# *Thrombectomy technique choices*

***Prof. Paolo Machi***
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**Prof. Paolo Machi speaks to Oruen for this expert interview.**

Prof. Paolo Machi is the head of the interventional neuroradiology unit of the university hospital of Geneva (Switzerland) and professor of interventional neuroradiology at the faculty of medicine of the Geneva University.

He has been trained in interventional neuroradiology by Professor Bonafé in Montpellier (France) where he was fellow in 2008 and staff member between 2009 and 2015.

In 2016 he obtained a doctorate (Ph.D.) in mechanical engineering at the University of Montpellier with a thesis focused on the experimental evaluation of stent retrievers' mechanical properties and effectiveness.

At present, he leads a research group based at Campus Biothec (Geneva) granted by the Swiss National Science Foundation focused on the development of a robotic arm conceived to assist the operator during mechanical thrombectomy procedures. The group is also focused on the mechanical evaluation of endovascular devices conceived to treat ischemic and haemorrhagic stroke and on the applications of the artificial intelligence in neurointervention.

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**Q1. Which thrombectomy technique do you use as a first line?**

This is a great question; in my practice this is related to the clot location. When I treat a proximal occlusion, such as a proximal middle cerebral artery (M1) occlusion, I try to understand if the clot is located in a straight portion of the vessel. In this case the aspiration catheter would potentially have a coaxial interaction with the clot, and we know according to clinical and experimental findings, that in such a situation, the direct clot aspiration could be highly effective. Unfortunately, in presence of a coaxial interaction between the catheter and the clot, direct clot aspiration is not always effective, in such instances we have to increase the faculties of the procedure by adding a stent retriever. For example, the very first portion of the MCA is often straight especially in the younger patients and so we know even from the literature that thrombus aspiration is very effective in such location. The same is for the basilar artery, which is commonly a straight artery, so we try to aspirate the clot as a first approach.

So, thrombus aspiration is my favourite approach when I can predict in a reasonable way that the interaction between the catheter and the clot will be effective meaning that that angulation within the catheter and the clot is straight angled. Conversely, if I can predict that there will be an acute angle between the aspiration catheter and the clot, I prefer to go for a stent retriever technique as a front-line approach, because I know that a stent retriever is more effective in that situation.

In a specific situation which is the occlusion of the carotid termination, I use the stent retriever in association with a balloon guide catheter, without using any aspiration catheter. In this case the occlusion is due to the presence of a large stiff clot and so I use the balloon guide catheter in association with a large stent retriever used to detach the clot from the vessel wall.

**Q2. Are there any differences between the different stent retrievers?**

A few years ago, I conducted an experimental study to evaluate the difference between different type of stent retrievers. One of the aims of the study was to evaluate the radial force of the stents, we had the idea that the radial force was related to the clot removal efficacy. In particular we had hypothesized that the clot removal efficacy was related to the capacity of the stent to maintain a constant radial force during retrieval within vessels of different diameters. We were able to demonstrate such relation and we found that such constant radial force was more frequent for open section stent retrievers. We mainly have two types of stent retrievers: the "open section" stent retrievers and the "closed section" stent retrievers. The open section are stents like the Solitaire (Medtronic), that you can unfold like a leaf, while the closed section stents are not foldable and one example of this is the Trevo (Stryker). Open section stent retrievers tend to maintain a constant radial force against the vessel wall along the retrieval and such features give them a longer and more effective interaction with the clot. Then the other factor to take into account when we think of the interaction between the stent and the clot is the size of the stent retriever, if we aim to treat a M2 or M3 occlusion, we tend to use a low profile stent retriever which are 3mm in diameter and they have very low radial force; this is because we know that we are treating very fragile vessels and we do not want to have any ruptures or dissection, therefore, it makes sense to use a little stent which is still very effective in removing the clot especially if used in combination with an aspiration catheters.

On the other hand, if we are treating a carotid termination occlusion, we prefer to have a large and long stent retriever because we want to ensure that the interaction between the stent and the clot will be as long as possible to get all opportunities to get the clot out from the patient's body.

**Q3. Are there any differences between the aspiration catheters?**

We have different components and different parts in making a catheter in general and a different part making a catheter stable, especially in the presence of a tortuous anatomy but at the same time trackable and able to navigate through the brain vessels up to the clot. Nowadays we have several manufacturers in the aspiration catheter market. It was not the case 4 or 5 years ago, at that time, catheters with such technology and such performance were not available.

**Q4. When do you use combined techniques, and what is your algorithm?**

Overall, I try to start if I can predict a favorable angle of interaction between the catheter and the clot with thrombus aspiration as a front-line technique, if it is not effective, I add a stent retriever and once I already have an aspiration catheter in place, I usually don't retrieve it, but I use it. So, in this case I perform a combine technique as a rescue treatment.

Another scenario in which I use the combined technique as a front-line approach is in case of distal occlusion such as M2 or M3; in such cases I use a low-profile stent retriever in association with an aspiration catheter that I usually keep in the proximal portion of the MCA. Hence, I use the low-profile stent retriever just to bring the clot closer to the aspiration catheter and try to aspirate. I keep the aspiration catheter in a straight segment, in order to reproduce a favorable angle of interaction between the aspiration catheter and the clot, then I completely retrieve the stent outside from the patient's body and keep the aspiration catheter in M1. If I am not successful, then I would repeat the process.