Medical Research Archives

ESMED
European Society of Medicine

OPEN ACCESS

Published: May 31, 2023

Citation: Bowen A, Soltani A, et al., 2023. Direct Carotid Artery Cutdown and flow diversions for the bilateral Internal Carotid Artery Dissecting Pseudoaneurysms: A Case Report, Medical Research Archives, [online] 11(5). https://doi.org/10.18103/mra.v11i5.3864

DOI
https://doi.org/10.18103/mra.v11i5.3864

ISSN: 2375-1924

CASE REPORT

Direct Carotid Artery Cutdown and flow diversions for the bilateral Internal Carotid Artery Dissecting Pseudoaneurysms: A Case Report

Adam Bowen,[1] Aria Soltani,[1] Adam Cloud,[1], Hanish Polavarapu,[1] Yahia Lodi,[1]

[1] Upstate Medical University, Binghamton & NYUHS-Hospitals, Binghamton, NY

Contact Information:
Yahia M Lodi, MD, FAHA, FANA, FAAN.
CAST Certified in Neuroendovasclar Surgery
Professor (tenured) and Neurosciences Academic Chair
Upstate Medical University, Binghamton, NY
Email: Yahia.lodi@gmail.com

ABSTRACT

Background: Surpass streamline flow diversion is performed by transfemoral, transradial or both approaches. Safety and feasibility of direct carotid artery cutdown and is not known. Objective is to report Surpass streamline flow diversion via direct carotid artery utdown for a patient with bilateral internal carotid artery dissecting pseudoaneurysm. Method: Case report. Outcome was measured using modified ranking scale (mRS). Results: Sixty-seven-year-old man with history of repaired aortic arch dissecting aneurysm using aortic stent, developed worsening headaches and dizziness and diagnosed with bilateral internal carotid artery dissecting pseudoaneurysm on a computed tomographic angiography; right internal carotid artery dissecting pseudoaneurysm measured 19x15x20 mm and left was 16x9x22 mm. Digital subtraction angiogram was attempted but failed. A direct carotid artery cutdown followed by surpass streamline flow diversion was performed in a staged fashion. A 6-french sheath was placed from right common carotid artery to right internal carotid artery by a vascular surgeon and was confined with digital subtraction angiography. An intermediate catheter was navigated to the internal carotid artery beyond the internal carotid artery dissecting pseudoaneurysm and surpass streamline flow diversion was achieved with 3 devices; 4x50 mm x2 and 5x40 mm. Carotid artery cutdown site was sutured by vascular surgeon. Patient was extubated and discharged home in 48 hours with NIHSS 0 and mRS1 at his baseline. The left internal carotid artery dissecting pseudoaneurysm was repaired after 3 month using similar technique as described above with two 5x50 mm flow diverters. For the second procedure, angioplasties were required for better appositions of flow diverters. Patient was discharged home in 24 hours. Patient's symptoms resolved and resumed baseline activities. Prescribed to continued 325 mg aspirin and 75 mg clopidogrel for six months followed by 162 mg aspirin and 75 mg of clopidogrel. Patient maintained mRS 0 in follow-up visits but refused to have a computed tomographic angiography, which finally performed in 24 months, demonstrates complete obligations of the left internal carotid artery dissecting pseudoaneurysm but occlusion of right internal carotid artery with robust collaterals from left internal carotid artery through collaterals. Patient admits premature discontinuation of antiplatelets when he learned about his computed tomographic angiography results. Conclusion: This is the first report of treatment of bilateral internal carotid artery dissecting pseudoaneurysm repaired by direct carotid artery cutdown approach. This is also the first report of a patient with an aortic arch stent, who developed bilateral internal carotid artery dissecting pseudoaneurysm and direct carotid artery cutdown required for treatment. Additionally, antiplatelets must be continued to prevent device occlusion.

