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Virtual Implantation of Stent-graft by Finite Element Simulation and Its Applications in Endovascular Treatment Planning for B Type Aortic Dissection

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Abstract: Thoracic endovascular aortic repair has been widely applied to treat Stanford Type B aortic dissection. However, retrograde type A dissection can occur as a complication after thoracic endovascular repair for Stanford type B aortic dissection. In order to investigated the possible mechanical reasons of the new entry occurring when stent grafts were implanted into the true lumen of one type B aortic dissection, a framework of virtual implantation of stent-graft by using finite element simulations was developed in this paper. The animal experiments were adopted to verify the finite element simulation of stent-graft implantation. Moreover, the manufactured stent-grafts were implanted virtually into the true lumen of the model of patient-specific aortic dissection with difference configurations such as oversizing ratio, anchoring position, stent struct. The following conclusions are summarized: (a) the radial force plays a more dominant role than the elastic recoil support in the deployed stent-graft. Excessive oversizing ratio may lead to the insufficient expansion of stent graft and retrograde aortic dissection; (b) the anchoring position of the stent-graft has a clear effect on the stress of the aorta, and the bare stent and thinner nickel-titanium alloy ring generate the higher stress at the aorta wall; (c) Comparing the three manufactured stent-grafts: Talent, Valiant and cTag, the later two have the better deployed geometries and better adherence to the artery wall.

Keywords: Aortic dissection; thoracic endovascular aortic repair; stent-graft; finite element simulation; endovascular treatment planning

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