

## Case Report

# Stent retriever angioplasty for acute atherosclerotic occlusion of internal carotid artery: A case report

Tatsuya Tanaka, Yuhei Michiwaki, Fumitaka Yamane, Tomihiro Wakamiya, Ryohei Sashida, Ren Fujiwara, Yoshinori Takaya, Kazuaki Shioji, Eiichi Suehiro, Keisuke Onoda, Masatou Kawashima, Akira Matsuno

Department of Neurosurgery, International University of Health and Welfare, Narita, Japan.

E-mail: \*Tatsuya Tanaka - s96047@hotmail.com; Yuhei Michiwaki - y.michiwaki@iuhw.ac.jp; Fumitaka Yamane - fyamane@iuhw.ac.jp; Tomihiro Wakamiya - twakamiya@iuhw.ac.jp; Ryohei Sashida - sashidaryohei@gmail.com; Ren Fujiwara - renfujiwara9@gmail.com; Yoshinori Takaya - yt560609@yahoo.co.jp; Kazuaki Shioji - shimoji@iuhw.ac.jp; Eiichi Suehiro - esuehiro@iuhw.ac.jp; Keisuke Onoda - onoda3883@gmail.com; Masatou Kawashima - mkawashima@iuhw.ac.jp; Akira Matsuno - akira.dr.ruby@gmail.com



### \*Corresponding author:

Tatsuya Tanaka,  
Department of Neurosurgery,  
International University of  
Health and Welfare, Narita,  
Japan.

s96047@hotmail.com

Received : 12 August 2022  
Accepted : 06 October 2022  
Published : 21 October 2022

DOI  
10.25259/SNI\_729\_2022

### Quick Response Code:



## ABSTRACT

**Background:** Despite the proven benefit of stent retriever thrombectomy for acute ischemic stroke caused by large-vessel embolic occlusion, acute revascularization in the setting of underlying intracranial, atherosclerosis-related, and emergent large-vessel occlusion remains to be a challenge. In this case report, we present a novel revascularization technique that can be used to treat acute ischemic stroke caused by suspected intracranial, atherosclerosis-related, and emergent large-vessel occlusion of the internal carotid artery (ICA).

**Case Description:** This case report presents two patients with intracranial, atherosclerosis-related, and emergent large-vessel occlusion of the ICA: a 73-year-old man with a right-sided hemiparesis and aphasia and a 60-year-old man with altered level of consciousness. These patients were treated using the prolonged deployment and partial resheath method with a stent retriever, using the following devices: Solitaire Platinum, Trevo Trak 21, and AXS catalyst 6 for suction. On prolonged deployment of the Solitaire Platinum device, underlying focal atherosclerotic disease was noted. The device remained in place for more than 10 min, until the blood vessel was occluded. Next, the device was partially resheathed into the Trevo Trak 21 to reduce the radial force and minimize vessel injury during the pull. The partially constrained device was then retrieved under continuous aspiration at the lesion site and blood flow was successfully restored. Both patients recovered without any new deficits.

**Conclusion:** The prolonged deployment and partial resheath method using a stent retriever may be safe and effective in the treatment of intracranial, atherosclerosis-related, and emergent large-vessel occlusion of the ICA.

**Keywords:** Internal carotid artery occlusion, Intracranial atherosclerosis, Percutaneous transcatheter angioplasty, Plaque, Stent retriever

## INTRODUCTION

The effectiveness of mechanical thrombectomy using a stent retriever or aspiration catheter for emergent large-vessel occlusion caused by cardiogenic embolic stroke has been established since the publication of several large, randomized, and controlled studies, and indications for this treatment are gradually expanding.<sup>[3]</sup> Use of a stent retriever seems less effective for intracranial, atherosclerosis-related, and emergent large-vessel occlusion than for purely embolic emergent large-vessel occlusion.<sup>[2,4]</sup> Reocclusion during endovascular treatment occurs often after an

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2022 Published by Scientific Scholar on behalf of Surgical Neurology International

initial recanalization with stent retriever thrombectomy in intracranial, atherosclerosis-related, and large-vessel occlusion.<sup>[2,4]</sup> For patients with refractory occlusions or a residual flow compromising the degree of stenosis after several attempts at stent retriever thrombectomy, subsequent use of suction thrombectomy, chemical thrombolysis, balloon percutaneous transcatheter angioplasty (PTA), and permanent stent placement is considered surgical bailout options.<sup>[1,5,8]</sup> However, aggressive use of these endovascular treatments can often result in additional infarction by dissection, hemorrhage, and thrombosis.