Abbreviations:
DCAC: direct carotid artery cutdown
DSA: digital subtraction angiogram
SSFD: surpass streamline flow diversion
ICA: internal carotid artery
ICADPA: internal carotid artery dissecting pseudoaneurysm
NES: neuroendovascular surgeon
mRS: modified Rankin Scale
NIHSS: National Institute of Health Stroke Scale

Introduction:

Pseudoaneurysms are a potential complication of a craniocervical dissection, and they can develop spontaneously or from trauma. Internal carotid artery (ICA) dissecting pseudoaneurysm (ICADPA) develops in 27-30.3% of patients for spontaneous or trauma etiologies.[1-4] Among pseudoaneurysms in the craniocervical arteries, internal carotid dissecting pseudoaneurysms (ICDPA) are more common than vertebral.[2] Pseudoaneurysms can be potentially life-threatening or severely debilitating when they predispose an individual to thromboembolism, create a mass effect on nearby structures, or rupture to create a subarachnoid hemorrhage if in the intracranial vasculature.[3,5]

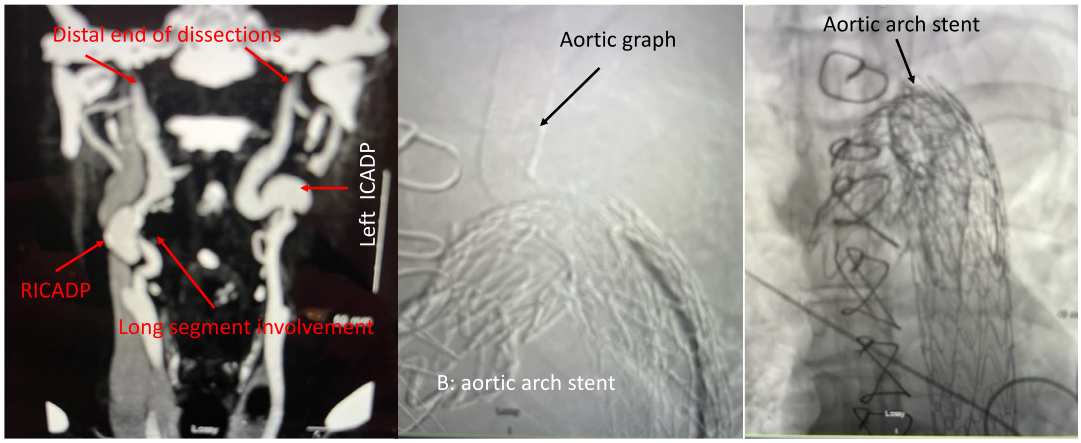
Identification of pseudoaneurysms is often after a symptomatic presentation of nonischemic symptoms, including headache, neck pain, Horner's Syndrome, or cranial nerve palsy.[3] Treatment of pseudoaneurysms surgically is often prompted by a traumatic initial presentation, recurrent ischemic or non-ischemic symptoms, or enlargement of the pseudoaneurysm on reimaging.[3] Endovascular treatment including use of stents, coiling, or an open surgical approach for pseudoaneurysms.[6-10] Flow diversions (FD) have demonstrated success in the treatment of ICADPA.[10-13] The safety and efficacy of stents and flow diverters is being increasingly supported in evidence based literatures.[12] ICADPA are endovascularly treated either via trans-femoral or trans-radial approaches. If these access points are not an option, there are no clearly defined alternative options for the access points. Direct carotid artery cutdown (DCAC) has been used in the emergent acute stroke thrombectomy cases.[4,13,14]

The patient outlined here had an aortic stent that would have precluded him from endovascular treatment for his bilateral internal carotid pseudoaneurysms via a trans-femoral or trans-radial approach. DCAC is the only option for endovascular treatment for this patient. Our patient was treated with a consecutive, team-based approach. A vascular surgeon initiated the procedure with trans-carotid surgical access via bilateral DCAC and an endovascular surgeon finished the procedure with FD on both internal carotid pseudoaneurysms. This is the first reported case of DCAC in the treatment of bilateral ICADPA in a nontraumatic or traumatic setting in our knowledge. It is also the first case of FD for the bilateral ICADPA in a setting of an aortic arch stent.

