

# Pterional approach for anterior communicating artery aneurysm

There are several changes in pterional [approach](#), including additional [lateral supraorbital approach](#) and frontotemporal orbital zygomatic approach, etc... <sup>1)</sup>.

The [pterional approach](#) for [anterior communicating artery aneurysm surgery](#), has the following advantage:

The [subarachnoid space](#) is widely opened and the [brain hemorrhage](#) can be removed as much as possible in the acute stages of [SAH](#); damage of the [olfactory nerve](#) is minimized and bilateral parent arteries of the proximal side can be secured in early stage of the procedure.

As a disadvantage, the brain must be compressed, and partial resection of the [gyrus rectus](#) is often required in cases of high-positioned [anterior cerebral artery aneurysms](#).

Because this area is composed of five densely aggregated arteries, it can be difficult to visualize the aneurysm and blood vessel in case of high-positioned and postero-superiorly directed aneurysms.

## Determinants of the Approaching Side

In the surgery of [clipping](#) of [intracranial aneurysm](#), proximal control as a technique is often used. So in clinic, the pterional approach of the supply of dominant blood was often performed in the microsurgery of clipping of [anterior communicating artery](#) aneurysms <sup>2) 3)</sup>. However, the local anatomy of communicating artery complex is very complicate, in some conditions aneurysm was shade by communicating artery complex and very difficult to be clipped, such as artery tumors located in the A2 section of the anterior cerebral artery between bilateral <sup>4) 5) 6)</sup>.

In the surgery of clipping aneurysms, it is very often to perform the proximal control. So it is very normal to choose the pterional approach contralateral to supply of dominant blood to clip the anterior communicating artery aneurysms <sup>7) 8)</sup>.

The determining factors include [A1](#) predominance, direction of [A2](#) fork, the direction of the aneurysm, the size of the aneurysm, and multiplicity of the aneurysms. The presence of fenestrations of the AcomA is an important factor in determining the side of approach. In cases of acute SAH, determining factors include the distribution of SAH and ICH.

In case of small and large sized aneurysms directed anteriorly, the A1 dominance should be the most important factor, because it is sometimes difficult to secure the opposite side of A1. But there is no marked difference in surgical difficulty between the right and left approaches.

In the case of aneurysms directed superiorly, the A1 is bilaterally secured before approaching the aneurysm. Therefore entry into the open part of the A2 (i.e. the side of A2 facing posteriorly) facilitates clipping

(A): The entry into the closed side of the A2 fork makes the exposure of the neck difficult because the neck is behind the ipsilateral A2.

(B): On the other hand, entry into the open part of the A2 fork, (i.e the side of the A2 located posteriorly), makes clipping easier.

In cases of aneurysms directed postero-inferiorly and located at the back of the AcomA, entry through the side of the A2 located more anteriorly is recommended, as if the posterior surface of A2, especially in cases of fenestration of the AcomA.

**Giant anterior communicating artery aneurysm** is, as a rule, treated by an approach from the direction in which early arrival at the aneurysm neck is accomplished. Approaching from the side of dominant A1 is generally recommended, but for such an aneurysm that projects anteriorly, the interhemispheric approach is recommended. Interhemispheric approach is also recommended in high positioned Acom aneurysm.

## Positioning

The patient is placed in the supine position with the upper part of the body elevated to 20 degrees to control the venous pressure. The head is placed down about 0~10 degrees with the chin up and rotated to the contra lateral side of the craniotomy about 35 degrees on the right side and approximately 45 degrees on the left side.

**Head positioning** and the degree of rotation is controversial.

In a anatomic study, a three-dimensional arterial tree was demonstrated, an anterior communicating artery region aneurysm model was prepared, and pictures were taken at various angles. According to the observations, 30-degree head rotation was found to be the most suitable position for the anterior and superior projected aneurysms. For posterior projection, aneurysm neck was best viewed with 15-degree head rotation. Aneurysms projecting inferiorly necessitated the greatest rotation at 45 degrees. Each aneurysm dome projection of the anterior communicating artery aneurysm should be individually considered, and the head position should be adjusted accordingly. The use of appropriate head positions during surgery will prevent the development of postoperative ischemic complications and will increase the success of surgery by preventing unnecessary tissue manipulation <sup>9)</sup>.

## Incision

A semi coronal incision is made along the hair line starting 5mm anterior to the tragus in the superior zygomatic margin to the medial of the forehead. Because the facial nerve runs between the skin and galea, the skin is reflected over the muscle sheath to avoid injury to the facial nerve. Especially around the orbit it is not necessary to dissect the skin, but instead to dissect the attachment of the temporalis muscle 1 cm under the zygoma.

