The annual incidence of intracranial VA dissecting aneurysms is estimated to be 1–1.5 per 100,000 people, and are increasingly recognized as a cause of stroke and devastating SAH. Although the treatment of cerebral aneurysms has exhibited noticeable improvements in recent years with the advent of microsurgical and endovascular techniques, VA dissecting aneurysms are still believed to be difficult to treat due to their deep position, morphological features, and proximity to some important branches arteries such as the PICA and ASA. A wide variety of treatment regimens have been advocated for intracranial VA dissecting aneurysms, including antithrombotic treatment, surgical trapping or wrapping, endovascular trapping, and proximal occlusion, using balloons and coils, with or without stents. Recently, another exciting development in stent technology has evolved—the use of covered stent grafts to obliterate the dissecting aneurysm from the VA without coil embolization. This innovative stent technology has the theoretical advantage of obliterating blood flow into aneurysms, as well as reconstruction of the parent vessels. Covered stent grafts have been used primarily in aneurysms involving vascular territories that are easier to access than the intracranial vasculature, such as the abdominal aorta, axillary artery, subclavian arteries, popliteal artery, and iliac and femoral arteries. In the past decade, covered stents have been used in the proximal extracranial carotid artery and VA to treat traumatic aneurysms or fistulas. In the past 6 years covered stent grafts have been successfully applied...
Covered stent grafts in intracranial vertebral artery aneurysms

in treating intracranial vascular diseases, including CCFs and intracranial aneurysms (traumatic, giant, fusiform, and dissecting aneurysms). In this paper we present our experience using covered stent grafts to treat intracranial VA dissecting aneurysms in 6 patients, with 6–14 months of angiographic follow-up.

Methods

Patient Population

This study included 6 consecutive cases of intracranial VA dissecting aneurysms treated using Jostent covered stent graft (Graftmaster, Abbott Vascular) placement at a single institution (the Neurosurgery Department of West China Hospital) between November 2005 and December 2006. During the same period, 31 intracranial aneurysms were treated using endovascular techniques, and 217 were treated using microsurgical clip placement. The 6 cases were composed of 5 men and 1 woman, with a mean age of 41 years (range 28–57 years). All patients were symptomatic. One patient was admitted for chronic headache, and the other 5 for SAH. In all cases, CT scanning was performed to detect if SAH and hydrocephalus were present, and DS angiography was performed to determine the location of the aneurysm. Four aneurysms were located in the VAs proximal to the PICAs, and 2 were located in the VAs distal to the PICAs (Table 1).

This study included patients with VA dissecting aneurysms in whom the use of conventional techniques such as microsurgical clip placement and endovascular coil embolization (with or without stent placement) would not satisfactorily treat the aneurysms. Patients were selected in accordance with the following criteria: 1) the involved VAs should not be tortuous with deep curves; 2) the covered stents could easily traverse the dissection; and 3) the dissection had to be distant from important blood vessels such as the PICA and VBJ by at least 2 mm to avoid covering the origin of these important arteries. The involved ASA had to meet the same criteria as the VAs, except if the ASAs were bilateral or with satisfactory collateral circulation; in those cases, the dissection could be within 2 mm of the ASAs. Although use of covered stent grafts would not sacrifice the parental VAs, we evaluated the compensatory ability of the contralateral VAs in all cases.

Stent Placement Procedures

Before the endovascular procedure, the patient was positioned supine in a dedicated neuroangiography suite and general anesthesia was induced. The patient’s heart rate, blood pressure, oxygen saturation, and urine output were monitored throughout the procedure. Two intravenous paths were established for drug administration. A 6 Fr femoral introducer was placed into the patient’s right femoral artery. Systematic heparinization was initiated immediately after the catheter placement, with intermittent bolus administrations performed throughout the entire procedure to keep the activated clotting time at 2–2.5 times normal. Selective catheterizations of the VAs were performed using a 6 Fr Envoy guiding catheter (Cordis) for angiography.

