foundation.

In the developing world, there's the dilemma that younger patients requiring heart valve replacement have a choice between a mechanical valve, requiring lifelong anti-coagulation therapy, and a biological valve (not requiring anti-coagulation), that degenerates and calcifies fairly quickly in patients under the age of 65 years.

Further, heart valve development is focused mainly on treating valvular disease in the elderly population with non-rheumatic valvular disease in the Industrialised world.

As an alternative, the Robert W M Frater Cardiovascular Research Centre in the department of cardiothoracic surgery, at the University of the Free State (UFS), School of Medicine, has developed a polyurethane heart valve. These valves do not require anticoagulation and might be an ideal solution for the young African patient.

This project was initiated by Professor Francis Smit and now includes close collaboration with the Centre for Rapid Prototyping and Manufacturing (CRPM) of the Central University of Technology (CUT) for manufacturing, and lately with the University of Stellenbosch, mechanical engineering department, focusing on computational fluid dynamics and solid mechanics modelling.

The valve has a titanium frame which is 3-D printed by the CRPM and then dip moulded using locally designed moulds and an automated dip moulding process developed at the CUT.

“Our five-year plan is to deliver a service to our community through manufacturing of implantable patient-specific prostheses as requested by medical practitioners,” says Gerrie Booysen, director of the CRPM.

The department will soon proceed with further benchmark testing required for FDA and CE mark registration, including strength testing and ultra-structure evaluation of the polyurethane leaflets.Using sophisticated pulse duplication and fatigue testing, valve design can be evaluated and modified before final testing in the large animal unit. The UFS and CUT received a Technology Innovation Agency (TIA) grant to support this development.

Smit has described the venture as the beginning of an exciting phase of collaborative development between the UFS, CUT, and Stellenbosch University. Animal testing will commence in 2017.