Unique Case

A 67-year-old man with a history of hypertension, hyperlipidemia, smoking history, and aortic arch endograph with stent after aortic dissection. He was diagnosed with bilateral ICADPA with computed tomographic angiography (CTA). Patient initially presented with ongoing worsening neck pain, headaches, and dizziness that prompted CTA. On CTA, he had a right ICADPA measured 19x 15x 20mm at multi-level, extending from cervical carotid artery to the skull base with inflow-zone stenosis (Figure 1A). The left ICADPA was measured 16x9x22m (Figure 1A). DSA was attempted but was unsuccessful due to aortic arch endograph and stent (Figure1B-C).

Figure 1A-C: 66 Y/O man developed headaches and neck pain. CTA of the head and neck demonstrated bilateral ICADP at multilevel up to skull-base. Aortic arch stent graph and stent in anterior posterior (AP) and lateral (LA) views prevented performing digital subtraction angiography (DSA).



Considering the severity and extends of the bilateral ICADPA and worsening symptoms, a team-based approach through DCAC was planned. Patient was prepared with good control of blood pressure with cessation of smoking. On the day of the procedure, patient was given 4 chewable baby aspirin, 300mg of clopidogrel was given, 2 hours before the procedure and activated coagulation time was kept 2 times of the baseline during the procedure. A vascular surgeon gained access to the ICA by DCAC approach followed by SSFD by a neuroendovascular surgeon (NES).

Regarding this DCAC approach; a long-segment carotid artery dissecting pseudoaneurysms extending to skull-base are extremely difficult either to get access or to repair surgically, especially when it is extensive. Both vascular surgeon and neurosurgeon have declined this case for surgical approach. Additionally, a vascular surgeon gained access to the carotid artery, which is very basic procedure for his specialty and an endovascular specialist performed the procedure, which is also very routine for his specialty. The combined approached opened a new strategy to offer treatment to this patient, when an aortic arch stent and stent graph are present and there is no safe alternative option available. Both vascular surgeon and the endovascular specialist had extensive discussion with patient and his wife using layman's terms and drawing diagrams. Patient and his wife understood the calculated risk and benefit clearly and given consent.

Techniques:

An ultrasound-guided access 6F sheath and was placed from the right common carotid artery to the right ICA by a vascular surgeon. The placement was confirmed with DSA by a NES. An intermediate catheter (CAT5, Stryker Neurovascular, Irving, CA) was navigated to the right ICA beyond the ICADPA (figure 2A-C) on the right side. FD was performed by using multiples surpass streamline devices; two 4x50 mm and one 5x50 mm to cover the entire dissecting pseudoaneurysm including diseased right ICA (Figure 3A-C).

Figure 2A-C: DSA of right ICA after FD with Surpass Streamline (SS)demonstrated immediate stasis and remodeling of the ICADP

