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Retrieving microcatheters from Onyx casts in a series of brain arteriovenous malformations: a technical report

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Abstract
Introduction To date, the "monorail snare technique" for the retrieval of entombed microcatheter tips during Onyx™ (ev3, Irvine, CA) embolisation of brain arteriovenous malformations (BAVM) has not been described. We report our experiences and some technical aspects in using this technique for the retrieval of entombed Marathon™ microcatheter (ev3, Plymouth, MN) tips during Onyx embolisation of BAVM treatment.
Methods Onyx was used in the embolisation of 11 patients using 25 feeders over 14 sessions. The 'monorail snare technique' was employed for 14 feeders. Each time, an Amplatz 4 mm Gooseneck Microsnare™ (ev3, Plymouth, MN) was loaded into an Excelsior 1018™ microcatheter (Boston Scientific, Natick, MA). The Marathon microcatheter was cut just distal to the hub, and the Amplatz/Excelsior combination was introduced along the length of the Marathon microcatheter towards its distal end, as far as possible. The embedded catheter was ensnared and both catheters were pulled free.
Results Microcatheter tip removal was successful in all cases, except for one microcatheter tip becoming detached and needing no further intervention. There were no complications as a direct result of the snare technique.
Conclusions The monorail snare technique is a safe and easy technique for retrieving Onyx-encased microcatheter tips in the treatment of BAVM.

Keywords Onyx · Brain arteriovenous malformation · Monorail snare technique

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Introduction

Brain arteriovenous malformations (BAVM) have recently undergone a renaissance in their management options. Onyx™ (ev3, Irvine, CA), a slow-precipitating liquid embolic treatment, is an effective tool in the treatment of BAVM [1]. Reflux of the onyx material can encase the microcatheter tip, which can often be overcome by providing traction on the microcatheter. However, if a longer segment of microcatheter tip becomes entrapped, proximal pulling force may not be adequately translated to the distal end, resulting in an entombed microcatheter tip. The use of detachable microcatheter tips can be a solution to this problem, but these are not yet readily available [2].

A recent case report of a dural arteriovenous fistula (DAVF) treated with Onyx, described the use of the 'monorail snare technique' for the retrieval of the trapped microcatheter tip [3], which was adapted from its more common use in the retrieval of stretched endovascular coils [4]. To our knowledge, this technique has not been reported in the treatment of BAVM. This technical report describes our experiences with the monorail technique in a series of 11 BAVMs treated with Onyx.

Technique and results

Embolisation for BAVM was carried out in 11 patients (M/F 8:3; range 23–69; mean, 49 years) over a 12-month period from February 2012 using Onyx liquid embolic agent. Indications for embolisation included intracranial haemorrhage in nine patients (81%) and seizures in one patient (9%). BAVM was an incidental finding in one patient (9%). In these 11 patients, a total of 14 sessions of Onyx embolisations were carried out using 25 feeders. Embolisation was performed under general anesthesia. The Marathon catheter™ (ev3, Irvine, CA) was navigated through 6-French guiding catheter into the feeding artery of AVM as near as nidus by transfemoral approach. Systemic heparinisation was performed after femoral puncture till removal of sheath introducer. Onyx was injected under blank roadmap of the biplane flat panel detector. We injected Onyx as much as possible using plug and push technique until a small amount of Onyx was refluxed over the catheter tip. Post-embolisation, five cases were surgically treated, two were treated with radiotherapy and four were observed.

In all of these cases, the Marathon™ microcatheter (ev3, Irvine, CA) tip was entrapped in Onyx. Eleven of 25 (44%) tips were removed spontaneously only by intermittent pulling technique within 5 to 50 min. The monorail snare technique was employed for 14 out of 25 feeders (56%).

An Amplatz 4 mm Gooseneck Microsnare™ (ev3, Plymouth, MN) was loaded into an Excelsior 1018™ microcatheter (Boston Scientific, Natick, MA). The Marathon microcatheter was cut just distal to the hub, and the Amplatz/Excelsior combination was introduced along the length of the Marathon microcatheter towards its distal end, as far as possible (Fig. 1). The embedded catheter was ensnared, and both catheters were pulled free. We did not use any antiplatelet agent and did not continue systemic heparinisation after embolisation.

Fourteen feeders (56%) were removed using the microsnare technique. Every feeder that required the use of this technique was successfully extracted. Tip removal was uncomplicated in all except one (4%) where the microcatheter tip became detached and was left encased within the Onyx. There were no haemorrhagic or thrombo-embolic events as a result of the microsnare technique. Only one patient (9%) suffered a mild dysesthesia due to a small infarction of the thalamus, directly related to the Onyx treatment itself, not related to this retrieval technique.

