Abstract

NanoCT for the characterization of degradable vascular grafts

Degradation patterns of small-diameter polycarbonate urethane grafts (PCU) are poorly understood and difficult to quantify or even monitor during the process of degradation. Currently, quantitative characterization is mainly performed on 2D histology specimens following explantation of degraded grafts. We investigated the feasibility of using micro/nano computed tomography (μCT/nanoCT) along with computational image analysis to perform quantitative 3D polymer graft degradation analysis on infrarenal aortic graft specimens explanted after 12 months of degradation from nine Sprague-Dawley rats. μCT/nanoCT is a viable method for 3D polymer graft characterization and the application of contrast agent significantly improved discrimination between pore and graft material, thereby facilitated segmentation. We further explored the use of high-resolution episcopic microscopy (HREM) as a means to validate μCT/nanoCT results. HREM produced high resolution images and gave additional information on fiber distribution, but the specimen processing led to an inconsistent geometry and shrinkage making a co-registration of both imaging methods extremely difficult and inconsistent. Histological assessment underestimated graft degradation in comparison to 3D μCT/nanoCT evaluation. The establishment of our protocol led to a successful 3D degradation assessment of small-diameter PCU grafts by μCT/nanoCT, although further work is required to standardize the imaging protocol and algorithms for automatized analysis.

M. Eilenberg et al.