



Incision of the anterior petroclinoidal fold during clipping for securing the proximal space of an internal carotid artery–posterior communicating artery aneurysm: a technical note

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Abstract

Surgical clipping of an internal carotid artery (ICA)–posterior communicating artery (PCoA) aneurysm is often difficult in cases involving limited space to insert a clip at the proximal aneurysm neck hidden by the tent. In such cases, we perform incision of the anterior petroclinoidal fold to secure the proximal space for clip insertion. Between April 2013 and March 2018, we treated 89 PCoA aneurysm cases by clipping. Incision of the anterior petroclinoidal fold was performed in 15 of the 89 cases (16.8%). Fast imaging employing steady-state acquisition (FIESTA) magnetic resonance imaging (MRI) can indicate the locations of the aneurysm and tent and can help assess the need for tent incision. We widely dissected the distal sylvian fissure and sufficiently exposed around the aneurysmal space. We coagulated and cut the anterior petroclinoidal fold supra between the ICA and proximal neck of the aneurysm using a low-power bipolar system and needles or micro-scissors with care to avoid injury around structures such as the ICA, aneurysm, and oculomotor nerve. When using this strategy, we often select the Yasargil FT717 clip that has a curve along the skull base because of easy insertion. All cases showed complete aneurysm exclusion on three-dimensional computed tomography angiography, and there was no cerebral infarction, neurological deficit (such as hemiparesis), or oculomotor nerve palsy. Therefore, our strategy of incision of the anterior petroclinoidal fold during clipping for securing the proximal space of an ICA aneurysm is effective and safe.

Keywords Clipping · Internal carotid artery aneurysm · Tent incision

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Introduction

Surgical clipping of an internal carotid artery (ICA)-posterior communicating artery (ICPC) aneurysm is often difficult in cases involving a low aneurysmal position and insufficient space for inserting a clip between the proximal aneurysm neck and ICA hidden by tent, also called as anterior petroclinoidal fold. At our institution, in cases involving the difficult insertion of a clip at the proximal neck of an ICPC aneurysm, incision of the anterior petroclinoidal fold is performed to secure the proximal neck.

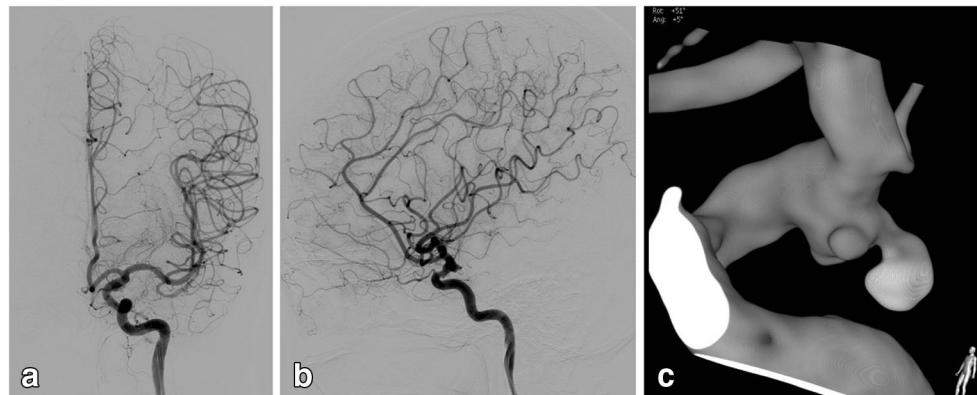
Preoperatively, we evaluate the need for incision of the anterior petroclinoidal fold using fast imaging employing steady-state acquisition (FIESTA) magnetic resonance imaging (MRI). We regularly use this strategy at our institution. Here, we report our technique and mention the usefulness of this strategy.

Materials and surgical outcome

We treated 89 ICPC aneurysm cases by clipping between April 2013 and March 2018. The indication for anterior petroclinoidal fold incision in ICPC aneurysm cases was difficult insertion of the clip at the proximal neck of the aneurysm intraoperatively. Incision of the anterior petroclinoidal fold was performed in 15 of the 89 cases (16.8%). Of these 15 cases, 9 were unruptured and 6 were ruptured.

