MCB, vol. 16, supplemental 1, pp.53, 2019

Mechanical Analysis of a Novel Biodegradable Zinc Alloy Stent Based on Degradation Model

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Abstract: Biodegradable stents which can avoid risks caused by incompatibility between artery and permanent stents are attracting much interests. However, biodegradable stents have not been extensively applied in clinical therapy because of their insufficient scaffold performance as a result of poor Young's Modulus of biodegradable materials and weaken structures in degradation process. In this study, a patented stent and a common stent were simulated to degrade in a 40% stenotic vesel based on a corrosion model involving uniform corrosion and stress corrosion. In the degradation process, the scaffold performance of the two stents and their functionality on reshaping diseased vessels are analyzed. The results showed that radial recoiling ratio and mass loss ratio of the common stent is 22.6% and 14.1%, respectively. In comparison, radial recoiling ratio and mass loss ratio of the common stent are definitely lower than those of the common stent, at the value of 7.19% and 3.1%. It is indicated that the patented stent still has a stronger scaffold performance compared with the common stent. Besides, with positive influence of the patented stent on stenotic vessel, a larger and flatter lumen was observed in the plaque deployed with the patented stent. It implies that mechanical performance of biodegradable stents and their functionality highly depend on their geometries. Owing to improved mechanical performance induced by structural innovation, the novel biodegradable zinc alloy stent is promised to be an alternative choice in intervention surgeries.

Keywords: Biodegradable stent, stent design, finite element analysis, corrosion.

Acknowledgement: This work was supported by Major Project of Science and Technology of Beijing Municipal Education Commission and Type B Project of Natural Science Foundation of Beijing (KZ200710005007).

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