Case Report

Thrombosed giant aneurysm of the distal anterior cerebral artery treated with aneurysm resection and proximal pericallosal artery–callosomarginal artery end-to-end anastomosis: Case report and review of the literature

Ken Matsushima, Masatou Kawashima, Kenji Suzuyama, Yukinori Takase, Tetsuro Takao, Toshio Matsushima

Department of Neurosurgery, Saga University, Saga, Japan

E-mail: Ken Matsushima - ken.matsushima@hotmail.co.jp; *Masatou Kawashima - m996kawa@cc.saga-u.ac.jp; Kenji Suzuyama - suzu@karatsu.jrc.or.jp; Yukinori Takase - takase@cc.saga-u.ac.jp; Tetsuro Takao - montblanc1999da@yahoo.co.jp; Toshio Matsushima - matsuto@cc.saga-u.ac.jp

*Corresponding author

Received: 15 June 11 Accepted: 4 August 11 Published: 30 September

Abstract

Background: Giant distal anterior cerebral artery (DACA) aneurysms are extremely rare, with only 32 cases reported in the literature. Most giant DACA aneurysms have features that make standard neck clipping difficult, and bypass surgery is sometimes required, although this surgery was performed in only three reported cases. This report presents the fourth case treated with bypass surgery.

Case Description: A 69-year-old female presented with an unruptured thrombosed giant DACA aneurysm. She underwent wrapping operation 7 years before, but radiological imaging revealed enlargement of the aneurysm at the left pericallosal artery (PerA)–callosomarginal artery (CMA) junction. Before operation, three different strategies were considered for bypass surgery in case the neck could not be clipped. Aneurysm resection and left proximal PerA–CMA end-to-end anastomosis were successfully performed under intraoperative digital subtraction angiography (DSA) and motor-evoked potential (MEP) monitoring.

Conclusion: Most DACA aneurysms are located at the PerA–CMA junction. In some cases, adequate retrograde flow to the distal PerA from the posterior or middle cerebral artery can be expected, making distal PerA reconstruction unnecessary. Moreover, when the distal PerA is cut, proximal PerA–CMA end-to-end anastomosis can be easily performed because of reduced tension in both vessels. We therefore conclude that this strategy should be utilized for treating such patients. We also presented here the effectiveness of intraoperative modalities, such as intraoperative DSA and MEP monitoring, for performing a safe operation.

Key Words: Bypass surgery, distal anterior cerebral artery, end-to-end anastomosis, intraoperative modalities, pericallosal artery, thrombosed giant aneurysm
INTRODUCTION

Distal anterior cerebral artery (DACA) aneurysms are rare, comprising approximately 5% of all intracranial aneurysms. Most DACA aneurysms are small. These aneurysms are known for their tendency to bleed even when they are very small and for difficulty with surgical treatment. Giant DACA aneurysms are extremely rare. To our knowledge, 32 cases have been reported, including only 3 cases treated with bypass surgery.

We successfully treated an elderly woman who presented with a partially thrombosed giant DACA aneurysm with aneurysm resection and proximal pericallosal artery (PerA)–callosomarginal artery (CMA) end-to-end anastomosis. We report here surgical treatments available for giant DACA aneurysms and the effectiveness of intraoperative modalities for performing a safe operation.

CASE REPORT

History

In August 2003, a 69-year-old female who had hypertension and an abdominal aortic aneurysm complained of dizziness. A computed tomography (CT) scan showed a 15-mm heterogeneous mass in the cerebral left frontal lobe [Figure 1a]. Neck clipping of this partially thrombosed DACA aneurysm was unsuccessful because of severe calcification. Therefore, wrapping operation was performed. After the operation, the patient showed no symptoms for 7 years.

In September 2010, magnetic resonance angiography at a local hospital revealed enlargement of the aneurysm, and the patient was admitted to our hospital. Neurological examinations did not show any abnormal findings. A CT scan [Figure 1b] and magnetic resonance imaging [Figure 1c] showed a 28-mm giant aneurysm with severe calcification and perifocal edema. Three-dimensional CT angiography (3D-CTA) [Figure 1d] and three-dimensional digital subtraction angiography (DSA) of the left internal carotid artery (ICA) [Figure 1e] demonstrated that the aneurysm was located at the left PerA–CMA junction. These examinations showed the presence of five additional aneurysms, including an anterior communicating artery (AcomA) aneurysm and a right middle cerebral artery (MCA) aneurysm.

