

## **Effect of Microcatheter Size and Wire-Guidance on Clot Fragmentation During Mechanical Thrombectomy**

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**Introduction:** For stent retriever thrombectomy, guidewires and microcatheters are used to access the clot before stent deployment. The interaction of endovascular devices and the clot can produce complications, i.e. clot fragmentation, compression, and embolus creation. We developed a simulation technique to study this phenomenon.

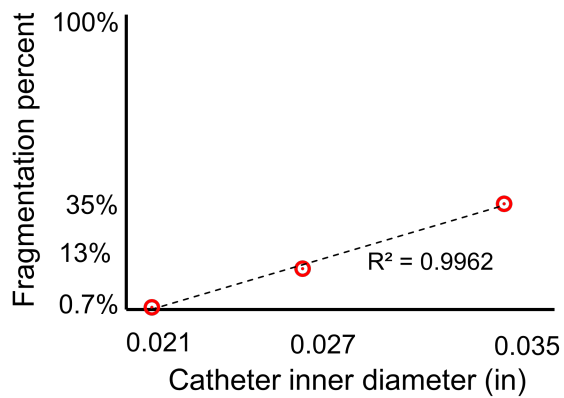
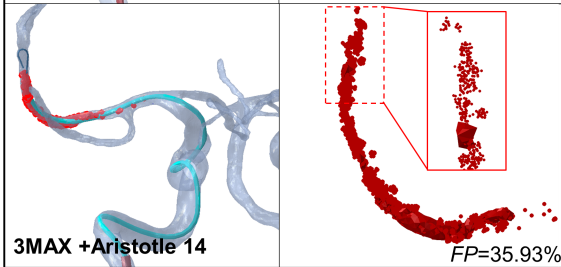
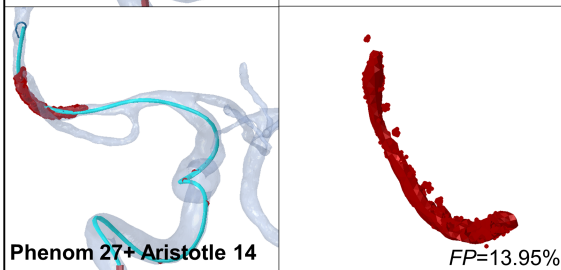
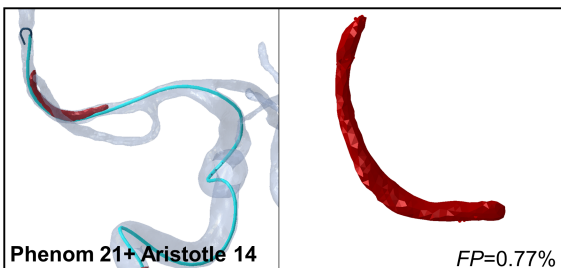
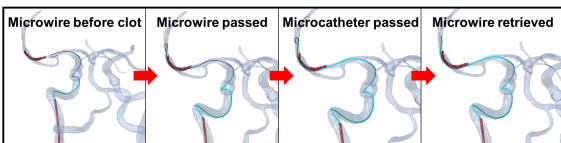
**Hypothesis:** Use of a guidewire and smaller microcatheters is associated with reduced embolus generation.

**Methods:** Six strategies (3 microcatheter sizes, with and without guidewire) were simulated using a hybrid finite element analysis (FEA) and smoothed particle hydrodynamics (SPH) technique. For wire-guided cases, we modeled the Aristotle 14 guidewire. For microcatheters, we modeled Medtronic's Phenom 21 and 27 (diameters of 0.021" and 0.027") and Penumbra's 3MAX (diameter=0.035"). Microcatheters were given a multilayer structure with Timoshenko beam elements that had modified elastic and shear modulus values. Shell elements with polymer material properties and bar reinforcements (stainless steel properties) were implemented. Each strategy was modeled in an M1 stroke case (with a 17 mm clot), which was reconstructed from CT images. Vessel walls were assumed to be rigid and the clot was modeled as a soft red blood cell-dominant tissue using the Ogden hyperelastic model. The fragmentation percentage (FP) of the clot was quantified based on the ratio of converted to non-converted elements in the FEA-SPH method.

**Results:** On average, higher fragmentation was observed in cases without a guidewire vs. with a guidewire (23.44% vs. 16.88%). Regardless of wire use, increasing microcatheter diameter was related to greater fragmentation. Emboli were created in 3 cases, including both uses of the 3MAX catheter and the Phenom 27 without a guidewire.

**Conclusion:** In our data, the use of a guidewire and the smallest diameter was associated with the least clot fragmentation. In the future, large *in silico* thrombectomy trials could help identify optimal endovascular strategies for ischemic stroke.

## Microwire-Guided Deployment



## Microcatheter-Only Deployment