Illustrative case

The case of a 52-year-old woman with ruptured AVM in the right posterior temporal lobe is presented. AVM was fed mainly from the right posterior cerebral artery (PCA) (Fig. 1a). We performed Onyx embolisation pre-surgically. A 6-Fr guiding catheter was inserted to the right internal carotid artery from the right femoral artery. The Marathon microcatheter was navigated to the feeder of PCA through the right posterior communicating artery by Transend™ guide wire (Boston Scientific, Natick, MA). The tip of Marathon microcatheter was positioned just in the nidus, and Onyx was injected by plug and push technique. Because the tip of Marathon microcatheter was trapped by an Onyx cast, we indicated the monorail snare technique. An Amplatz 4 mm Gooseneck Microsnare in an Excelsior 1018 microcatheter was inserted into the distal of Marathon microcatheter as far as possible (Figs. 2b and 3a). The Gooseneck Microsnare was closed tightly, and all microcatheters were pulled together. Care was taken so that microcatheters were extended and tensed before the Marathon microcatheter was released from the Onyx cast (Fig. 3b). After that, several sessions were performed, and almost all nidus was finally full of Onyx (Fig. 2c, d).

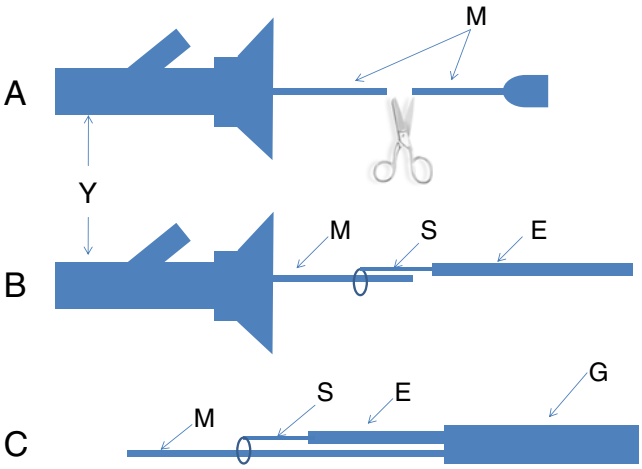

Fig. 1 **a** The proximal of Marathon catheter™ is cut outside of the Y-shaped connector. **b** The Gooseneck Microsnare™ in the Excelsior 1018™ is put into guiding catheter along the Marathon catheter™ through Y-shaped connector. **c** The Gooseneck Microsnare™ is put into the distal of Marathon catheter™ through the guiding catheter. *Y*: Y-shaped connector, *M*: Marathon catheter™, *S*: Gooseneck Microsnare™, *E*: Excelsior 1018™, *G*: guiding catheter

Discussion

Onyx is a promising tool in the treatment of BAVM and DAVF, but certain technical difficulties remain to be overcome [3–6]. The rescue of an Onyx-encased, non-detachable microcatheter tip has been described in a previous case report relating to the treatment of DAVF. But to our knowledge, it has not been reported in the treatment of BAVM [3].