## Incision of the temporalis muscle

A pedicle bone flap is recommended to be prepared for the following reasons: 1) The side of head closure after craniotomy is cosmetically favorable with the pedicle flap and 2) the pedicle flap is more resistant to infection than the free flap. With regard to subcutaneous dissection, part of the temporal fascia particularly of the superior zygomatic margin near the orbit should be separated carefully because of the facial nerve. It should be noted that transient facial palsy may be caused by the heat

of electric cauterization.

If a free flap is selected, the temporalis muscle must be separated with the skin. The pterion is adequately exposed by posterior eversion after separation of the temporalis muscle on the orbital margin.

## Craniotomy

Craniotomy should be performed, so that the temporal and frontal lobes will be included in the visual field in an almost symmetrical pattern centering on the sylvian fissure. Burr holes are opened at the following three points: 1) a point near the orbit beneath the temporalis muscle on the superior orbital margin; 2) the deep side of the temporal bone near the posterior part of the zygoma and 3) beneath the temporalis muscle above the sylvian fissure. For cosmetic purposes a titanium miniplate is positioned before bone separation. An airtome is used for bone separation and the burr holes at points 1 and 2 may be omitted for cosmetic reasons.

The craniotomy must be done in oblique direction, making the outer table of the bone lateral and the inner table medial. But the basal part of the temporal bone under the zygoma is used for craniotomy. However if the oblique direction is reversed, making the outer table medial and inner table lateral, then the craniotomy will not be convenient. For the pterion only grooving of the outer table is necessary to facilitate reflection of the bone by bone elevators.

On this occasion, it is important that the dura mater be adequately separated with a dural separator through the burr hole at point 3. The separation of the dura mater must be performed while the inner surface of the bone is touched with the tip of dural dissector. After bone flap separation, the bone flap is elevated and reflected. The pterion is eliminated with a Luer's rongeur and removed with an air drill especially the inner surface. Bleeding is controlled with bone wax. Dural bleeding is controlled by coagulation, tenting of the dura with gel foam (Johnson & Johnson, New Brunswick, NJ) and oxidized cellulose with fibrin glue.

## Dissection of sylvian fissure

The [sylvian fissure](#) is, as a rule, separate from the side of the [frontal lobe](#) of the [sylvian veins](#).

Because of the number of small veins enter the medial side of the sylvian vein from the frontal lobe, the lateral side of the vein is spared as long as possible and particularly the thick walled large veins must be preserved. In cases where the vein must be cut, the venous circulation must be considered.

Of the veins entering on the side of the frontal lobe, those of particular thickness should be preserved.

A micro knife (disposable tuberculin syringe with 21-23 gauge disposable injection needle) is used for the dissection of the arachnoid membrane of the sylvian fissure. For successful incision of the arachnoid membrane, the vein is protected with an aspirator in the surgeon's left hand, tension is added to the membrane, and the blade of the micro knife is pulled towards the surgeon, being used like a knife rather than a needle. On this occasion neurosurgical spatula should be placed over the frontal lobe to give mild tension to the arachnoid membrane of the sylvian fissure.

The arachnoid membrane is dissected with a bipolar forceps or micro-scissors after it is incised with a micro-knife and the tight connective tissue is cut with scissors. After the entry into the sylvian fissure,

the arachnoid membrane is separated and raised from inside of the sylvian fissure with an aspirator in the surgeon's left hand and the arachnoid membrane is incised sharply with scissors.

## **The process of dissection and exposure of AcomA**

The internal carotid and the optic nerve are exposed after preparation of the sylvian fissure, then the anterior part of the optic chiasma is dissected. After the contralateral A1 is secured beyond the inferior surface of the AcomA, the AcomA is separated.

The angle of the microscope and the position of spatula should be changed in order to facilitate the surgical procedure. Retrograde dissection of the sylvian fissure leads to the oculomotor nerve. Therefore the parachiasmatic cistern may be opened by way of dissection of the sylvian fissure and be connected to the sylvian fissure. A tight ligament exists in the boundary between frontal lobe and temporal lobe and also between the parachiasmatic cistern and the sylvian fissure as if it is connecting the frontal lobe with the temporal lobe. After the ligament is sharply dissected, the sylvian fissure is opened and the approach becomes possible by mild compression of the frontal lobe.

After the sylvian fissure is opened, the spatula is inserted to hold the frontal lobe, and gradually retracted toward the parachiasma. The internal carotid artery (C2) is secured, and then the arachnoid membrane is incised, so that the contra lateral optic nerve will be exposed. The parent artery (A1) is secured, and followed by the approach to the aneurysmal peduncle.

## **Approach to the aneurysm**

The direction of the A1 is generally correlated with that of the aneurysm; in cases where the A1 takes an anterior bend in it's the posterior part, the aneurysm will be present on the extension line, (i.e., to face antero-inferiorly). In cases where the A1 extends straight toward the poster superior part, the aneurysms will be present on the extension line (i.e., to face postero-superiorly). In case of the aneurysm facing on anteriorly or inferiorly, A1 is directed anteriorly and posteriorly.

