



# A Traumatic Dural Arteriovenous Fistula between the Inferolateral Trunk of the Internal Carotid Artery and the Ophthalmic Vein: A Case of Transvenous Coil Embolization via the Facial Vein

아래가쪽동맥 외상성 손상에 의한 눈정맥의 경질막동정맥루: 얼굴정맥을 통한 경정맥 코일 색전술 사례

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A 31-year-old man was admitted with exophthalmos. He suffered from progressive exophthalmos, bruit and conjunctival chemosis 7 days after head trauma caused by falling down. Cerebral angiography showed a dural arteriovenous fistula (DAVF) draining into the ophthalmic vein caused by tear in the inferolateral trunk, which is a rare presentation of traumatic DAVF. Selective transvenous coil embolization was performed via the facial vein without neurologic complications.

### Index terms

Internal Carotid Artery  
Cranio-cerebral Trauma  
Dural Arteriovenous Fistula  
Therapeutic Embolization

Received December 22, 2015

Revised July 28, 2016

Accepted September 19, 2016

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## INTRODUCTION

DAVF caused by tear in the inferolateral trunk (ILT) is an uncommon pathology, which mainly involves the cavernous sinus as well as the adjacent draining veins (1-3). We describe a case of DAVF between the ophthalmic vein and the ILT, which is a rare pathology with symptoms mimicking carotid cavernous fistula, and it was treated successfully by performing transvenous coil embolization via the facial vein.

## CASE REPORT

A 31-year-old man was admitted with exophthalmos 7 days after head trauma. He suffered from progressive exophthalmos,

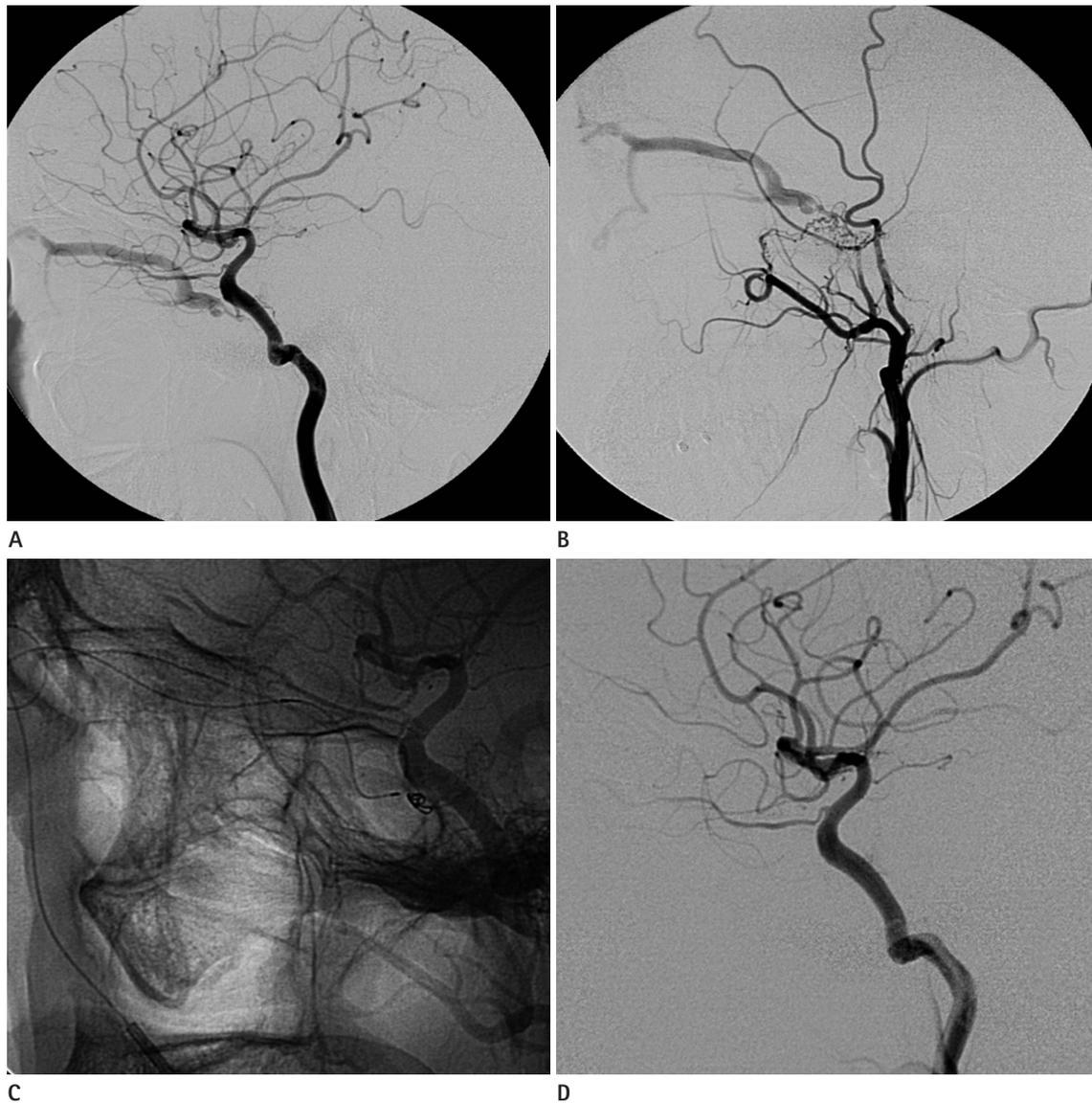
bruit and conjunctival chemosis. Cerebral angiography showed a dural arteriovenous fistula (DAVF) fed by the ILT, artery of the foramen rotundum of the internal maxillary artery (IMA) and the small branches of the right middle meningeal artery (MMA), draining mainly into the right superior ophthalmic vein (SOV) and the facial vein (Fig. 1A, B).

