The overall objective of this research program is to develop novel methods for measuring 3D blood flow dynamics in vivo, and to use these methods to explore relationships between flow parameters and the progression of atherosclerosis in clinical populations. The primary objective of this pilot study is to apply a novel MRI-based flow imaging method, that we have recently developed at USC, to patients with advanced carotid atherosclerosis and to characterize its advantages, opportunities for technical improvement, and limitations. The key components of the research design are 1) the application of novel MRI-based techniques along with conventional techniques to patients from the AIMHIGH multi-center trial (USC PI: Colletti), 2) a retrospective analysis of scan acceleration techniques, spatial resolution requirements, and image artifacts using sub-sampled versions of the acquired raw-data, and 3) the examination of automatic segmentation and processing approaches. This project mirrors the objectives of the CTSI pilot study program, in that it will translate an engineering innovation to a clinical population, is based on an interdisciplinary approach from investigators in the Viterbi School of Engineering and the Keck School of Medicine, and will provide necessary seed data for subsequent hypothesis-driven clinical studies of the relationship between blood flow patterns and the formation and growth of atherosclerotic plaques.