Proper covered stent grafts were chosen based on the sizes of the aneurysms and their parent vessel, which was confirmed using angiography. Subsequently, a 6 Fr Envoy guiding catheter was positioned proximally in the affected vessel. A Prowler-14 microcatheter (Cordis) carrying an Essence microguidewire was navigated across the level of the aneurysm with its tip in the distal parent vessel. The Essence microguidewire was then replaced with a Transcend ES 0.014-in, 300-cm exchange guidewire, so that the Jostent covered stent graft could reach the level of the aneurysm by following the exchange guidewire. After careful angiographic confirmation of the lumen of the aneurysm and the ostium of the ipsilateral perforating branches (PICA and ASA), stent delivery was accomplished using a single brief dilation of the balloon up to 8–10 atm. The balloon catheter was withdrawn after deflation, with care taken to maintain the position of the guidewire across the aneurysm. Control angiography was then performed to confirm proper stent position.

### TABLE 1: Summary of patient clinical, treatment, and follow-up data*

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Clinical Presentation</th>
<th>Aneurysm Location</th>
<th>Time Btwn SAH &amp; Treatment</th>
<th>Aneurysm Size (mm)</th>
<th>Stent Size (mm)</th>
<th>Angiogram Result</th>
<th>FU Duration (mos)</th>
<th>Clinical Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57, M</td>
<td>chronic headache</td>
<td>rt VA, PICA (P)</td>
<td>6 days</td>
<td>3.5 × 13</td>
<td>4.05 × 16</td>
<td>aneurysm obliterated, no stenosis in parent vessel</td>
<td>14</td>
<td>full recovery</td>
</tr>
<tr>
<td>2</td>
<td>37, M</td>
<td>SAH</td>
<td>rt VA, PICA (P)</td>
<td>3 days</td>
<td>1.55 × 7.5</td>
<td>3.05 × 16</td>
<td>aneurysm obliterated, no stenosis in parent vessel</td>
<td>13</td>
<td>full recovery</td>
</tr>
<tr>
<td>3</td>
<td>37, M</td>
<td>SAH</td>
<td>rt VA, PICA (P)</td>
<td>6 days</td>
<td>2.75 × 12</td>
<td>3.55 × 16 &amp; 4.05 × 16</td>
<td>aneurysm obliterated, no stenosis in parent vessel</td>
<td>11</td>
<td>full recovery</td>
</tr>
<tr>
<td>4</td>
<td>28, M</td>
<td>SAH</td>
<td>rt VA, PICA (P)</td>
<td>7 days</td>
<td>4.95 × 13</td>
<td>4.05 × 16</td>
<td>aneurysm obliterated, no stenosis in parent vessel</td>
<td>8</td>
<td>full recovery</td>
</tr>
<tr>
<td>5</td>
<td>46, F</td>
<td>SAH</td>
<td>rt VA, PICA (P)</td>
<td>10.5 yrs</td>
<td>5.85 × 5.6</td>
<td>4.05 × 16</td>
<td>aneurysm fully obliterated (3D CT)</td>
<td>6</td>
<td>full recovery</td>
</tr>
<tr>
<td>6</td>
<td>41, M</td>
<td>SAH</td>
<td>rt VA, PICA (P)</td>
<td>2 days</td>
<td>4.85 × 9.2</td>
<td>failure</td>
<td>not applicable</td>
<td>none</td>
<td>death</td>
</tr>
</tbody>
</table>

* D = distal to; FU = follow-up; P = proximal to.

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complete aneurysm obliteration, and avoidance of PICA or ASA occlusion. In cases of incomplete aneurysm obliteration, postdilation was needed to achieve satisfactory obstruction, and the dilation pressure was increased to a maximum of 16 atm.

Following confirmation of aneurysm obliteration using control angiography, heparinization was continued for 48 hours and then allowed to taper physiologically. Oral administration of ticlopidine (250 mg twice a day) or clopidogrel (75 mg daily) was prescribed for 8 weeks, and oral administration of enteric-coated aspirin (100–200 mg daily) was continued for 3 months. All patients were evaluated neurologically by experienced neurologists within days after discharge, and were then followed up periodically.

Results

Overall Outcomes

Covered stent grafts were successfully placed in 5 patients in this study (Table 1). The size of the aneurysms in the study ranged from 1.5 × 7.5 mm to 4.9 × 13 mm. The diameter of the covered stent grafts that were placed ranged from 3.0 to 4.0 mm, and all had a length of 16 mm. Three patients exhibited transient reflux into the aneurysm sac immediately after the placement of the stent grafts. Balloon reflation of the stent graft to appose it to the parent vessel wall successfully avoided the reflux in 2 of these 3 patients, and their aneurysms were fully excluded from the blood flow. In only 1 case (Case 3), balloon reflation could not exclude the proximal end of the aneurysm from the circulation. A larger covered stent graft (4.0 × 16 mm) was delivered to the nonexcluded site and was apposed to the vessel wall. Resolution of the reflux in this patient was evident on control angiography performed later, and the PICAs were carefully preserved.