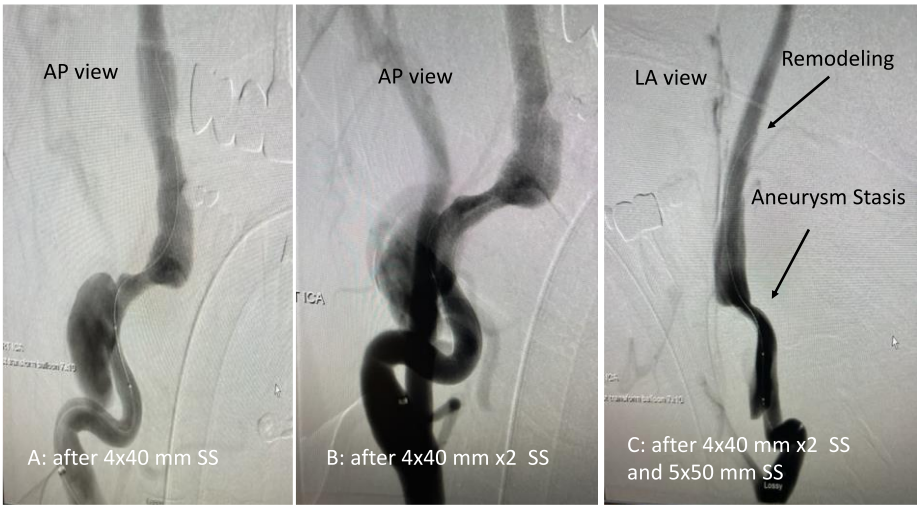
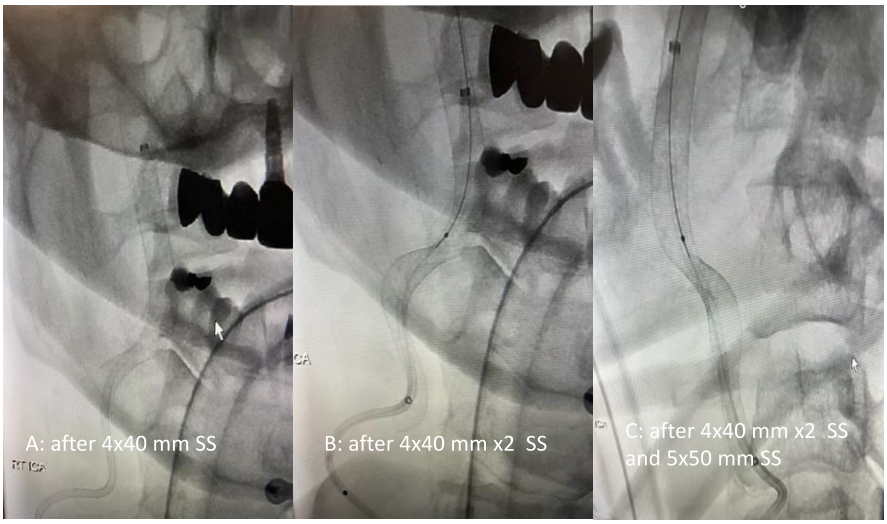
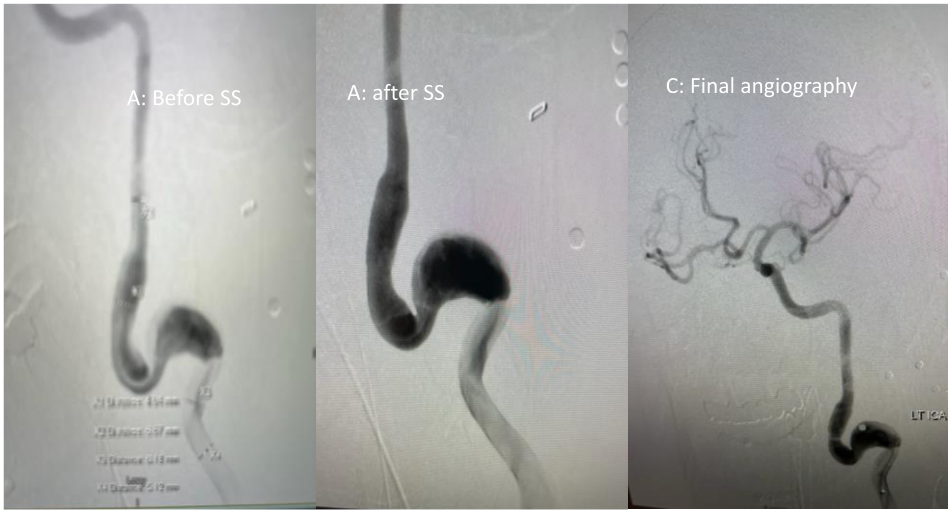