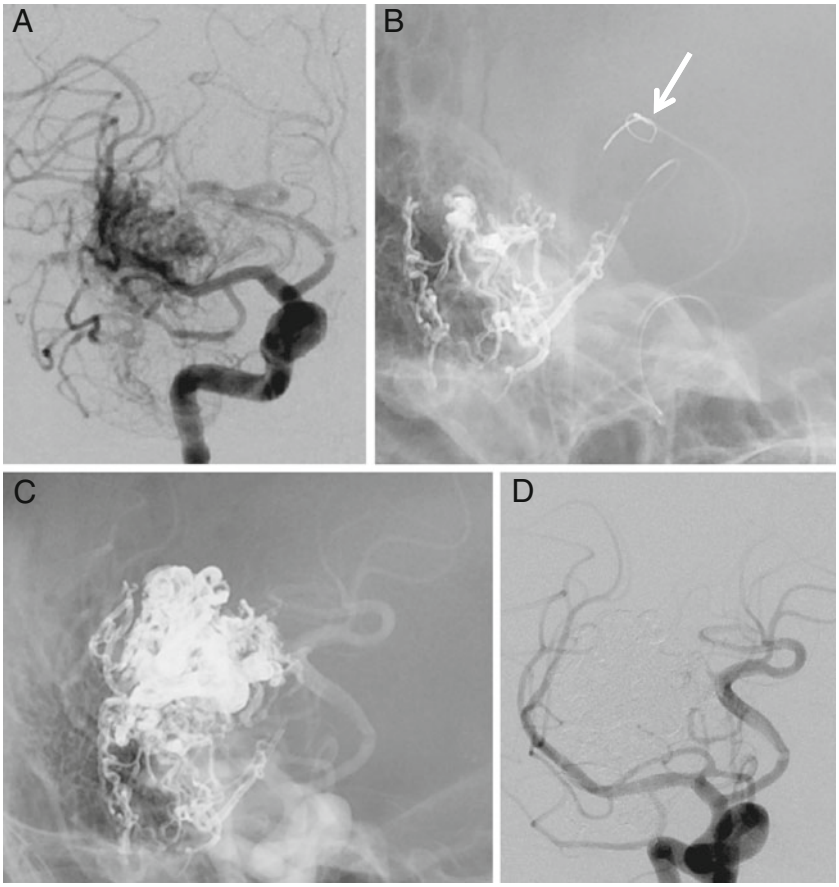

Fig. 2 **a** Pre-treatment right internal carotid angiogram of AP view. AVM was feeding from branches of posterior cerebral artery (PCA) via posterior communicating artery. The nidus of the AVM was located in the posterior temporal lobe. **b** The Marathon catheter™ was inserted into a feeder of PCA through a posterior communicating artery from an internal carotid artery. After the injection of Onyx™, the tip of the Marathon catheter™ was trapped in Onyx™. The Gooseneck Microsnare™ (*arrow*) with a Excelsior 1018™ was inserted nearly to nidus along the Marathon catheter™, monorail snare technique. Then, the Gooseneck Microsnare™ with a Excelsior 1018™ and the Marathon catheter™ were pulled out together. **c** The live image of the final angiogram which showed final Onyx mass clearly. **d** Final digital subtraction angiogram showed the disappearance of the nidus

Due to the "plug and push" technique necessary to achieve a successful embolisation, reflux is inevitable and necessary, resulting in the entrapment of the microcatheter tip in a dense Onyx cast. The degree of difficulty of removal in such cases is related to vessel tortuousity and how far the Onyx refluxes towards the proximal end of the microcatheter, amongst other factors [7]. During our initial experiences (the eighth case) with Onyx, microcatheter tips could become so solidly trapped that, in one case, an hour of traction forced us to attempt to remove the catheter a day later. In the next case, 55 min of traction also proved fruitless, leading us to attempt to use the microsnare technique. It might be due to the learning curve of our intermittent pulling technique, and we had to wait a longer time, then the tip of catheter might be retrieved successfully. However, we do not think it is good just to wait more than 1 h.

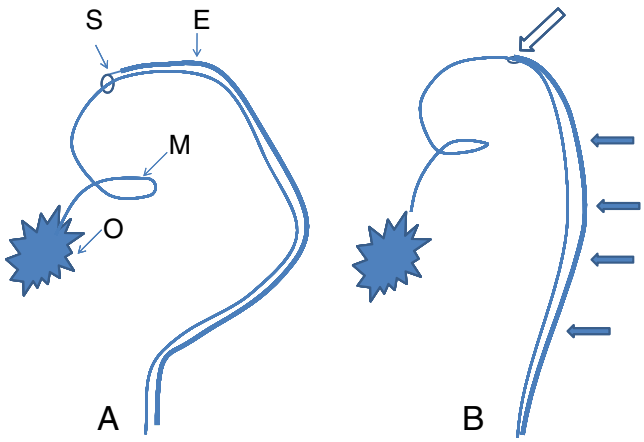

Fig. 3 **a** The Gooseneck Microsnare™ is put into the distal end of Marathon catheter™ as far as possible. **b** After closing of loop of the Gooseneck Microsnare™ tightly (*white arrow*), the Gooseneck Microsnare™ in the Excelsior 1018™ and the Marathon catheter™ are pulled together. Catheters are extended and tensed (*black arrow*). *S*: Gooseneck Microsnare™, *M*: Marathon catheter™, *E*: Excelsior 1018™, *O*: Onyx

The snare technique described in this technical note was initially developed as a simple and effective way of retrieving stretched platinum coils used during the embolisation of cerebral aneurysms [4], but we have also successfully used it in Onyx-treated AVMs. The advent of detachable microcatheter tips such as the SONIC™ catheter (Balt, Montmorency, France) or Appllo™ catheter (ev3, Irvine, CA) presents an answer to the entrapment within Onyx, but, as yet, they are not widely available [2].

Technical success in using the microsnare was defined as the removal of the entire microcatheter and tip, or detaching the tip without the need for its removal neurosurgically. This was achieved in all patients, granting us a 100%

success rate. The snare should be advanced as close to the distal end of the microcatheter tip as possible, but this is not absolutely required in all cases. The high degree of traction directed towards the distal portion of the microcatheter using this technique means that there is a certain amount of freedom as to where to place the snare, and results are comparable. Some mechanical vasospasm is likely to occur, and using this technique for smaller feeders may be substantially more risky, although we have recorded no complications in such cases. The feeding arteries of our cases were big enough to apply this technique. So, we might not encounter any complications due to endothelial damage caused by the retriever without any antiplatelet agents. However, we have to be careful not to cause this kind of complication, so we have to use an antiplatelet agent if we think the technique causes severe endothelial damage.

In conclusion, we believe that the monorail snare technique is a safe and easy technique for retrieving Onyx-encased microcatheter tips in the treatment of BAVM, until detachable tip systems become more widely available.

Conflict of interest We declare that we have no conflict of interest.

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