After informed consent was obtained, transvenous embolization was chosen in order to avoid the transarterial approach for preventing the progression of embolic complications. Through the right femoral vein, a 5F guiding catheter (Envoy, Codman Neurovascular, Raynham, MA, USA) was placed in the right internal jugular vein. Initially, transvenous approach via the right cavernous sinus was attempted, but it was unsuccessful due to navigation failure. Next, through the right facial vein, the

angular vein, to the SOV, a microcatheter (preshaped J Excelsior, Stryker, Fremont, CA, USA) could be navigated up to the far distal fistulous point under guidance of a 0.014-inch microwire (Synchro, Stryker) and embolization was performed using a single coil (GDC helical 2 × 5 mm, Stryker) (Fig. 1C). Immedi-

ately after the procedure, angiography confirmed that the fistula was completely occluded (Fig. 1D).

After the procedure, his ocular symptoms improved without any neurologic complications and he was discharged well. The patient had no recurrent symptoms at the 12-month follow-up.



**Fig. 1.** A dural arteriovenous fistula of the ophthalmic vein caused by traumatic injury of the inferolateral trunk in a 31-year-old male who presented with exophthalmos.

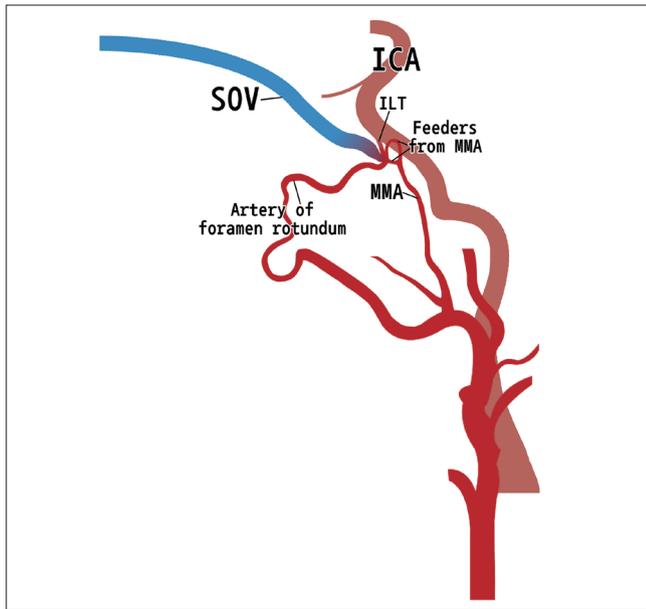
**A.** The right ICA angiography showed a fistulous point between the right ILT and confluence of right ophthalmic veins.

**B.** The right ECA angiography showed a dural arteriovenous fistula with multiple dural feeders from the right MMA, artery of foramen rotundum of the internal maxillary artery, which formed a common fistulous point draining directly into the confluence of right ophthalmic veins.

**C.** Through the right facial vein and the SOV, a microcatheter was navigated distal to the fistulous point and embolization was performed using a detachable coil (2 × 5 mm).

**D.** The right ICA angiography performed immediately after the procedure showed complete obliteration of the dural arteriovenous fistula between the ophthalmic vein and the inferolateral trunk.

ECA = external carotid artery, ICA = internal carotid artery, MMA = middle meningeal artery, SOV = superior ophthalmic vein



**Fig. 2.** Diagram of the dural arteriovenous fistula. Multiple feeders from the right MMA, artery of foramen rotundum of the internal maxillary artery formed a common fistulous point draining directly into the confluence of right ophthalmic veins.

ICA = internal carotid artery, MMA = middle meningeal artery, SOV = superior ophthalmic vein

## DISCUSSION

DAVFs associated with the ILT have been rarely reported in the literatures (1-3). Duncan and Fourie (1) reported a case of traumatic DAVF between the cavernous sinus and the ILT and its management with transarterial embolization. Uchiyama et al. (2) described a spontaneous DAVF fed by the ILT and draining into the superficial sylvian vein with varix formation, which was treated by surgical clipping. Interestingly, the case presented in this report showed a rare type of DAVF fed by the ILT, MMA, and IMA forming a common fistulous tract, draining directly into the confluence of ophthalmic veins (Fig. 2) without cavernous sinus involvement, but with symptoms mimicking carotid cavernous fistula. Horie et al. (3) also reported a similar case, which was treated by transarterial embolization via the ILT.