Figure 3A-C: Still images obtained during FD of the right ICADP



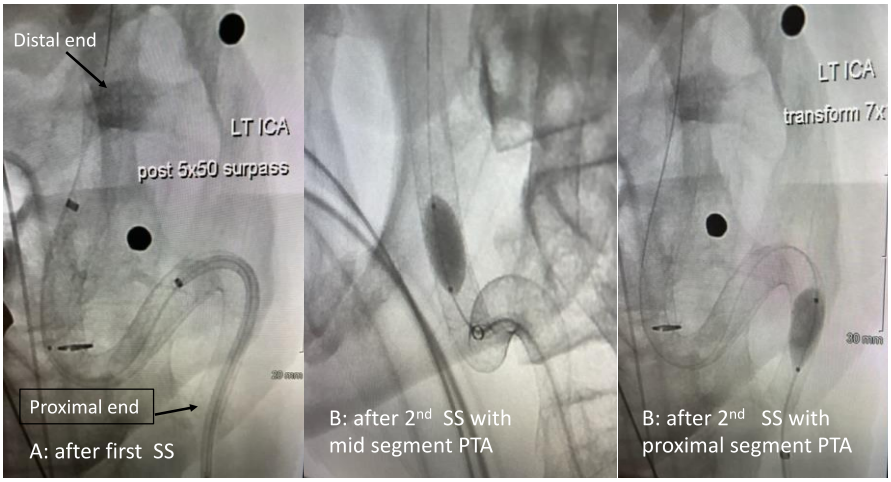
The DCAC site was sutured by the vascular surgeon and the patient was extubated. Patient was discharged home for 48 hours with NIHSS of 0 and mRS 1, at his baseline. Using the similar techniques, the left sided ICDPA was repaired using two 5 x 50 mm surpass streamline flow diverters (Figure 4A-C). For better apposition of the FD, multiple angioplasties were performed, resulting in good apposition (Figure 5A-C).

Figure 4A-C: DSA of the left ICA before and after the FD using Surpass Streamline (SS) 5x50 mmx2



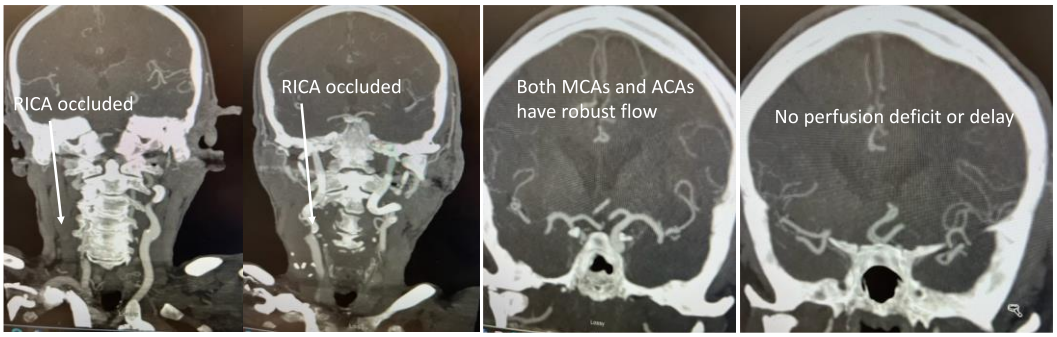
Note: Left ICA angiogram demonstrated robust filling of the right hemisphere.

Figure 5A-C: Still images obtained during FD of Left ICADP using SS



Patient was discharged home in 24 hours. After the interventions, patient was prescribed to continue 325 mg of aspirin and 75mg of clopidogrel for six months, followed by 162 mg of aspirin and 75mg of clopidogrel for additional 12 months. Patient's symptoms resolved and he resumed his baseline activities of living. Patient's mRS improved to 0 in Six-month, which sustained in 24 months follow-up visits. Patient claimed and confirmed taking his prescribed dual antiplatelets in all visits. Patient refused to obtain a follow-up CTA despite our multiple recommendations. A magnetic resonance images could not be performed due to the presence of aortic arch stent. Finally, CTA was performed in 24 months, which demonstrates complete obliteration of the left ICADPA with remodeling of the ICA but occlusion of right ICA with robust collaterals from left ICA (Figurer 6A-D).