Surgical strategy

Because of the obvious enlargement of the aneurysm and perifocal edema, we planned surgical treatment. Standard neck clipping [Figure 2a] seemed difficult because of severe calcification, similar to that observed in the previous operation. Therefore, three possible strategies were considered for bypass surgery before...
operation [Figure 2b–d]. Reconstruction of the left CMA was necessary because it is a major branch supplying the anterior cerebral artery (ACA) territory. However, the possible need for reconstruction of the left distal PerA was left to be decided during operation.

**Operation**

Intraoperative DSA and transcranial motor-evoked potential (MEP) monitoring were performed in this operation. Bifrontal craniotomy was performed on the patient under general anesthesia. Initially, the neck of an AcomA aneurysm was clipped using the interhemispheric approach. We proceeded distally along both A2 vessels and found the DACA aneurysm at the left PerA–CMA junction. The aneurysm was yellowish and solid because of severe calcification [Figure 3a]. The left distal PerA was running behind the aneurysm and was densely adherent to the aneurysm because of fibrosis from the previous wrapping operation and could not therefore be dissected from the aneurysm. An occlusion test of the left A2 segment at its proximal portion was performed for 20 min. During this procedure, intraoperative DSA confirmed good retrograde flow in the left distal PerA, and MEP amplitude showed no changes. Based on these findings, the left distal PerA was cut just distal to the aneurysm after clipping without any reconstruction.

Temporary clips were placed on the left A2 segment and left CMA to trap the aneurysm. The aneurysm was incised and the thrombus within the aneurysm was removed. After removal of the thrombus, three lumens were visualized in the aneurysm [Figure 3b]. Neck clipping with reconstruction was attempted but could not be performed without occlusion of the parent artery because of severe calcification of the neck. MEP amplitude subsequently decreased to 50% of the control level while attempting neck clipping. At this point, it was apparent that the neck of the aneurysm could not be clipped with preservation of the feeding artery. Therefore, aneurysm resection and proximal PerA–CMA end-to-end anastomosis [Figure 2c] were performed [Figure 3c]. After anastomosis, intraoperative DSA and microvascular

---

**Figure 2:** Illustrations showing four possible surgical strategies. Reconstruction for the left distal PerA was to be decided during operation. (b) Shows the reconstructive procedure for the left distal PerA, and (c) and (d) show the surgical strategies requiring no reconstruction. (a) Neck clipping. (b) Left A2 trapping plus A3–A3 side-to-side anastomosis with reconstruction of the left distal PerA by right CMA–left distal PerA side-to-end anastomosis. (c) Left A2 trapping plus bonnet bypass using a short graft of the right superficial temporal artery. (d) Aneurysm resection plus proximal PerA–CMA end-to-end anastomosis

**Figure 3:** Intraoperative photographs taken during the interhemispheric approach. (a) A yellowish solid aneurysm (box) at the left PerA (short arrow)–CMA (long arrow) junction. (b) Thrombectomy of the aneurysm while trapping the aneurysm after cutting the left distal PerA. The neck of the aneurysm is highly calcified. (c) Left proximal PerA–CMA end-to-end anastomosis
Doppler ultrasonography demonstrated good flow in the left CMA and adequate retrograde flow to the left distal PerA from the left MCA through leptomeningeal anastomosis. MEP amplitude was maintained at the control level until dural closure. Findings from intraoperative DSA are shown in Figure 4.

**Postoperative course**

The patient had no neurological deficits after operation, and the postoperative CT scan demonstrated no infarction including the left ACA territory [Figure 5a]. Elimination of the aneurysm and good flow in the left CMA were observed on 3D-CTA [Figure 5b]. The patient was doing well 6 months after operation.

**DISCUSSION**

Giant intracranial aneurysms (≥25 mm in diameter) comprise approximately 5% of all intracranial aneurysms,\(^1,2,5,22\) and most of them arise on the proximal segment of the cerebral arteries, such as ICAs and the vertebrobasilar arteries. In most cases, standard neck clipping is difficult because of specific characteristics of the aneurysms, such as the broad neck, involvement of the branch vessels, calcification and thrombus. In the cases of giant ACA aneurysms, Yokoh et al. studied and proposed many variations of bypass surgeries to reconstruct ACAs and their branches.\(^{36}\) The aneurysms should be treated using appropriate surgical methods because of their poor natural history.