We secured the cervical ICA in ruptured cases. In unruptured cases, using preoperative examinations, such as computed tomography (CT), MRI, FIESTA MRI, three-dimensional CT angiography (3DCTA), and three-dimensional digital subtraction angiography (3DDSA), we determined whether the cervical portion needed to be opened to secure the proximal cervical ICA. We opened the cervical portion at the aneurysm neck located near the skull base and predicted the difficulty to secure the proximal ICA and aneurysm neck.

Fig. 1 Case of a ruptured ICPC aneurysm. **a** Preoperative frontal view of right ICA angiography shows an ICPC aneurysm. **b** Preoperative lateral view of right ICA angiography shows an ICPC aneurysm. **c** Preoperative 3DDSA shows a 7.8-mm ICPC aneurysm. ICPC, internal carotid artery–posterior communicating artery; ICA, internal carotid artery; 3DDSA, three-dimensional digital subtraction angiography



There were no statistically significant differences in factors, such as aneurysm size, direction, and distance from the skull base to the proximal aneurysm neck, between the need for a tent incision and no need for this incision. However, we could predict the need for incision of the anterior petroclinoidal fold before the operation using FIESTA MRI, which shows the structures around the aneurysm, such as the anterior petroclinoidal fold and anterior and posterior clinoid processes.

All cases showed complete aneurysm exclusion on 3DCTA, or angiography and there was no cerebral infarction, neurological deficit (such as hemiparesis), or oculomotor nerve palsy.

Surgical technique

Figure 1 shows the preoperative angiography and 3DDSA images of a 73-year-old woman with a ruptured aneurysm after coiling involving an aneurysm neck remnant. Figure 2 shows the intraoperative view, and Fig. 3 shows a schematic drawing of incision of the anterior petroclinoidal fold.

All patients were intraoperatively monitored by transcranial motor-evoked potentials. We widely dissected the distal sylvian fissure with the anterior temporal approach to visualize the aneurysm dome, neck, and perforating artery [1].

After sufficiently securing and exposing the intracranial proximal ICA and aneurysm, clipping was performed. At this time, in case of difficult insertion of the clip at the proximal neck of the aneurysm owing to the anterior petroclinoidal fold, we performed its incision as described below.

We coagulated and cut the anterior petroclinoidal fold supra between the ICA and proximal neck of the aneurysm using a low-power bipolar system and needles or micro-scissors with care to avoid injury around structures such as the ICA, aneurysm, and oculomotor nerve. After securing the proximal space of the aneurysm neck with the incised anterior petroclinoidal fold and achieving sufficient separation of the posterior communicating artery and aneurysm, we carefully inserted the clip. When using this strategy, we often select the