The stent graft placement failed in 1 patient (Case 6). The patient was admitted because of abrupt change in his level of consciousness and was found to have severe SAH in the posterior cranial fossa. A left intracranial VA dissecting aneurysm was diagnosed in this patient (Hunt and Hess Grade IV) and he underwent interventional covered stent graft treatment. In the intervention procedure, his VA was found to be distorted more than the VAs in previous patients, and severe vasospasm occurred due to repetitive manipulation. Thus, the covered stent graft could not reach the aneurysm, and the treatment was ceased. The patient was returned to the ward for further treatment. Unfortunately, another severe SAH occurred 3 days later, resulting in the patient’s death.

In the 5 patients who received successful stent graft placement, no complications (such as infection, distal embolization, vessel ruptures, or puncture site complications) occurred in either the immediate postprocedure period or during follow-up. Postoperative CT demonstrated no signs of hydrocephalus, intracranial hemorrhage, or related brain ischemia.

The 5 remaining patients were followed up for 6–14 months (average 10.4 months). In addition to a neurological examination, 4 patients received control angiography, and 1 patient (Case 5) received 3D CT angiography. No obvious intimal hyperplasia occurred. Neither aneurysm refill-
neurological examination upon admission found no disturbance in consciousness (Hunt and Hess Grade 0) and no motor or sensory deficit. The results of DS angiography were identical to the previous results, revealing a VA dissecting aneurysm distal to the PICA. The aneurysm was 5.8 mm long and 5.6 mm wide, with a 4.0 mm inflow tract and a 3.5 mm outflow tract (Fig. 2A and B).

Four days after admission, the patient underwent an endovascular intervention. A 4.0 × 16–mm covered stent graft was placed at the site of the dissecting aneurysm, with immediate occlusion of the aneurysm lumen. The balloon was expanded to 10 atm. Control DS angiography confirmed patency of the parental VA, PICA, and AICA (Fig. 2C and D). A week later, the patient was in satisfactory

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**Fig. 1.** Case 2. Angiograms obtained in the patient at various stages of the covered stent graft procedure. A: Initial anteroposterior left VA angiogram shows a dissecting aneurysm on the VA, proximal to the PICA. B: Initial lateral left VA angiogram shows noticeable narrowing of the distal and proximal ends of the VA lumen. C: Control anteroposterior left VA angiogram obtained immediately after the covered stent graft placement shows complete elimination of the aneurysm. D: Control lateral left VA angiogram obtained immediately after stent placement shows elimination of the aneurysm and patency of the basilar artery, VA, and PICA. E: Control anteroposterior left VA angiogram obtained 13 months after the procedure demonstrates satisfactory reconstruction of the basilar artery without aneurysm refilling. F: Control lateral left VA angiogram obtained 13 months postoperatively shows complete aneurysm obliteration and the smooth inner wall of the stent graft. G: Three-dimensional angiogram demonstrates the position of the covered stent graft at the VA.
condition and was discharged. Her antithrombotic therapy was continued for 3 months. At the 6-month follow-up, a neurological examination showed that the patient had attained a full recovery without any neurological deficit. No ischemic focus was revealed by the CT scan. Control 3D CT angiography confirmed that the stent graft was in the correct location, that the aneurysm was no longer visible, and that the parental right VA was patent (Fig. 2E).

Discussion

Intracranial VA dissecting aneurysms are rare but can potentially be deadly, and may serve as a source of thrombus formation or SAH. Spontaneous healing of these aneurysms will occur in some cases, thus a conservative strategy is a possible option. To date, most neurosurgeons treat VA dissecting aneurysms more radically using surgical or endovascular therapies due to the risk of rebleeding and thrombosis.

Current surgical recommendations for the treatment of intracranial VA dissecting aneurysms include clip occlusion or trapping procedures if the contralateral VA is not particularly smaller in caliber than the ipsilateral VA, or wrapping of the dissecting aneurysm if the parental VA is dominant. Balloon test occlusion is very useful in choosing a surgical strategy. Importantly, if the PICA is involved because of the dissection, then a PICA reconstruction procedure—including ophthalmic artery–PICA anastomosis, VA–PICA anastomosis, and others—should be considered to prevent cerebellar infarction and lateral medullary syndrome.

