

**Title: Investigating the Clinical Utility of 3-D Printed Models of Arterial Pathology****Authors:** Andrew H. Schulick, MD\*, and Devika Singh**Background:**

Treatment of arterial aneurysms and stenoses is increasingly performed through minimally invasive, endovascular approaches, which can be complex and time consuming. This study investigates the utility of 3-D printing technology in producing models of patient-specific vascular pathology, for use in pre-operative planning and simulation. Patient specific modeling of arterial aneurysms and arterial stenoses will add valuable insight to pre-procedural care. By literally being able to perform procedures ex-vivo, modeling will allow for advanced selection of optimal endovascular tools, including shaped catheters, balloons, wires, and stents.

**Aim:**

Specific objectives of the study include: 1) Creating models of arterial pathology using 3-D printing technology; 2) simulating in vivo conditions using a fluid environment (ultimately a flow pump); 3) performing procedures on the 3-D printed models, and assessing the technical success and visualization afforded by the materials used.

**Methods:**

A 3-D printed model of an aortic aneurysm including an iliac artery stenosis was created with patient specific computed tomography data using the Mimics Innovation Suite software. The initial model for proof of concept studies was created from transparent Tusk stereolithography, a rigid resin-based material. Initial simulated procedures were performed in a non-flow environment.

**Results:**

Simulations of angioplasty and stenting procedures were uniformly technically successful. Specifically, visualization of endovascular devices used on the transparent 3-D models was better than anticipated.

**Conclusions:**

This pilot study demonstrates that 3-D models of vascular pathology can be used for planning and simulation of endovascular procedures.

Next steps include refining the models to more closely approximate in vivo conditions. The insights gained from simulating procedures ex-vivo will then be correlated with the actual in vivo procedures, and the time and cost savings of pre-operative modeling will be assessed. By allowing for pre-procedural practice, we anticipate that operative times, as well as material costs will be reduced, and as a result, patient safety will be enhanced. Further, 3-D models will assist in pre-procedural counseling of patients and resident training. To allow multiple use and cost savings, subsequent models will be printed in a modular fashion, using a Tusk base, with Heart Print flex (a compliant material) inserts at the sites of pathology.

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