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TRACHEOBRONCHIAL STENTS PERFORMANCE ANALYSIS

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Summary: Tracheomalacia is a disease characterized by flaccidity of the supporting tracheal cartilage, and consequentially by a stenosis, or a tracheal collapse when respiratory volume increases, for instance with cough. With a large stenosis, patient could have breath and eating problems. Tracheal cancer and traumatic lesions, could also lead to stenosis. Tracheobronchial stents are a common procedure in patients with tracheomalacia. However, silicone stents have some performance limitations related with implant migration, development of granulation tissue and accumulation of secretions. On the other hand, implant performance is strongly related with stent geometry and its accommodation with the patient. Additionally, this accommodation is also related with studs geometry, position and number. In fact, different studs are used by manufacturers, but stent performance limitations still persist. In order to study stents performance, a comparative finite element analysis was performed. Granulation tissue formation is related with contact stresses between stent and tissue, migration is related with interface movements. So, swallowing simulations is performed, since this complex movement in the digestive system also creates a complex adaptation on tracheal tree. This analysis is computational complex, due to significant displacements and due to tracheal properties. In fact, airway cartilage rings, annular ligaments and muscle membranes should be considered, however, the analysis complexity increases. To reduce computational time and complexity, equivalent material properties were obtained with homogenization method. Consequently, two sections were considered, a proximal part with more cartilage and less ligaments and the rest with annular ligaments and cartilage rings. Results showed that granulation tissue formation and stent migration depend on studs' geometry and number. So, the optimum performance is difficult to achieve, but a multi-criteria optimization procedure could be a good approach in order to develop new stud designs.