Endovascular intervention for intracranial VA dissecting aneurysms can be divided into deconstructive techniques (such as occlusion or sacrifice of the VA) and reconstructive techniques (such as preserving blood flow through the VA). Deconstructive endovascular techniques include proximal occlusion or trapping of the involved VA using coils and/or balloons. Reconstructive endovascular techniques include porous stent placement alone and porous stent-assisted coil embolization, which offers the advantage of parent vessel preservation.

Deconstructive surgical and endovascular procedures alone can be sufficient in a variety of cases if they pass balloon test occlusion. After sacrificing the parental VA,
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the collateral vessels are used exclusively by the patient. But the longevity of a patient’s collateral vessels is not predictable during the rest of the patient’s life. In theory, reconstructive procedures are more reasonable than deconstructive ones, and we believe that the more the parent artery is preserved, if possible, the better the prognosis for the patient. Because the porous stent placement technique cannot promise complete aneurysm obliteration,\textsuperscript{28} and the stent-assisted coil embolization technique includes the risk of an acute rupture and long-term rebleeding,\textsuperscript{24,40} an innovative covered stent technique was introduced as an alternative reconstruction approach.

Theoretically, a covered stent graft can obliterate the dissecting aneurysm while retaining patency of the parent vessel. There are several kinds of covered stent grafts used in intracranial aneurysms, including the Symbiot stent (Boston Scientific/Scimed)\textsuperscript{2} and Jostent Graftmaster stent.\textsuperscript{31} The Symbiot stent is a small, nitinol, self-expandable, flexible stent that is covered on both the luminal and abluminal sides with a highly porous PTFE.\textsuperscript{20} The Jostent stent is a stainless steel stent with the PTFE membrane placed between 2 layers of stent struts (a “sandwich” structure). Both of the stents were designed for vascular use in coronary saphenous vein grafts and are flexible, so they are appropriate for intracranial vascular application. Covered stent grafts have been used primarily in aneurysms involving vascular territories that are easier to access than the intracranial vasculature, such as the abdominal aorta, axillary artery, subclavian arteries, popliteal artery, iliac and femoral arteries, and even the extracranial carotid artery.\textsuperscript{19,26,28}

Covered stent graft application in intracranial aneurysms was first reported by Redekop and colleagues in 2001.\textsuperscript{35} These authors described 2 AVFs and 2 pseudoaneurysms of the distal extracranial ICA or VA resulting from penetrating trauma, and 2 petrous carotid pseudoaneurysms associated with basal skull fractures, in 6 patients. Two of the 6 patients received autologous-vein covered stent graft placement, and 3 received PTFE-covered stent grafts. To our knowledge, 56 patients with neurovascular diseases have been treated with covered stent grafts and have been documented since this initial report. Most of the cases were treated using PTFE-covered stent grafts, ranging in size from $3 \times 12$ mm to $4 \times 45$ mm. Four of the 50 patients who were followed up achieved near-complete occlusion of the CCFs. Complete occlusion of the aneurysms or CCFs was attained in the other 46 cases (92%). Neurological examination results revealed good or full patient recovery in most of the cases, except for 1 death and several cases of improvement only. Only 2 cases involving VA dissecting aneurysms were included in these studies (Table 2).

Because the covered stent occludes any branch of the parent vessel along the length of the stent—which is different than placement of porous stents—avoidance of important branches of the parent vessel should be emphasized during placement of a covered stent. Thus, suitable cases with VA dissecting aneurysms should be chosen carefully due to the extreme importance of these perforator branches. In the previous studies, 2 AVFs, 14 CCFs, 5 VA aneurysms (including 2 VA dissecting aneurysms), 6 petrous ICA aneurysms, 6 petrous ICA aneurysms, 19 cavernous ICA aneurysms, 4 petrous and cavernous ICA aneurysms, and 1 middle cerebral artery aneurysm were treated using the covered stent technique (Table 2). The petrous or cavernous ICA aneurysms did not involve the crucial perforator artery. The PICAs were carefully excluded in VA aneurysm treatment.\textsuperscript{31} In some instances, the ophthalmic artery was sacrificed when treating a paracoloid ICA aneurysm, without clinical deficit. By viewing multiple angiograms, extreme care has been taken to confirm the positioning of the stent to avoid occlusion of the anterior choroidal artery when treating an intradural ICA aneurysm.\textsuperscript{36} In the only case of a middle cerebral artery aneurysm, the lenticulostriate artery was carefully spared during stent placement.