Figure 6A-D: 2 years follow-up CTA head and neck demonstrated occlusion of the RICA and have robust flow from LICA through anterior communication artery. At present patient mRS 0 and has no symptoms.



Patient admits premature discontinuation of the prescribed dual full dose of antiplatelets to an 81 mg aspirin daily. Reason of discontinuation of dual antiplatelets was bleeding risks which he read in the newspaper published for an observational study with antiplatelets and related bleeding risks. Patient was restarted on aspirin 325 mg and clopedrogel 75 mg for 30 days followed by aspiring 325 mg daily. Patient platelets mapping demonstrated excellent platelets inhibitions. Both Patient and his wife were counseled again for potential life-threatening stroke related to device occlusion if aspirin is discontinued. Both voiced understanding of our conversations, and that was documented in the medical records.

Discussion

To our knowledge, this is the first case of the endovascular repair of a bilateral ICADPA with FD with the approaches of DCAC. This is also the first report of a patient with an aortic arch stent, who developed bilateral ICADPA and bilateral DCAC were required for his treatment. This case has significant scientific merits for the reasons: it is the first case of DCAC methods being used for the treatment of bilateral ICADP with an un-traversable aortic arch stent; it is the first case where FD was used in bilateral ICADP; and it is the first case where DCAC was done twice for endovascular treatment. A team-based approaches where DCAC was performed by and vascular surgeon followed by neuroendovascular repair by FD by a neuroendovascular surgeon resulting in successful treatment of unpredictable symptomatic ICADPA and without impairing baseline functionality. In our patient, DCAC was used twice for the treatment of symptomatic bilateral ICADPA without any complication may indicate the reproducibility of DCAC in a controlled setting like ours. Further examination of CAC cutdown data might show that specialization and team-based approaches are more ideal for this type of intervention, as vascular surgeons are more likely to have done DCAC more frequently, improving their skill and lessening potential complications.

DCAC is a relatively safe procedure based on literature with rates of carotid dissection and cervical hematoma occurring in .8% and 1.9% of cases respectively.[14] In one study, a 5-french sheath carotid punctures without complications, but 6-French sheaths could be a safe alternative.[15] Percutaneous direct puncture (PDP) approach instead of DCAC could be an alternative method to access the carotid artery, while bypassing the aortic arch.[16] However, the risk of cervical hematomas is likely lower in DCAC in the setting of endovascular treatments.[17] Anticoagulation is used prophylactically in either DCAC or PDP to decrease the risk of distal embolization or proximal thrombus formation in the setting of endothelial dysfunction from the procedure.[17] The risk for cervical hematoma (5-8.6%) and possibly carotid dissection is significantly higher with the use of anticoagulants in the percutaneous PDP.[15,16,18]

There have been a few cases where DCAC approached were used in the emergent

endovascular mechanical thrombectomy.[14,19] For these instances, DCAC was done in an emergent setting with patients with difficult anatomy and thrombolysis was use in 40% of the cases without complication.[14] Difficult anatomy can delay access to the carotid artery up to 20-90 minutes, with carotid access not being possible in a 5% of patients, significantly worsening outcomes. DCAC cutdown has also been used in the setting of treating intracranial aneurysms in 6 patients in Japan with good results with stenting and coiling with 16% cervical hematoma.[20] Of significant difference, our case was in the setting of bilateral symptomatic ICADPA at multilevel treated with FD. In another study, 7 patients with unilateral ICA loop dissecting pseudoaneurysm was treated with successful Surpass Streamline flow diverter.[21] Our strategies of bilateral DCAC in the treatment of symptomatic large bilateral ICADP with multilevel diseases, where a trans-femoral or trans-radial approach are not feasible due to the presence of aortic arch stents, opens the doors to explore DCAC in a team approaches to extend the treatment opportunities. Father studies are required.