We report the cases of two patients treated with mild angioplasty using the prolonged deployment and partial resheath technique with a stent retriever. This method enables avoidance of injury to the vascular endothelium and is excellent at dilating blood vessels for intracranial, atherosclerosis-related, and emergent large-vessel occlusion of the internal carotid artery (ICA).

## CASE DESCRIPTION

### Case one

A 73-year-old man was transferred to our hospital by ambulance for evaluation and treatment of complete right-sided hemiparesis and aphasia that occurred 3 days after he first perceived transient weakness in his right leg. His National Institutes of Health Stroke Scale (NIHSS) at admission was 14 points. On presentation, cranial magnetic resonance imaging (MRI)/magnetic resonance angiography (MRA) showed ICA occlusion and acute and subacute infarctions in the left ICA territory on the MRI diffusion-weighted image sequences [Figure 1]. Given the presence of multiple subacute infarctions, tissue plasminogen activator was not administered, and the patient directly proceeded to endovascular recanalization. Aspirin 200 mg and clopidogrel 150 mg were orally administered before the procedure for immediate effect, and the target activated clotting time was set at  $\geq 250$  s with a heparin dose.

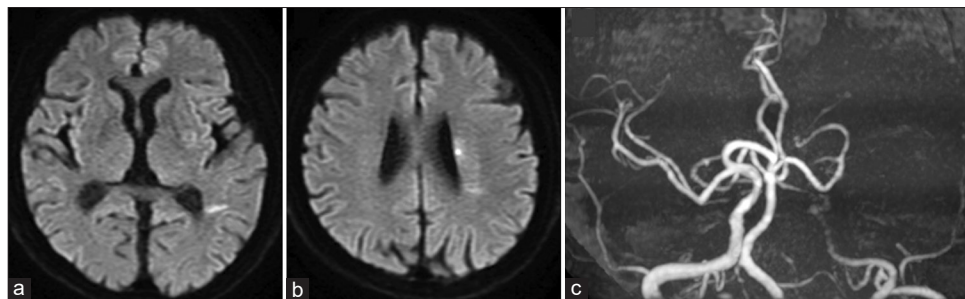
For endovascular recanalization, an 8-Fr long sheath was inserted into the right femoral artery, and an 8-Fr Optimo (Tokai Medical Products, Aichi, Japan) was delivered to the left ICA. Angiography revealed a tapered occlusion of the left ICA and moderate pial anastomosis in the left middle cerebral artery (MCA) territory from the left anterior and posterior cerebral arteries [Figure 2]. These angiographic findings, the clinical course, and no existence of atrial fibrillation indicated the possibility of gradually progressive, intracranial, atherosclerosis-related, and emergent large-vessel occlusion of the ICA.

Initially, a Trevo Trak 21 microcatheter (Stryker, Kalamazoo, MI, USA) was delivered to the distal side of the occluded site, and Solitaire Platinum 6  $\times$  40 mm (Medtronic, Minneapolis, MN, USA) was thereafter deployed. Immediate restoration of flow was confirmed, although the stent retriever could not completely open. This event similarly indicated atherothrombotic disease as the underlying pathology [Figure 3a]. Therefore, Solitaire was deployed to the occluded site for mild forced angioplasty for approximately 30 min with contrast every 10 min. After occlusion for a 2<sup>nd</sup> time, the Solitaire was partially resheathed into the microcatheter to reduce the radial force and minimize vessel injury during the pull [Figure 3b]. The partially constrained device was then retrieved under continuous aspiration at the lesion site. After the removal of the microcatheter, the ICA recanalized with stenosis over 30 min [Figure 3c], and the right hemiparesis remarkably improved.