The present case series included 6 VA dissecting aneurysms, in which 4 aneurysms were proximal to the PICAs and 2 were distal to the PICAs. The 6 cases were selected because there was at least 2 mm between the dissecting aneurysm and the PICA. We use this criterion to ensure the important preservation of the PICAs; if they are mistakenly occluded, Wallenberg syndrome may occur or even death. Vertebrobasilar junction occlusion should be carefully avoided as well. If a VA dissecting aneurysm involves the PICA and/or VBH, vessel anastomosis should first be considered. The ASA should be carefully evaluated before placing a stent, paying particular attention to the pattern of arterial supply and potential collateral circulation.

Reaching the aneurysm neck with the covered stent is another key point of the technique. The restricted flexibility of the catheter and stent is the main limitation of the operation, which is not a major concern in extracranial stent application due to the uncomplicated nature of this vasculature structure. Thus, cases involving extremely tortuous or spasmodic proximal arteries should be excluded from the selected cases for this technique. To advance stent grafts into moderately tortuous vessels, 8 Fr guided systems or a coaxial (8 Fr within 10 Fr) double-guided system is required. Because the covered stent we used was designed for coronary artery application, it must be noted that inappropriate use of the stent may cause an arterial dissection with subsequent occlusion. In the present series, we presented the case of a patient with SAH (Case 6) with severe vasospasm, causing failure of stent placement. The other 5 patients underwent successful stent placement with a covered stent into the intracranial vasculature lesion of interest.

With continued experience in the use of coronary stents, the induction of intimal hyperplasia has been a significant complication.\textsuperscript{29} Unlike in that setting, experimental aneurysm research has demonstrated a slight tendency of intimal proliferation on the vessel wall 1–3 months after the stent graft placement procedure. This slight tendency is believed to be due to a chronic inflammatory reaction against the covered polyurethane membrane.\textsuperscript{36} Data from a meta-analysis of 11 randomized studies demonstrated that the pooled rate of restenosis was 25.8% when using stent treatment of coronary artery stenosis.\textsuperscript{21} Fortunately, this phenomenon has not been extensively observed in the published series of studies involving intracranial stents.\textsuperscript{36} and no severe parent vessel stenosis have been reported. This may be possible because the PTFE layer may not only
exclude blood flow through the stent, but also may serve as a physical barrier to prevent late neointimal proliferation and stenosis. In addition, the PTFE layer may decrease embolization during stent deployment by trapping debris that otherwise would have been extruded through the stent struts. Furthermore, the PTFE layer may reduce the rate of neointimal hyperplasia and stent-related stenosis by inhibiting the migration of inflammatory cells and by attenuating the diffusion of cytokines.\(^{13,21}\) In the last 13 independent reports of this technique, 89% of the patients underwent angiographic follow-up obtained at 3–48 months postoperatively. Slight asymptomatic intimal hyperplasia occurred in only 3 patients in these studies. No severe intimal hyperplasia or parent vessel stenosis was reported. In our series, none of the 5 patients who received stent placements encountered stent–related complications, and no obvious intimal hyperplasia occurred after the procedure during 6–14 months of follow-up. Although the preliminary result of this moderately long follow-up study was encouraging, the comprehensive assessment of covered stent grafts will depend on further long-term angiographic and clinical follow-up data. To avoid the occurrence of stent-related thrombosis, a variety of medications have been used. The use of aspirin as well as clopidogrel or ticlopidine is one strategy. Abciximab, which binds to the human platelet glycoprotein IIb/IIIa receptor and inhibits platelet aggregation, is another antiplatelet agent that has been used to avoid thrombosis with this technique. Fibrinolytics such as urokinase have also been attempted and can promote the dissolution of thrombi by activating endogenous plasminogen to plasmin. Heparin infusion is maintained throughout the