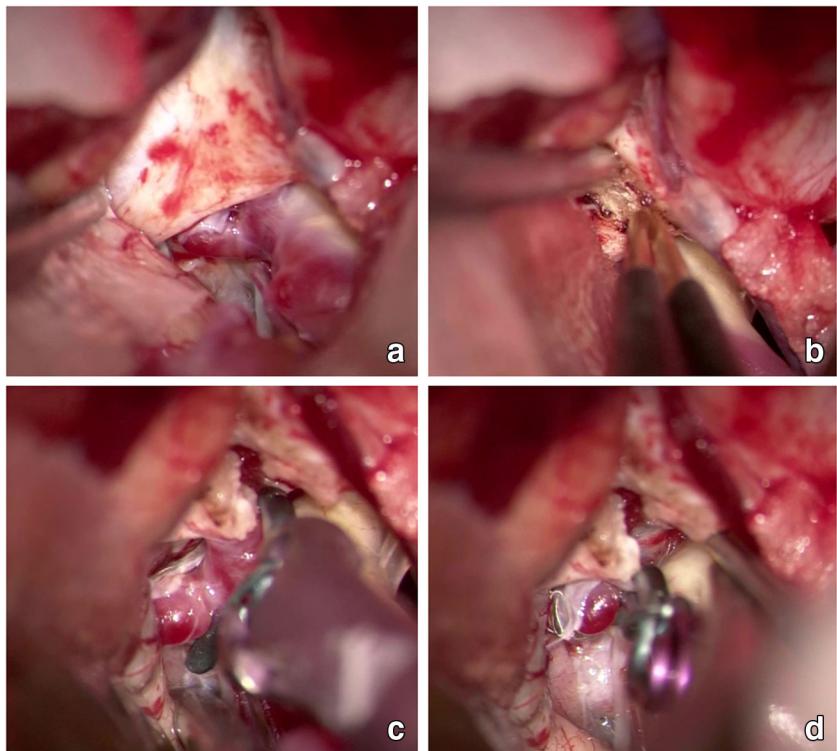
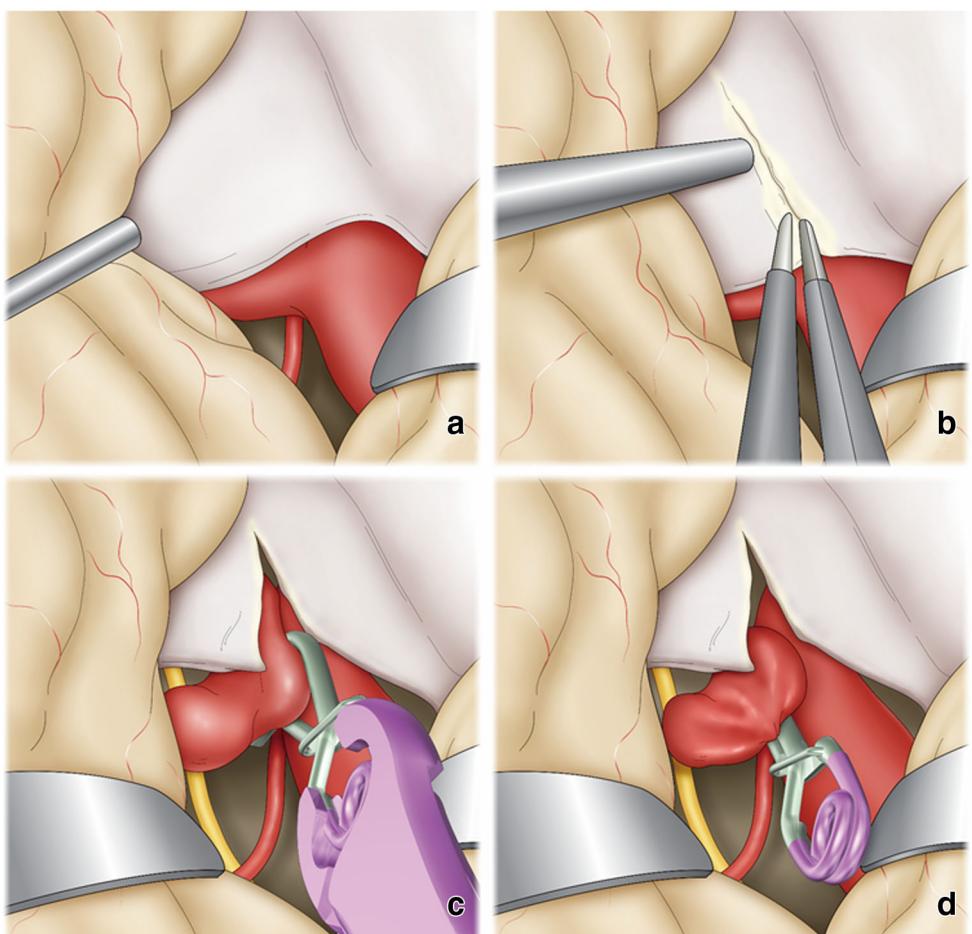
Fig. 2 a–d Intraoperative view

Fig. 3 Intraoperative view. **a** Proximal neck of the aneurysm and the ICA hidden by the anterior petroclinoinal fold. **b** Coagulotomy of the tent using a bipolar system for securing the proximal space. **c** Possible insertion of a clip blade to the proximal space. **d** Clipping of the aneurysm. Final operative view. ICA, internal carotid artery



Yasargil FT717 clip that has a curve along the skull base because of easy insertion. After clipping, we confirmed complete elimination of the aneurysm and patency of the parent and perforating arteries using fluorescein video angiography.