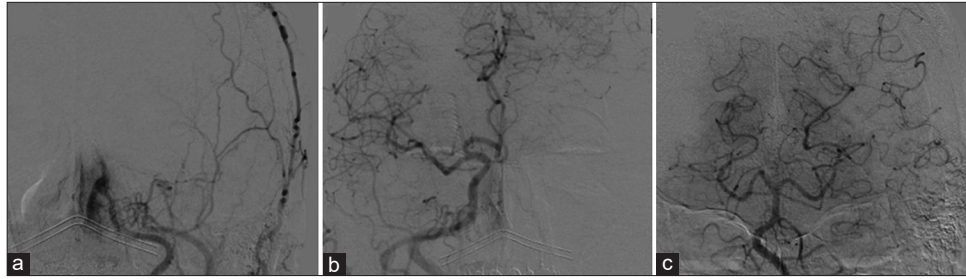
The patient's immediate postoperative course was uneventful. Pharmacologic treatment was continued with aspirin 100 mg/day and the cilostazol was increased to 200 mg/day. At 1-month follow-up, the MRA showed persistent mild stenosis in the right ICA. Having completed 3 months of rehabilitation, the patient was discharged with a modified Rankin Scale (mRS) score of 2 at 90 days.

### Case two

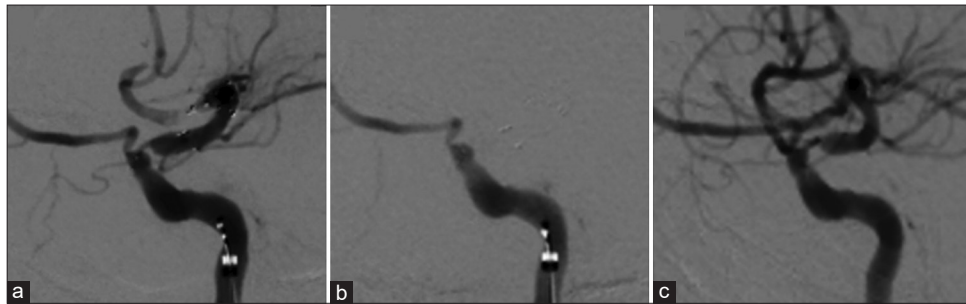
A 60-year-old man was transferred to our hospital by ambulance for evaluation and treatment of altered level



**Figure 1:** Case 1: Initial magnetic resonance imaging, diffusion-weighted image (a and b), and magnetic resonance arteriography (c) results at stroke onset. Acute lesions are visualized in the left corona radiata and temporal lobe. Magnetic resonance arteriography shows a left internal carotid artery occlusion. MCA: Middle cerebral artery.



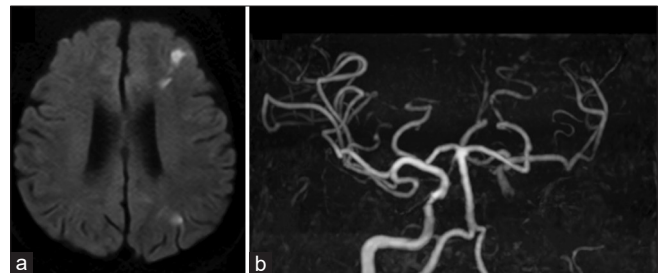
**Figure 2:** Case 1: Angiography reveals left internal carotid artery occlusion (a) and the development of pial anastomoses from the anterior communicating artery and left posterior cerebral artery to left anterior cerebral artery and middle cerebral artery (b and c).



**Figure 3:** Case 1: Angiography of the left ICA. The stent retriever fails to open completely at the occluded point (a). After prolonged deployment with stent retriever for 30 min, the left ICA is occluded (b). Following the removal of the stent retriever and microcatheter, the left ICA recanalizes with stenosis (c). ICA: Internal carotid artery.

of consciousness that occurred 5 h after he first perceived gait disturbance. His NIHSS at admission was 30 points. On presentation, cranial MRI/MRA showed ICA occlusion and acute and subacute infarctions in the left watershed territories between the anterior cerebral artery, MCA, and posterior cerebral arteries on the MRI diffusion-weighted image sequences [Figure 4]. Given the presence of multiple subacute infarctions, tissue plasminogen activator was not administered, and the patient directly proceeded to endovascular recanalization. No drugs were administered as the cause was suspected to be a cardiogenic cerebral embolism.