### TABLE 2: Summary of previous studies involving covered stent grafts in neurovascular diseases*  

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Patients</th>
<th>Aneurysm Location</th>
<th>Stent Size (mm)</th>
<th>Angiographic Results</th>
<th>FU Duration</th>
<th>Clinical Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redekop et al., 2001</td>
<td>6</td>
<td>2 AVFs, 2 pseudoaneurysms (1 VA), 2 petrous ICA aneurysms</td>
<td>NA</td>
<td>aneurysm occluded, fistula closed, parent artery preserved</td>
<td>3–6 mos</td>
<td>good recovery</td>
</tr>
<tr>
<td>Kocer et al., 2002</td>
<td>1</td>
<td>CCF</td>
<td>4 × 12</td>
<td>CCF closed, patent ICA, no intimal hyperplasia</td>
<td>3 mos</td>
<td>good recovery</td>
</tr>
<tr>
<td>Alexander et al., 2002</td>
<td>1</td>
<td>iatrogenic petrous ICA pseudoaneurysm</td>
<td>4 × 31</td>
<td>none</td>
<td>none</td>
<td>full recovery</td>
</tr>
<tr>
<td>Chiaradio et al., 2002</td>
<td>2</td>
<td>1 VBJ aneurysm, 1 paracanlloid aneurysm</td>
<td>3 × 12, 4 × 9</td>
<td>total occlusion of the aneurysm, parent vessel preserved, slight intimal hyperplasia in 1 patient</td>
<td>3–4 mos</td>
<td>good recovery</td>
</tr>
<tr>
<td>Vanninen et al., 2003</td>
<td>1</td>
<td>iatrogenic ophthalmic segment of ICA pseudoaneurysm</td>
<td>4.5 × 12</td>
<td>total occlusion of aneurysm, full patent ICA</td>
<td>1 yr</td>
<td>full recovery</td>
</tr>
<tr>
<td>Auyeung et al., 2003</td>
<td>2</td>
<td>2 iatrogenic petrous ICA pseudoaneurysms</td>
<td>4 × 20, 4 × 45</td>
<td>none</td>
<td>none</td>
<td>hemorrhage stopped, no neurological deficit</td>
</tr>
<tr>
<td>Burbelko et al., 2004</td>
<td>1</td>
<td>VBJ aneurysm</td>
<td>4 × 12</td>
<td>no filling of the aneurysm, normal patency of the VA &amp; BA</td>
<td>6 mos</td>
<td>good recovery, no complication</td>
</tr>
<tr>
<td>Blasco et al., 2004</td>
<td>1</td>
<td>cavernous ICA aneurysm</td>
<td>4 × 17</td>
<td>aneurysm occluded, no stenosis</td>
<td>11 mos</td>
<td>recovery with some cranial nerve dysfunction</td>
</tr>
<tr>
<td>Felber et al., 2004†</td>
<td>7</td>
<td>2 cavernous ICA aneurysms, 1 VA dissecting aneurysm, 5 CCFs‡</td>
<td>4 × 12 to 4 × 19</td>
<td>3 complete occlusions of CCFs, 2 nearly complete occlusions of CCFs, 3 complete occlusions of aneurysms</td>
<td>3 mos–4 yrs (in 5 of 7 patients)</td>
<td>full recovery, 1 transient hemiparesis, 1 hemiparesis, 1 ICA dissection, 1 death</td>
</tr>
<tr>
<td>Saatci et al., 2004</td>
<td>24</td>
<td>16 cavernous ICA aneurysms, 4 petrous and cavernous ICA aneurysms, 4 caroticoophthalmic aneurysms, 1 petrous ICA aneurysm‡</td>
<td>NA</td>
<td>all aneurysms occluded, slight intimal hyperplasia in 1 patient</td>
<td>6 mos–2 yrs</td>
<td>full recovery, no ischemia</td>
</tr>
<tr>
<td>Pero et al., 2006</td>
<td>1</td>
<td>M, of MCA aneurysm</td>
<td>3 × 16</td>
<td>aneurysm occluded, perfect MCA patency</td>
<td>18 mos</td>
<td>full recovery</td>
</tr>
<tr>
<td>Archondakis et al., 2007</td>
<td>8</td>
<td>8 posttraumatic CCFs</td>
<td>4 × 16 to 4.5 × 26</td>
<td>6 complete occlusions of CCFs, 2 nearly complete occlusions of CCFs, 1 asymptomatic ICA occlusion, 1 intimal hyperplasia</td>
<td>6 mos–1 yr</td>
<td>6 good recovery, 2 improved</td>
</tr>
</tbody>
</table>

* BA = basilar artery; MCA = middle cerebral artery; NA = not available.
† Series with VA dissecting aneurysms.
‡ Including multiple aneurysms or CCFs.
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