Discussion

Our strategy involving incision of the anterior petroclinoidal fold during clipping for securing the proximal space of the ICA aneurysm was effective and safe. In addition, FIESTA MRI was useful for predicting the need for incision of the anterior petroclinoidal fold.

For ICPC aneurysms, the use of endovascular treatment has recently increased because of its low invasiveness [2, 3]. The low position of an ICPC aneurysm from the skull base or paraclinoid aneurysm is an advantage of endovascular treatment because of easier access to the lesion with endovascular treatment than with craniotomy. However, complex aneurysmal conditions, such as a perforating artery arising from the aneurysmal dome, are associated with a low occlusion rate and often need stent-assisted coiling, and despite anti-platelet treatment, they are associated with thromboembolic

complications in the future [2, 4, 5]. Therefore, we perform direct surgical clipping for ICPC aneurysms at our institution.

Surgical clipping of ICPC aneurysms is important to secure the proximal parent artery [6]. Temporary clipping is particularly useful in the case of ruptured or large/giant aneurysms needing a decrease in the aneurysmal pressure [7]. For cases in which the aneurysm neck is near the skull base, safe aneurysmal clipping often requires a procedure to secure the cervical ICA or anterior clinoidectomy. Cases of large/giant aneurysms that cannot be clipped are treated using high-flow bypass and trapped or cervical ligation to reduce blood flow to the aneurysm and thrombosis [8]. For cases in which the need for clipping cannot be preoperatively judged, we prepare for bypass or complete bypass before manipulation of the aneurysm [9].

When an ICPC aneurysm can be clipped but clip insertion is difficult owing to concealment by tent, incision of the anterior petroclinoidal fold is performed according to the above-mentioned approach to secure the proximal neck. The structures around the tent are the ICA, perforating artery, and oculomotor nerve; therefore, care should be taken to avoid injuring these structures. Nossek et al. [10] reported a similar technique. They created a small fenestration at the lateral to the anterior clinoid process and entirely exposed the aneurysmal