Regarding right ICA occlusion, most likely cause was early discontinuation of full dose of dual antiplatelets. However, other cause could be related to the SSFD, the first-generation device had 68 wires and be associated with thrombogenicity. The exact time of occlusion is not clear. However, presence of robust flow from the left ICA to the right hemisphere during the repair of the left ICADPA (Figure 4A-C) may indicate that occlusion might have happened before the repair of the left ICADPA. Patient also had long-segment stenosis in the inflow-zone of the right ICADPA, therefore after flow diversion, the competitive flow from left ICA might have overcome the flow from right ICA leading to early occlusion.

Conclusion

Symptomatic ICADPA were repaired with flow diverters in both internal carotid arteries with DCAC approach twice without complications and patient achieved good functional outcome with mRS 0 and NIHSS 0. This case report may further support that DCAC may be offered for a potential life threatening intracranial cerebrovascular disease in the setting of an aortic arch stent, when there is no safe alternative safe option available. Team-based intervention for concomitant endovascular treatment with a vascular surgeon and neuroendovascular surgeon can work hand-in-hand to achieve the focused expected goals. This study prompts further consideration of DCAC for nonemergent endovascular intervention and further broadens the armamentarium for neuroendo-vascular surgery with future studies. We have created a registry for all patients that were treated by DCAC strategies for the treatment of carotid artery aneurysm in our institution, and we are in the process of collecting all relevant data for future publication.