In some anatomical reports (4), the ILT was identified in 80% of cadaveric studies, and it arose directly from the cavernous part of the ICA in 84% of studies and from the meningohypophyseal trunk in 6% of studies. ILT gives off branches that run to the superior orbital fissure, foramen rotundum, foramen ovale, and foramen spinosum, where they anastomose with

branches of the IMA, the MMA and the accessory meningeal artery. Any of these branches can be injured and may be connected to venous structures outside the cavernous sinus after head trauma (2, 5). The anterior ramus of the ILT divides into medial and lateral branches: the former supplies the third, fourth, and fifth cranial nerves and ends as the deep recurrent ophthalmic artery, which interrelates with some branches of the IMA; the latter supplies the dura of the adjacent temporal fossa and the nerve, and it anastomoses with the artery of the foramen rotundum. Unique hemodynamics in this case could be explained by the anatomical proximity of the ILT to the SOV, adjacent narrowing of the transitional zone from the ophthalmic confluence to the cavernous sinus, and topographical complexity of the superior orbital fissure (3, 6).

Endovascular treatment has become the first treatment option for DAVF because it can offer similar results with use of a less invasive approach, while direct vascular surgery or indirect packing may be performed only if the endovascular option fails (2, 5). In this case, we preferred the transvenous approach via the facial vein to transarterial embolization via the ILT, MMA, or IMA due to the possible risk of cranial nerve damage from embolic complications. Some authors (1) reported catheterization failure in the ILT via the transarterial approach and development of neurologic complications following transarterial glue embolization via the MMA or ILT. Kiyosue et al. (7) also described the potential risk of ophthalmic nerve injury following embolization of the distal branches of the IMA.

For transvenous embolization of paracavernous DAVFs, Kim et al. (8) remarked that the facial vein is likely to be a safe and effective route, and our case was also treated successfully through the same route. Caragine et al. (9) described transvenous embolization of DAVFs of the ophthalmic vein fed by the ophthalmic artery and the IMA or the MMA without any neurological deficit.

In conclusion, a DAVF between the ILT and the ophthalmic vein without direct involvement of the cavernous sinus caused by traumatic injury of the ILT is a rare pathology, and it was successfully treated with transvenous coil embolization.

## REFERENCES

1. Duncan IC, Fourie PA. Type D traumatic carotido-cavern-

- ous fistula due to selective transection of the inferolateral trunk (ILT). Diagnosis and endovascular treatment. *Interv Neuroradiol* 2003;9:373-377
2. Uchiyama T, Horiuchi T, Murata T, Hongo K. Dural arteriovenous fistula between inferolateral trunk of the internal carotid artery and superficial sylvian vein. *Neurol Med Chir (Tokyo)* 2011;51:642-644
  3. Horie N, Morikawa M, So G, Hayashi K, Suyama K, Nagata I. Direct arteriovenous fistula at the inferolateral trunk mimicking carotid cavernous fistula without involving the cavernous sinus: a case report. *Acta Neurochir (Wien)* 2012; 154:465-469
  4. Rhoton AL Jr. The cavernous sinus, the cavernous venous plexus, and the carotid collar. *Neurosurgery* 2002;51(4 Suppl): S375-S410
  5. Tu YK, Liu HM, Hu SC. Direct surgery of carotid cavernous fistulae and dural arteriovenous malformations of the cavernous sinus. *Neurosurgery* 1997;41:798-805; discussion 805-806
  6. Govsa F, Kayalioglu G, Erturk M, Ozgur T. The superior orbital fissure and its contents. *Surg Radiol Anat* 1999;21: 181-185
  7. Kiyosue H, Tanoue S, Hongo N, Sagara Y, Mori H. Artery of the superior orbital fissure: an undescribed branch from the pterygopalatine segment of the maxillary artery to the orbital apex connecting with the anteromedial branch of the inferolateral trunk. *AJNR Am J Neuroradiol* 2015; 36:1741-1747
  8. Kim MJ, Shin YS, Ihn YK, Kim BM, Yoon PH, Oh SY, et al. Transvenous embolization of cavernous and paracavernous dural arteriovenous fistula through the facial vein: report of 12 cases. *Neurointervention* 2013;8:15-22
  9. Caragine LP Jr, Halbach WW, Dowd CF, Higashida RT. Intra-orbital arteriovenous fistulae of the ophthalmic veins treated by transvenous endovascular occlusion: technical case report. *Neurosurgery* 2006;58(1 Suppl):ONS-E170; discussion ONS-E170

## 아래가쪽동맥 외상성 손상에 의한 눈정맥의 경질막동정맥루: 얼굴정맥을 통한 경정맥 코일 색전술 사례

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31세 남자가 안구돌출증으로 입원하였다. 환자는 7일 전 추락 사고로 인한 두부 외상 후 점차 심해지는 안구돌출, 잡음, 결막부종을 호소하였다. 뇌혈관조영술에서 아래외측동맥의 손상에 의해 발생한 눈정맥과의 경질막동정맥루가 발견되었고, 이것은 외상성 경질막동정맥루 중에서 드문 경우이다. 얼굴정맥을 통한 선택적 경정맥 코일 색전술이 신경학적 합병증 없이 시행되었다.

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