For endovascular recanalization, an 8-Fr long sheath was inserted into the right femoral artery, and an 8-Fr Optimo was delivered to the left ICA. Initially, a Trevo Trak 21 microcatheter was delivered to the distal side of the occluded site. The Solitaire Platinum 6 × 40 mm was deployed. Immediate restoration of flow was confirmed, although the stent retriever could not completely open. The Solitaire was gently retrieved; however, no significant clot was identified and the lesion recoiled and occluded a second time. These angiographic findings, the clinical course, and no existence of atrial fibrillation indicated the possibility of gradually progressive, intracranial, atherosclerosis-related, and emergent large-vessel occlusion of the ICA. Aspirin 200 mg and clopidogrel 300 mg were initiated through a



**Figure 4:** Case 2: Initial magnetic resonance imaging, diffusion-weighted image (a), and magnetic resonance arteriography (b) images at stroke onset. Acute lesions are visualized in the left watershed territories between anterior cerebral artery, middle cerebral artery, and posterior cerebral artery. Magnetic resonance arteriography shows a proximal left internal carotid artery occlusion.

nasogastric tube, sodium ozagrel 80 mg was administered intravenously for immediate effect, and the target activated clotting time was set at  $\geq 250$  s with a heparin dose afterward as atherothrombotic stroke was diagnosed after starting the treatment.

During the second attempt at endovascular recanalization, PTA with a balloon was considered; however, there was concern in this case that PTA could induce dissection and thrombosis and occlude it. Therefore, the Solitaire was deployed to the occluded site for mild forced angioplasty

for approximately 10 min with contrast every 10 min. After occlusion for a 3<sup>rd</sup> time, the Solitaire was partially resheathed into the microcatheter to reduce the radial force and minimize vessel injury during the pull [Figures 5a and b]. The partially constrained device was then retrieved under continuous aspiration at the lesion site. After the removal of the microcatheter, the ICA recanalized with mild stenosis over 30 min [Figure 5c].

The patient's altered level of consciousness remarkably improved. Pharmacologic treatment was continued with aspirin 100 mg/day and cilostazol 200 mg/day. At the 2-week postoperative evaluation, MRA showed persistent mild stenosis in the right ICA, and the patient was discharged without rehabilitation because of no further symptoms or progression, but is being monitored. The mRS was 0 at 90 days.

## DISCUSSION

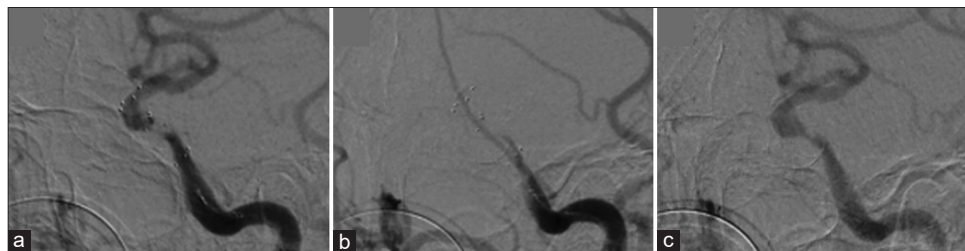
Although endovascular treatment for acute occlusion of the main intracranial arteries associated with an embolic source has already been well established, aggressive therapy for intracranial, atherosclerosis-related, and emergent large-vessel occlusion remains challenging as well as controversial.<sup>[2,4]</sup> With simple thrombectomy using a stent retriever, acute or subacute arterial reocclusion is often observed within a few minutes or days of transient recanalization of the intracranial atherothrombotic lesion. In patients with intracranial, atherosclerosis-related, and emergent large-vessel occlusion, physicians may be concerned that stent retrieval may induce vessel injury at the stenotic site, and that the repeat passage of a microwire, microcatheter, and stent retriever may further damage the inflamed plaque, thereby provoking further platelet activation and even arterial dissection.<sup>[2,4]</sup> However, aggressive PTA with noncompliant balloons for atheromatous disease carries the potential risk of vessel rupture and dissection.

In contrast, the effectiveness of the stenting without retrieval using the Solitaire was reported for intracranial, atherosclerosis-

related, and emergent large-vessel occlusion.<sup>[5,8]</sup> This technique puts the patient at risk of developing complications associated with temporary stent placement, such as thromboembolic phenomena, antiplatelet therapy risks, and in-stent thrombosis.<sup>[1,5,8]</sup> Stenting-related ischemic complications are a major concern of stent deployment in the acute stage.