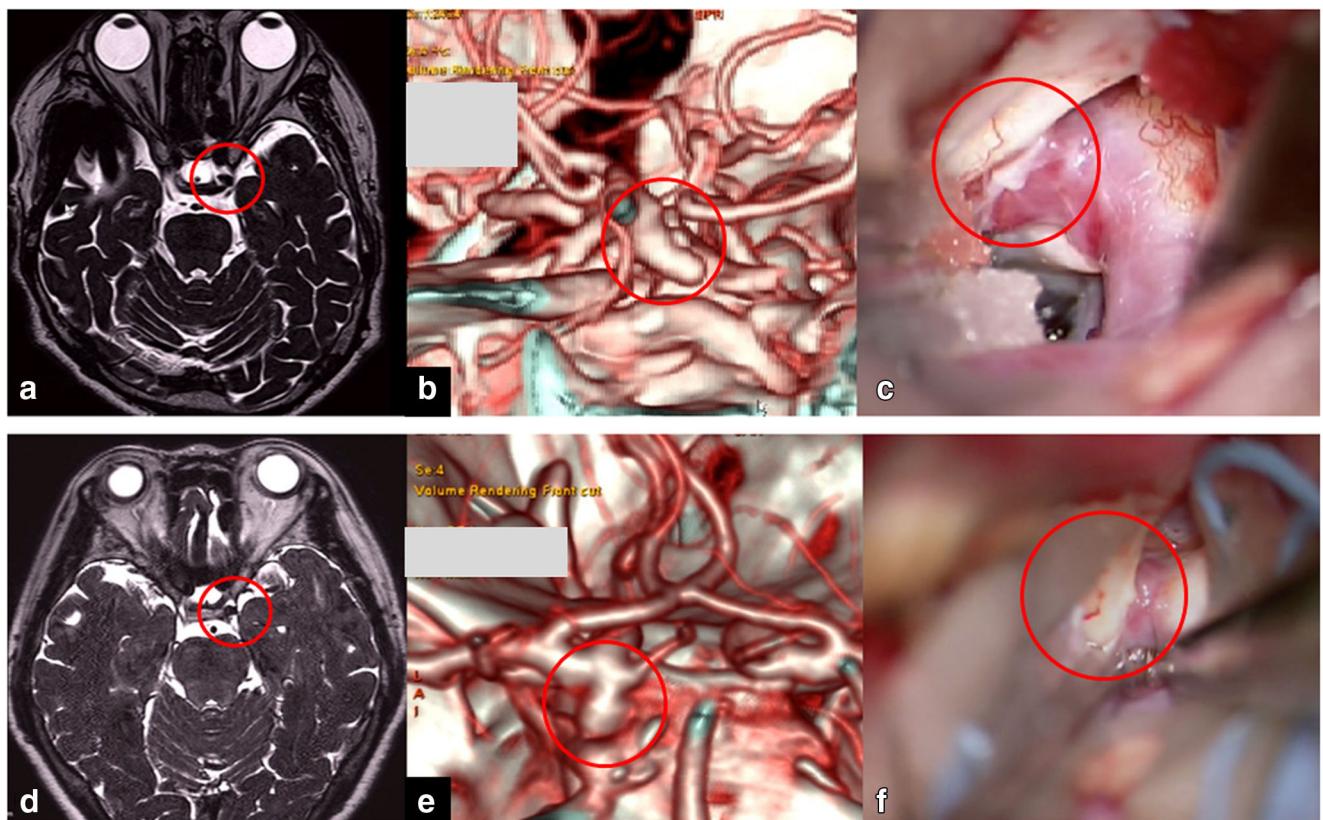


Fig. 4 Two cases of a left ICPC aneurysm. **a, d** Preoperative FIESTA MRI images. **b, e** Preoperative 3DCTA images. **c, f** Intraoperative view. ICPC, internal carotid artery–posterior communicating artery; FIESTA,

fast imaging employing steady-state acquisition; MRI, magnetic resonance imaging; 3DCTA, three-dimensional computed tomography angiography

neck; on contrast, the position of the aneurysm neck was lower in our cases; therefore, only proximal neck was exposed by incision of the anterior petroclinoidal fold.

FIESTA MRI can intensify the contrast between water and solid structures with a high signal-to-noise ratio [11]. Kimura et al. [12] reported the efficacy of FIESTA MRI to distinguish important structures, including microvascular structures, nerves, and the dural edge, in an unruptured cerebral aneurysm study. We could preoperatively predict the need for incision of the anterior petroclinoidal fold using FIESTA MRI by analyzing the direction of the aneurysm dome and the anatomical relations of the aneurysm neck and the anterior petroclinoidal fold (Fig. 4).

In this study, incision of the anterior petroclinoidal fold was performed in only 15 cases. None of the patients developed neurological deficits, such as oculomotor palsy, and diffusion-weighted MRI did not show cerebral infarction postoperatively. Therefore, we believe that this strategy is useful and can aid in the safe clipping of an ICPC aneurysm when the aneurysm neck is hidden by the anterior petroclinoidal fold in any institution.

Limitations

We performed incision of the anterior petroclinoidal fold in only 15 cases during a period of 5 years. Further cases and analyses of the results of a cohort are required to support our findings.

Conclusion

Our results indicated that the strategy of incision of the anterior petroclinoidal fold is effective and safe for clipping ICPC aneurysms.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval This study was approved by Chiba Hokusoh Hospital Research Ethics committee, Chiba, Japan.

Informed consent All patients have consent to submission of this paper.

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