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Finite Element Analysis and Design Optimization of Stent and Balloon System

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Abstract : Stent implantation is being seen as the most successful method to treat coronary artery diseases. Different types of stents are available in the market these days and the success of a stent implantation greatly depends on the proper selection of a suitable stent for a patient. Computer numerical simulation is the cost effective way to choose the compatible stent. Studies confirm that the design characteristics of stent do have great importance with regards to the pressure it can sustain, the maximum displacement it can produce, the developed stress concentration and so on. In this paper different designs of stent were analyzed together with balloon to optimize the stent and balloon system. Commercially available stent Palmaz-Schatz has been selected for analysis. Abaqus software is used to simulate the system. This work is the finite element analysis of the artery stent implant to find out the design factors affecting the stress and strain. The work consists of two phases. In the first phase, stress distribution of three models were compared - stent without balloon, stent with balloon of equal length and stent with balloon of extra length than stent. In second phase, three different design models of Palmaz-Schatz stent were compared by keeping the balloon length constant. The results obtained from analysis shows that, the design of the strut have strong effect on the stress distribution. A design with chamfered slots found better results. The length of the balloon also has influence on stress concentration of the stent. Increase in length of the balloon will reduce stress, but will increase dog boning effect.

Keywords : coronary stent, finite element analysis, restenosis, stress concentration
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