Effect of Material Properties on the Mechanical Performance of Nitinol Esophageal stent: Finite Element Analysis

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Stent placement has been a main approach to solve gastrointestinal diseases during past decade. Nitinol superelastic stents has been considered a solution to such difficulties as restenosis after implantation, low twisting ability, inadequate radial mechanical strength and inappropriate dynamic behaviors associated with the ducts. In this paper, effects of A_f temperatures on mechanical performance of z-shaped Nitinol wire stent under crimping test for clinical applications are investigated by finite element simulation. With 60 % crimping, high radial resistive strength, favorable superelastic behaviors are attained at A_f temperature of 22°C. Performance of the stent is seen to drastically different with a merely change of 1° in the segments angle.

Keywords: Finite Element Analysis, Material Properties, Mechanical Performance, Nitinol Stent, Esophageal

1. INTRODUCTION

Gastrointestinal disease is a main cause of death these days [1]. Esophageal cancer is a worldwide source of gastrointestinal malignancies [1-2]. Stent placement has been a major approach to solve gastrointestinal diseases like esophageal malignancy during past decade. Application of stent has two main objectives: (1) short-term effect by avoiding intimal dissection and the elastic recoil and (2) long-term effect by avoiding restenosis owing to the neointimal hyperplasia [3-4].Nitinol stent placements have been developed as a behavioral modality for palliation of malignant dysphagia. Nitinol stents for esophageal duct are easily implanted with low risk of severe complication. Nitinol superelastic stents has been considered a solution to such problems as restenosis after implantation, low twisting ability, unsatisfactory radial mechanical strength and improper dynamic behaviors associated with the ducts. Because of good retrievability and flexibility, z-shaped wire stents are most widely used in stent designs [3-4]. They can be used to fabricate custom stents of preselected values exerting radial forces of clinical need. Z-shape models are also advantageous due to their easy manufacturing even in laboratory by hand. They permit various designs with different amounts of radial forces [5]. Important parameters like length, wire diameter, stent inner diameter, number of bends, segments angle and radial con-

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