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STRESS ANALYSIS AND UNFOLDED ALGORITHM OF THE BIOPROSTHETIC HEART VALVE

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Abstract. *This paper establishes parametric model of the biopresthetic heart valve via computer aided design. A series of accurate parameters of the biopresthetic heart valve, such as radius of the sutural ring, height of the supporting stent and inclination of the supporting stent are determined. The finite element analysis results show that the stress distribution of cylindrical and paraboloidal valve leaflets is quite different during the diastole period. The stress distribution of cylindrical and paraboloidal valve leaflets under the same load is analyzed as the leaflets are closed. Both the maximal primary stress of the two curved surface sorts appear on the bind area. Paraboloidal valve leaflets have the following advantages over cylindrical valves leaflets: the peak stress area of paraboloidal valve leaflets is comparatively far from seam position, the maximal primary stress of paraboloidal valve leaflets is lower than that of cylindrical valve leaflets. The unfolded algorithm on the paraboloidal valve leaflets is discussed in detail. The applied programs of the unfolded paraboloidal valve leaflets are designed based on finite element analysis. This work is very helpful to manufacture reasonable shaped valvular leaflets and to prolong the lifetime of the bioprosthetic heart valve.*
Keywords: Finite element analysis, Bioprosthetic heart valve, Unfolded algorithm

1. **Introduction.** Bioprosthetic heart valve consists of valvular leaflets, supporting stent and sutural ring. The flow field of bioprosthetic heart valve is similar to that of the human heart valve. Its flow pattern is central-like. The valve design must meet three basic requirements

(1) Three leaflets intersect with the root of the aortic at the lines which divide the circle into three equal parts.
(2) There should be no leak when the vavles close.
(3) Projecting the free edge of valve leaflets at the normal direction, the sum area should be larger than that of the sutural ring at least [1-3].

Based on three basic requirements, we create the cylindrical, praboloidical curved surfaces and conical curved surfaces which satisfy the actual condition. A series of accurate parameters of the biopresthetic heart valve, such as radius of the sutural ring, height of the supporting stent and inclination of the supporting stent, are determined. The stress distribution of cylindrical and paraboloidal valve leaflets under the same load is analyzed and compared as the leaflets are closed. The unfolded algorithm on the paraboloidal valve leaflets is discussed in detail. The applied programs of the unfolded paraboloidal valve leaflets are designed based on above finite element analysis. This work could provide direct and useful information for the bioprosthetic-heart-valve designer.