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► To cite this version:

Paolo Machi, Dominique Ambard, Cédric Reynaud, Vincent Costalat, Franck Jourdan. In-vitro testing of stent retrievers for cerebral thrombi removal. 22nd Congress of the European Society of Biomechanics, Jun 2016, Lyon, France. hal-01368841

HAL Id: hal-01368841

<https://hal.science/hal-01368841>

Submitted on 20 Sep 2016

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IN-VITRO TESTING OF STENT RETRIEVERS FOR CEREBRAL THROMBI REMOVAL

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Background and purpose:

Recent articles appeared in literature [1-2] demonstrated that early mechanical thrombectomy offered to patients presenting with acute ischemic stroke is related to improved functional outcome. Stent retrievers (STR) are recognized as the most effective devices for intracranial thrombectomy. In the present study we experimentally analyzed devices mechanical properties, behavior during retrieval and their interaction with clots of different features. The aim of this study was to identify any device feature that was functional to the thrombus removal.

Materials and Methods:

All stent-retriever devices available in the French market up to Juin 2015 were evaluated by mechanical and functional tests aimed to investigate the variation of their radial pressure and their behavior during retrieval. Devices were also tested by in-vitro thrombectomies using white and red experimental thrombi produced with human blood. Functional tests and in-vitro thrombectomies were conducted using a rigid 3D printed vascular model.

Two types of mechanical tests were performed in order to investigate devices radial pressures. Such tests were aimed to measure the force exerted by the stent in two specific conditions: upon deployment and during the retrieval.

Flat plate compression test

This test measured the STR outward radial force density. It corresponds to the force exerted by the device against a plane surface during compression. Tests were performed with a tensile test machine.

Pull up traction test

This test was aimed to evaluate how the outward radial pressure exerted by the STRs

varied during retrieval along tubes of different diameters. The device was deployed within a silicone tube maintained by a rigid scaffold and the push wire was connected to the traction transducer arm of a tensile test machine. The radial pressure exerted by the STR on the silicone pipe was calculated considering the contact pressure.

Retrieving test

This test was conceived to visual evaluate the STR's ability in remaining in close apposition to the vessels wall during the retrieval. Tests were performed using a rigid 3D printed vascular model reproducing the brain anterior circulation.

In vitro thrombectomies

This test was aimed to visually evaluate the STR's ability in maintaining the thrombus engaged within its struts during the retrieval. In order to identify any difference in STR's behavior when interacting with thrombi of different features [3], red and white artificial thrombi were employed.

Results and Conclusions:

Mechanical tests showed different behavior in terms of radial pressure variation during retrieval for each stents. Constant radial pressure during retrieval was related to constant cohesion over the vessel wall during retrieval and higher rate of clot removal efficacy. All stent retrievers slide over the clot failing in clot removal when interact with white large thrombi (diameter ≥ 6 mm).

References

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