Although the natural history of unruptured giant intracranial aneurysms has not been sufficiently clarified, many authors reported high rupture rates and high mortality.\(^1,2,16,22,33\) The risk of aneurysm rupture increases with aneurysm size. In the ISUIA (International Study of Unruptured Intracranial Aneurysms), the 5-year cumulative rupture rate for anterior circulation was 40% and that for posterior circulation was 50%.\(^{33}\) Peerless et al., who reported 31 untreated cases of patients with giant aneurysms, including 25 saccular and 6 fusiform types, stated that the mortality rate with the saccular type was 68% at 2 years and that all but four patients were dead at 5 years.\(^{22}\) Moreover, when an aneurysm is extensively or completely thrombosed, it still has a risk of rupture and the natural history may be even poorer.\(^2\)

Most DACA aneurysms arise at the PerA–CMA junction.\(^{14}\) In de Sousa’s report, 61 of 74 aneurysms were located at the PerA–CMA junction.\(^{18}\) Yasargil stated that DACA aneurysms present specific difficulties during surgery, including a narrow working space in the interhemispheric fissure, dense adhesions between the cingulated gyri, a broad-based and/or sclerotic neck in the aneurysm, difficulty in controlling the parent artery, the fixed dome on the pial layer and increased association of multiple aneurysms and vascular anomalies.\(^{35}\) In addition, they are fragile and frequently rupture prematurely during exposure.
Table 1: Summary of reported cases of giant distal anterior cerebral artery aneurysms

| Author (year)          | Age | Sex | Symptoms and signs                              | Treatment                                                                 | Outcome       |
|------------------------|-----|-----|-------------------------------------------------|---------------------------------------------------------------------------|---------------|
| Drake CG (1979)        | 41  | M   | SAH                                             | Occlusion of the neck, evacuation of the thrombus                         | Dead          |
| Pia HW et al. (1979)   | -   | -   | SAH                                             | Clipping of the feeding artery, resection of the sac                      | Good          |
| O’Neill M et al. (1980)| 29  | F   | Loss of limb control, headache, ataxia, incontinence | Thrombectomy                                                             | Good          |
| Pozzati E et al. (1982)| 20  | F   | Headache, papilledema                           | Clipping of the feeding artery, aneurysm resection                        | Good          |
| Smith RR et al. (1982) | 67  | M   | SAH                                             | Aneurysm resection, end-to-end anastomosis of ACA                        | Good          |
| Shigemori M et al. (1982)| 69 | F   | Headache, hemiparesis, memory disturbance, disorientation | Neck clipping, thrombectomy                                               | Good          |
| Hayashi M et al. (1985)| 57  | M   | Transient hemiparesis                           | Conservative                                                              | Unchanged     |
| Hayashi M et al. (1985)| 59  | M   | Seizures, anosmia                               | Neck clipping, thrombectomy                                               | Good          |
| Yamagami T et al. (1986)| 51 | M   | Gait disturbance, dysarthria, dysphasia, left to right angnosia | Neck clipping                                                            | Good          |
| Nitta T et al. (1987)  | 61  | M   | Headache                                        | Thrombectomy, aneurysmorrhaphy                                           | Good          |
| Fukushima T (1987)     | 68  | M   | No rupture                                      | Neck clipping                                                            | Dead          |
| Maiuri F et al. (1990) | 64  | M   | Transient ataxia, loss of vision, dizziness     | Conservative                                                             | Unchanged     |
| Mishima K et al. (1990)| 53  | M   | Meningitis                                      | Neck clipping, thrombectomy                                               | Vegetative    |
| Hernesniemi J et al. (1992)| - | -   | -                                               | -                                                                        | Good          |
| Preul M et al. (1992)  | 72  | M   | Mental deterioration                            | Clipping of the feeding artery, thrombectomy                             | Dysphasia     |
| Hashizume K et al. (1992)| 67 | M   | SDH                                             | Neck clipping, resection of the sac                                       | Good          |
| Shiokawa K et al. (1993)| 69 | F   | SAH                                             | Neck clipping, thrombectomy                                               | Good          |
| Farias JP et al. (1997)| 49  | F   | Intracerebral hematoma                          | Neck clipping, thrombectomy                                               | Good          |
| de Sousa AA et al. (1999)| - | -   | Operation (clipping)                            | Operation (clipping)                                                     | Good          |
| de Sousa AA et al. (1999)| - | -   | Operation (clipping)                            | Operation (clipping)                                                     | Good          |
| Kanemoto Y et al. (2000)| 77 | F   | Acute onset of akinetic mutism                  | Neck clipping, thrombectomy                                               | Good          |
| Ewald CH et al. (2000) | -   | -   | Headache, hemiparesis                           | Clipping of the feeding artery, CCA–PerA side-to-end anastomosis using a saphenous vein graft | Good          |
| Koyama S (2000)        | 66  | F   | SAH, SDH                                        | Neck clipping                                                            | Dead          |
| Hoh BL et al. (2001)   | -   | -   | Endovascular proximal occlusion                 | Endovascular proximal occlusion                                          | Good          |
| Hoh BL et al. (2001)   | -   | -   | Endovascular proximal occlusion, A3–A3 side-to-side anastomosis | Good          |
| Ture U et al. (2001)   | 65  | F   | Headache, personality changes, seizures, papilledema | Neck clipping, thrombectomy                                               | Good          |
| Topsakal C et al. (2003)| 65 | F   | SAH                                             | Neck clipping                                                            | Dead          |
| Biondi A et al. (2006) | 60  | F   | Visual deficit                                  | Endovascular proximal occlusion                                          | Good          |
| Biondi A et al. (2006) | 49  | M   | SAH                                             | Endovascular proximal occlusion                                          | Good          |
| Steven DA et al. (2007) | -  | -   | Operation                                       | Operation                                                                | -             |
| Steven DA et al. (2007) | -  | -   | Operation                                       | Operation                                                                | -             |
| Park DH et al. (2008)  | 65  | F   | Headache, memory loss, hemiparesis              | Neck clipping, thrombectomy                                               | Good          |
| Matsushima K et al. (2011)| 69 | F   | None                                            | Aneurysm resection, proximal PerA–CMA end-to-end anastomosis              | Good          |