Based on these considerations, we attempted to perform mild angioplasty by the prolonged deployment and partial resheath method using the stent retriever, with the intention of avoiding injury to the vascular endothelium. Prolonged deployment of the stent retriever safely produces an angioplasty effect and maintains cerebral blood flow during the procedure. Stent retriever angioplasty has been identified to be safer than balloon PTA, even in tortuous vessels, such as the siphon of the ICA. Even if an in-stent thrombus develops, it can be retrieved, and the same procedure can be repeated if reocclusion occurs. To the best of our knowledge, to date, some reports have described revascularization in atheromatous disease with the deployment and resheath method.<sup>[6,7]</sup> Because of the relatively low radial force of the stent retriever, the safety of angioplasty with a stent retriever is emphasized compared with PTA using a noncompliant balloon.<sup>[6,7]</sup> In addition, our prolonged deployment technique was used until reocclusion with contrast every 10 min. Because the lesions in these two cases were atheromatous disease of the ICA, a stent with a larger caliber, such as 6-mm Solitaire, should have been used.

The technique used for these cases was relatively simple and the damage to the blood vessel was small. Consequently, the prolonged deployment and partial resheath methods may be particularly effective for lesions with unstable soft plaques near the important perforating arteries, although it is extremely palliative. The technique cost was relatively low, creating favorable conditions for obtaining a good prognosis, and it was a clinically beneficial technique. Because of the relatively small number of cases, a larger sample size is needed to confirm these findings, and the restenosis rates and long-term effects also require further investigation.



**Figure 5:** Case 2: Angiography of the left ICA. The stent retriever fails to open completely at the occluded point (a). After prolonged deployment with stent retriever for 10 min, the left ICA is occluded (b). Following the removal of the stent retriever and microcatheter, the left ICA recanalizes with stenosis (c). ICA: Internal carotid artery.

## CONCLUSION

The prolonged deployment and partial resheath technique using a stent retriever may be safe and effective in the treatment of acute ischemic stroke caused by suspected, intracranial, atherosclerosis-related, and emergent large-vessel occlusion of ICA.

### Declaration of patient consent

Patients' consent not required as patients' identities were not disclosed or compromised.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Ahmed SU, Mann J, Houde J, Barber E, Kelly ME, Peeling L. Permanent implantation of the solitaire device as a bailout technique for large vessel intracranial occlusions. *J Neurointerv Surg* 2019;11:133-6.
- Baek JH, Kim BM, Kim DJ, Heo JH, Nam HS, Song D, *et al.* Importance of truncal-type occlusion in stentriever-based thrombectomy for acute stroke. *Neurology* 2016;87:1542-50.
- Campbell BC, Hill MD, Rubiera M, Menon BK, Demchuk A, Donnan GA, *et al.* Safety and efficacy of solitaire stent thrombectomy: Individual patient data meta-analysis of randomized trials. *Stroke* 2016;47:798-806.
- Gascou G, Lobotesis K, Machi P, Maldonado I, Vendrell JF, Riquelme C, *et al.* Stent retrievers in acute ischemic stroke: Complications and failures during the perioperative period. *AJNR Am J Neuroradiol* 2014;35:734-40.
- Kim JH, Jung YJ, Chang CH. Feasibility and safety of the strategy of first stenting without retrieval using solitaire FR as a treatment for emergent large-vessel occlusion due to underlying intracranial atherosclerosis. *J Neurosurg* 2021;135:1091-9.
- Kwon HJ, Lim JW, Koh HS, Park B, Choi SW, Kim SH, *et al.* Stent-retriever angioplasty for recurrent post-subarachnoid hemorrhagic vasospasm-a single center experience with long-term follow-up. *Clin Neuroradiol* 2019;29:751-61.
- Moteki Y, Shimizu A, Nakamura A, Yamahata H, Kobayash T. Mild angioplasty with a stent retriever for acute atherothrombotic middle cerebral artery occlusion: A case report. *Interdiscip Neurosurg* 2020;22:100856.
- Woo HG, Sunwoo L, Jung C, Kim BJ, Han MK, Bae HJ, *et al.* Feasibility of permanent stenting with solitaire FR as a rescue treatment for the reperfusion of acute intracranial artery occlusion. *AJNR Am J Neuroradiol* 2018;39:331-6.

**How to cite this article:** Tanaka T, Michiwaki Y, Yamane F, Wakamiya T, Sashida R, Fujiwara R, *et al.* Stent retriever angioplasty for acute atherosclerotic occlusion of internal carotid artery: A case report. *Surg Neurol Int* 2022;13:482.

### Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Journal or its management. The information contained in this article should not be considered to be medical advice; patients should consult their own physicians for advice as to their specific medical needs.