References

1. Schievink WI. Spontaneous dissection of the carotid and vertebral arteries. *N Engl J Med*. 2001;344:898-906. doi: 10.1056/NEJM200103223441206
2. Cruciata G, Parikh R, Pradhan M, Shah J, Greif E, Stein EG. Internal carotid artery dissection and pseudoaneurysm formation with resultant ipsilateral hypoglossal nerve palsy. *Radiol Case Rep*. 2017;12:371-375. doi: 10.1016/j.radcr.2017.01.016
3. Daou B, Hammer C, Chalouhi N, Starke RM, Jabbour P, Rosenwasser RH, Tjoumakaris S. Dissecting pseudoaneurysms: predictors of symptom occurrence, enlargement, clinical outcome, and treatment. *J Neurosurg*. 2016;125:936-942. doi: 10.3171/2015.10.JNS151846
4. Wiesmann M, Kalder J, Reich A, Dekeyzer S, Riabikin A, Mpotsaris A, Nikoubashman O. Combined Surgical and Endovascular Carotid Access for Endovascular Thrombectomy in Acute Ischemic Stroke. *World Neurosurg*. 2019;132:e1-e4. doi: 10.1016/j.wneu.2019.09.031
5. Touze E, Randoux B, Meary E, Arquizan C, Meder JF, Mas JL. Aneurysmal forms of cervical artery dissection : associated factors and outcome. *Stroke*. 2001;32:418-423. doi: 10.1161/01.str.32.2.418
6. Li Z, Chang G, Yao C, Guo L, Liu Y, Wang M, Liu D, Wang S. Endovascular stenting of extracranial carotid artery aneurysm: a systematic review. *Eur J Vasc Endovasc Surg*. 2011;42:419-426. doi: 10.1016/j.ejvs.2011.05.008
7. Perez-Cruet MJ, Patwardhan RV, Mawad ME, Rose JE. Treatment of dissecting pseudoaneurysm of the cervical internal carotid artery using a wall stent and detachable coils: case report. *Neurosurgery*. 1997;40:622-625; discussion 625-626. doi: 10.1097/00006123-199703000-00039
8. Garg K, Rockman CB, Lee V, Maldonado TS, Jacobowitz GR, Adelman MA, Mussa FF. Presentation and management of carotid artery aneurysms and pseudoaneurysms. *J Vasc Surg*. 2012;55:1618-1622. doi: 10.1016/j.jvs.2011.12.054
9. Kadkhodayan Y, Jeck DT, Moran CJ, Derdeyn CP, Cross DT, 3rd. Angioplasty and stenting in carotid dissection with or without associated pseudoaneurysm. *AJNR Am J Neuroradiol*. 2005;26:2328-2335.
10. Seward CJ, Dumont TM, Levy EI. Endovascular therapy of extracranial carotid artery pseudoaneurysms: case series and literature review. *J Neurointerv Surg*. 2015;7:682-689. doi: 10.1136/neurintsurg-2014-011252
11. Phogat V, Gandhi A, Srivastava T, Mishva K. Endovascular management of intracranial pseudoaneurysm: an institutional experience. *J Cerebrovasc Endovasc Neurosurg*. 2020;22:211-215. doi: 10.7461/jcen.2020.E2019.11.001
12. Beaty N, Patel M, Martinez C, Hollis L. Use of flow diverter stent for treatment of a cervical carotid artery dissection and pseudoaneurysm causing Horner's syndrome. *BMJ Case Rep*. 2021;14. doi: 10.1136/bcr-2020-241156
13. Baptista-Sincos APW, Simplicio AB, Sincos IR, Leaderman A, Neto FS, Moraes A, Aun R. Flow-diverting Stent in the Treatment of Cervical Carotid Dissection and Pseudoaneurysm: Review of Literature and Case Report. *Ann Vasc Surg*. 2018;46:372-379. doi: 10.1016/j.avsg.2017.06.151
14. Wiesmann M, Kalder J, Reich A, Brockmann MA, Othman A, Greiner A, Nikoubashman O. Feasibility of combined surgical and endovascular carotid access for interventional treatment of ischemic stroke. *J Neurointerv Surg*. 2016;8:571-575. doi: 10.1136/neurintsurg-2015-011719
15. Nii K, Kazekawa K, Onizuka M, Aikawa H, Tsutsumi M, Tomokiyo M, Iko M, Kodama T, Matsubara S, Go Y, et al. Direct carotid puncture for the endovascular treatment of anterior circulation aneurysms. *AJNR Am J Neuroradiol*. 2006;27:1502-1504.
16. Dorfer C, Standhardt H, Gruber A, Ferraz-Leite H, Knosp E, Bavinzski G. Direct percutaneous puncture approach versus surgical cutdown technique for intracranial neuroendovascular procedures: technical aspects. *World Neurosurg*. 2012;77:192-200. doi: 10.1016/j.wneu.2010.11.007
17. Caplan LR, Biousse V. Cervicocranial arterial dissections. *J Neuroophthalmol*. 2004;24:299-305. doi: 10.1097/00041327-200412000-00007
18. Blanc R, Piotin M, Mounayer C, Spelle L, Moret J. Direct cervical arterial access for

intracranial endovascular treatment. *Neuroradiology*. 2006;48:925-929. doi: 10.1007/s00234-006-0157-1

19. Ghosh R, Chalouhi N, Sweid A, Saiegh FA, Khanna O, Mouchtouris N, Tjoumakaris S, Gooch MR, Rosenwasser RH, Jabbour PM. Carotid cutdown for mechanical thrombectomy in the setting of intravenous tissue plasminogen activator: A technical report. *J Clin Neurosci*. 2020;81:302-305. doi: 10.1016/j.jocn.2020.10.003
20. Takano I, Matsumoto Y, Fujii Y, Inoue Y, Sugiura Y, Kawamura Y, Suzuki R, Nakae R, Tanaka Y, Nagaishi M, et al. Carotid surgical cut-down technique for neuroendovascular therapy. *Interv Neuroradiol*. 2019;25:348-352. doi: 10.1177/1591019918815920
21. Kuhn AL, Singh J, Massari F, de Macedo Rodrigues K, Gounis MJ, Puri AS. Flow Diverter Reconstruction of Internal Carotid Artery (Loop) Dissections with or without Associated Pseudoaneurysms. *World Neurosurg*. 2022;162:e65-e72. doi: 10.1016/j.wneu.2022.02.073