Gray zone of the table indicates four cases treated with bypass surgery. SAH: Subarachnoid hemorrhage, ACA: Anterior cerebral artery, SDH: Subdural hematoma, CCA: Common carotid artery, PerA: Pericallosal artery, CMA: Callosomarginal artery.
Giant DACA aneurysms are extremely rare. This may be due to their tendency to rupture early. This feature may be related to anatomical features such as the lack of resistant arachnoid membranes at the level of the pericallosal cisterns. In 2009, Gelfenbeyn et al. reviewed the largest series of 26 cases of giant DACA aneurysms. We reported here six more cases and one additional case of our own, thereby reviewing a total of 35 cases. [Table 1]. Thirty of the 35 cases were treated surgically, and the neck was clipped in 13 of them. Only four cases were treated with bypass surgery, and good outcomes were obtained in all of them. The first bypass surgery, including aneurysm resection and end-to-end anastomosis of ACA, was reported in 1982. The second case involved clipping of the parent artery and common carotid artery—PerA side-to-end anastomosis using a saphenous vein graft, while the third case involved A3–A3 side-to-side anastomosis with endovascular proximal occlusion.

In our case, standard neck clipping with preservation of the parent artery was impossible because of severe calcification. A3–A3 side-to-side anastomosis seemed difficult in the narrow and deep working space in the interhemispheric fissure, and it might have required longer occlusion time. Furthermore, the bonnet bypass using the right superficial temporal artery was suspected to cause ischemia of the scalp in our case. Eventually, PerA–CMA end-to-end anastomosis with aneurysm resection was selected as the most appropriate treatment.

End-to-end anastomosis with aneurysm resection is usually excluded as a treatment for aneurysms because the vessels cannot be anastomosed as a result of their lengths. However, in some cases of aneurysm at the PerA–CMA junction, adequate retrograde flow in the distal PerA can be expected because PerA is supplied from the posterior cerebral artery through the posterior PerA or from MCA through leptomeningeal anastomosis. In such cases, reconstruction of the distal PerA is not necessary. Moreover, when the distal PerA is cut, proximal PerA–CMA end-to-end anastomosis becomes easier because the anastomosis site becomes more flexible and tension at this site reduces.

