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GEOMETRICAL DESIGN AND FINITE ELEMENT ANALYSIS ON THE BIOPROSTHETIC HEART VALVE

Quan Yuan, Chengrui Zhang and Xiaowei Wang

School of Mechanical Engineering
Shandong University
Jinan 250061, P. R. China
yuanquan66@sdu.edu.cn

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Abstract. *To maximally reach the function of a human being's heart valve, the geometrical design on the bioprosthetic heart valve was carried out and the stress distribution of leaflets with different shapes was analyzed based on the Membrane theory and finite element analysis. After constructing parametric models of bioprosthetic heart valves via computer aided design, a series of accurate dimension parameters are obtained. The experimental result via the finite element analysis is consistent with the theoretical result for the loaded leaflets with different shapes. It is showed that the stress distribution of the spherical valve leaflets is comparatively reasonable. Spherical valve leaflets have some advantages over cylindrical valves leaflets: the position of the peak stress of spherical valve leaflets is comparatively far from seam position, and the maximal primary stress of spherical valve leaflets is less than that of the cylindrical valve leaflets. While the cylindrical valve leaflets have the following disadvantages: there exists obvious stress concentration and the stress distribution within the whole component is not uniform. Therefore, mechanical properties of spherical valve leaflets are superior to those of cylindrical valve leaflets. The present result provides a theoretical guide and useful information for the bioprosthetic-heart-valve designer.*

Keywords: Membrane theory, Finite element analysis, Bioprosthetic heart valve

1. **Introduction.** Bioprosthetic heart valve consists of valvular leaflets, supporting stent and sutural ring. The main objective for the bioprosthetic heart valve designer and manufacturers is to improve its long-term durability, which is closely associated with the geometrical design. Valvular leaflets made with polymer materials of porcine or bovine pericardial can be opened or closed by ejected blood [1-3]. The supporting stent acts not only as a configuration functional part but also as a component to support and bear forces. The flow field of a bioprosthetic heart valve is similar to that of the human heart valve. Its flow pattern is central-like. Although its function is improved in antihemolysis and antithrombotic, the efficiency in device design of the bioprosthetic heart valve is still not satisfied [4-7].

According to Membrane theories, we construct the geometrical parametric model of bioprosthetic heart valve to approach or attain the function of the natural heart valves of a human body using the CAD/CAM/CAE integration software-Pro/ENGINEER. Combining traditional design theories and modern design methods, we create the cylinder, sphere curved surfaces in accordance with the geometrical equations in the appropriate