For safe treatment of giant aneurysms, it is very important to plan alternative strategies before operation and change the strategy during operation if necessary. Moreover, intraoperative modalities including intraoperative DSA and MEP monitoring are helpful in deciding the strategy. In our case, the distal PerA could be cut without any reconstruction because adequate retrograde flow was observed in DSA. The decreased MEP amplitude suggested occlusion of the parent artery, and the recovery of MEP amplitude suggested preservation of the parent artery. After anastomosis, intraoperative DSA and microvascular Doppler ultrasonography proved good patency of anastomosis.

**CONCLUSION**

Giant DACA aneurysms are extremely rare, and surgical treatment is very difficult in most cases. We conclude that proximal PerA–CMA end-to-end anastomosis with aneurysm resection is a useful treatment for thrombosed giant DACA aneurysms at the PerA–CMA junction, especially when the distal PerA can be cut. In this report, we also presented the effectiveness of intraoperative modalities, such as intraoperative DSA and MEP monitoring, for performing a safe operation.

**ACKNOWLEDGMENTS**

We would like to express our gratitude to Mrs. Akiko Soejima, Mrs. Takako Shiga and Mrs. Sumiko Matsuhashi for their assistance in preparing and completing this manuscript.

**REFERENCES**

1. Anson JA. Giant aneurysms. Epidemiology and natural history. In: Awad IA, Barrow DL, editors. Giant Cerebral Aneurysms. Park Ridge, IL: AANS, 1995.
2. Barrow DL, Alleyne C. Natural history of giant intracranial aneurysms and indications for intervention. Clin Neurosurg 1995;42:214-44.
3. Biondi A, Jean B, Vivas E, Le Jean L, Boch AL, Chiras J, et al. Giant and large peripheral cerebral aneurysms: Endovascular considerations. Endovascular treatment, and long-term follow-up. AJNR Am J Neuroradiol 2006;27:1685-92.
4. De Sousa AA, Dantas FL, de Cardoso GT, Costa BS. Distal anterior cerebral artery aneurysms. Surg Neurol 1999;52:128-36.
5. Drake CG. Giant intracranial aneurysms: Experience with surgical treatment in 174 patients. Clin Neurosurg 1979;26:12-95.
6. Ewald CH, Kuhne D, Hassler WE. Bypass-surgery and coil-embolisation in the treatment of cerebral giant aneurysms. Acta Neurochir (Wien) 2000;142:731-8.
7. Farias JP, Trindade AM. Giant distal anterior cerebral artery aneurysm not visualized on angiography: Case report. Surg Neurol 1997;48:348-51.
8. Gelfenbeyn M, Natarajan SK, Sekhar LN. Large distal anterior cerebral artery aneurysm treated with resection and interposition graft: Case report. Neurosurgery 2009;64:E1008-9.
9. Hashizume K, Nukui H, Horikoshi T, Kaneko M, Fukamachi A. Giant aneurysm of the ayzygos anterior cerebral artery associated with acute subdural hematoma. Case report. Neurol Med Chir (Tokyo) 1999;39:693-7.
10. Hayashi M, Kobayashi H, Kawano H, Handa Y, Kubo M. Giant aneurysm of an ayzygos anterior cerebral artery: Report of two cases and review of the literature. Neurosurgery 1985;17:341-4.
11. Heningeniem J, Tapaniino A, Vapalaiti M, Niskanen M, Kari A, Lukkonen M. Saccular aneurysms of the distal anterior cerebral artery and its branches. Neurosurgery 1992;31:994-9.
12. Hoh BL, Putman CM, Budzik RF, Carter BS, Ogilvy CS. Combined surgical and endovascular techniques of flow alteration to treat fusiform and complex wide-necked intracranial aneurysms that are unsuitable for clipping or coil embolization. J Neurosurg 2001;95:24-35.
13. Kanemoto Y, Tanaka Y, Nonaka M, Hironaka Y. Giant aneurysm of the ayzygos anterior cerebral artery: Case report. Neurol Med Chir (Tokyo) 2000;40:472-9.
14. Kawashima M, Matsushima T, Sasaki T. Surgical strategy for distal anterior cerebral artery aneurysms. Microsurgical anatomy. J Neurosurg 2003;99:517-25.
15. Kayama S. Giant aneurysm of the pericallosal artery causing acute subdural hematoma: Case report. Neurol Med Chir (Tokyo) 2000;40:268-71.
16. Lawton MT, Spetzler RF. Surgical management of giant intracranial aneurysms: Experience with 171 patients. Clin Neurosurg 1995;42:245-66.
17. Mairi F, Corrigo G, D’Amico L, Simonetti L. Giant aneurysm of the pericallosal artery. Neurosurgery 1990;26:703-6.
18. Mishima K, Watanabe T, Sasaki T, Saito I, Takakura K. An infected partially
thrombosed giant aneurysm of the azygous anterior cerebral artery. No Shinkei Geka 1990;18:475-81.

19. Nitta T, Nakajima K, Maeda M, Ishii S. Completely thrombosed giant aneurysm of the pericallosal artery: Case report. J Comput Tomogr 1987;11:140-3.

20. O’Neill M, Hope T, Thompson G. Giant intracranial aneurysms: Diagnosis with special reference to computerized tomography. Clin Radiol 1979;31:27-36.

21. Park DH, Chung YG, Shin IY, Lee JB, Suh JK, Lee HK. Thrombosed giant aneurysm of the pericallosal artery with inconclusive findings of multiple neuroimaging studies: Case report. Neuror Med Chir (Tokyo) 2008;48:26-9.

22. Peerless SJ, Wallace MC, Drake CG. Giant intracranial aneurysms. In: Youmans JR, editor. Neurological Surgery. 3rd ed. Philadelphia, PA: WB Saunders; 1990. p. 1742-63.

23. Pia HW, Zierski J. Giant cerebral aneurysms: Problems in treatment. In: Pia HW, Langmaid C, Zierski J, editors. Cerebral aneurysms. Advances in diagnosis and therapy. Berlin: Springer; 1979. p. 336-42.

24. Pozzati E, Nuzzo G, Gaist G. Giant aneurysm of the pericallosal artery: Case report. J Neurosurg 1982;57:566-9.

25. Preul M, Tampieri D, Leblanc R. Giant aneurysm of the distal anterior cerebral artery: Associated with an anterior communicating artery aneurysm and dural arteriovenous fistula. Surg Neurol 1992;38:347-52.

26. Shigemori M, Kawaba T, Ogata T, Yoshimura K, Kuramoto S. Giant aneurysm of the distal anterior cerebral artery simulating brain tumor on CT scan. CT Kenkyu 1982;4:456-9.

27. Shiokawa K, Tanikawa T, Satoh K, Kawamata T, Kubo O, Kagawa M. Two cases of giant aneurysms arising from the distal segment of the anterior cerebral circulation. No Shinkei Geka 1993;21:467-72.

28. Sindou M, Guyotat JP, Mertens P, Keravel Y, Athayde AA. Pericallosal aneurysms. Surg Neurol 1988;30:434-40.

29. Smith RR, Parent AD. End-to-end anastomosis of the anterior cerebral artery after excision of a giant aneurysm: Case report. J Neurosurg 1982;56:577-80.

30. Steven DA, Lowrie SP, Ferguson GG. Aneurysms of the distal anterior cerebral artery: Results in 59 consecutively managed patients. Neurosurgery 2007;60:227-34.

31. Topskal C, Ozveren MF, Erol FS, Cihangiroglu M, Cetin H. Giant aneurysm of the azygous pericallosal artery: Case report and review of the literature. Surg Neurol 2003;60:524-33.

32. Tate U, Hidemonez T, Elmaci I, Peker S. Giant pericallosal artery aneurysm: Case report and review of the literature. Neurosurg Rev 2001;24:151-5.

33. Wiebers DO, Whisnant JP, Huston J 3rd, Meissner I, Brown RD Jr, Piepgras DG, et al. International study of unruptured intracranial aneurysms investigators. Lancet 2003;362:103-10.

34. Yamagami T, Handa H, Hashimoto N, Nagata H, Watanabe H. Giant aneurysm of the azygous anterior cerebral artery. Arch Jpn Chir 1986;55:777-82.

35. Yasargil MG. Microneurosurgery. Vol. 1. New York; Georg Thieme Verlag; 1984.

36. Yokoh A, Ausman JJ, Dujovny M, Diaz FG, Berman SK, Sanders J, et al. Anterior cerebral artery reconstruction. Neurosurgery 1986;19:26-35.