When complete exposure of the neck is impossible because of risk of aneurysmal rupture, tentative clips are placed at the dome or neck, sometimes including the arterial branches. After dome coagulation is performed for making the wall of the aneurysm thicker, the neck is adequately separated and clips are placed in the accurate site.

Many aneurysms may adhere to or be embedded in the optic nerve. Because this type of aneurysm is most likely to rupture prematurely during retraction of the fontal lobe, the surgeon should focus on gentle retraction so that the approach to the aneurysm neck can be accomplished using temporary clipping to ipsilateral A1 and the aneurysm. Even in case where the aneurysm adheres to the optic chiasma, the adhesions can be dissected after the tentative clipping on the aneurysm, and the contra lateral A1 patency can be confirmed. Permanent clipping should then be reapplied if necessary.

Aneurysms directed laterally or superiorly. The aneurysm may exist on the extension line of the A1. This type of aneurysm projects to contra lateral side along the Acom A. The aneurysm is observed parallel to A2; if an approach from the side on which the A2 faces anteriorly, (i.e., the side on which the A2 fork is closed), is selected, the aneurysm is covered by A2 and the contra lateral A1-A2 junction is concealed behind the aneurysm.

**Bridging veins** arising from the frontal base (frontobasal bridging veins, FBBVs) can pose obstacles when performing clipping of anterior communicating artery (ACoA) aneurysms via the **pterional approach**. Although FBBVs can in general be sacrificed without critical complications to achieve an adequate retraction of the frontal lobe, neurosurgeons sometimes encounter postoperative venous infarction or contusion of the retracted **frontal lobe**, which may be accounted for by the damage to the venous drainage system. Thus, preservation of **intracranial veins** is desirable to prevent postoperative venous complications, especially when they are prominent <sup>10)</sup>.

The ventral endoscopic endonasal approach to the ACoA complex provides excellent vascular visualisation without brain retraction or gyrus rectus resection. However, the limitation in access to the A2 for temporary clip placement may prove to be a significant limitation of this approach <sup>11)</sup>.

This situation makes it difficult not only to secure the contra lateral A1 but also to dissect and clip the aneurysm neck; therefore the approach should be selected from the open side of the A2 fork. Prior to clipping, the aneurysmal neck is dissected between the A2 and AcomA.

Aneurysms directed posteriorly. The approach to the posteriorly directed aneurysm must be selected to visualize the back side of the AcomA in which the aneurysm exists.

Usually it is the nondominant side of A1. After the A1 is secured at the bifurcation of the internal carotid artery, the anterior part of the optic chiasma is dissected, when the A1 is located in the high position, and the contra lateral A1 is easily secured beyond the anterior inferior surface of the AcomA. The gyrus rectus is sometimes partly aspirated and removed in the case of high positioned AcomA, and the distal A1 and proximal A2 are exposed. The proximal control site can also be secured, and the contra lateral A1 is confirmed. Subsequently the medial side of A2 on the approaching side of the aneurysm is approached. When the surrounding area of the aneurysm neck is dissected, the origin of the contra lateral A2 is exposed beyond the aneurysm.

Clipping In this region five blood vessels must be confirmed before neck clipping of the aneurysm, namely, the bilateral A1 and A2 and the AcomA. In some cases it may be difficult to dissect the neck of the aneurysm completely. For such cases, a tentative clipping method is useful.

There are two types of tentative clipping methods: (1) dome clipping on the proximal side of the rupture point to prevent further rupturing, and (2) aneurysmal neck clipping, sometimes including arterial branches behind the aneurysm. After tentative clipping the aneurysm can be dissected completely, and then the ruptured point is coagulated with or without trimming of the aneurysm. This makes the aneurysm small and accurate neck clipping becomes easy for dissection, bipolar forceps, silver dissector is useful. When the bipolar forceps is used as a dissector the tip must be placed accurately at the dissecting point; otherwise it causes bleeding. In the acute stages of SAH, Jet irrigation is very useful. The surgeon can irrigate the blood clot to recognize blood vessels of the arachnoid membrane. Water itself raises the arachnoid membrane, so that the arachnoid membrane can be cut sharply, accurately and safely. The point of dissection is dissected using bipolar forceps or a dissector and the strong adhesion is cut with a micro scissors. The dissection is performed towards the direction of aneurysm and the space for the clip blade is secured without tension to the aneurysm. Exposure of the whole aneurysm is not necessary and is avoided. Before clipping, the area surrounding the aneurysm should be inspected for arterial branches and perforators. During clipping, the clip holder should be gradually inserted to allow visibility of the blade tip during opening and closing of the clip. The clip is placed parallel to the parent artery as a rule. It should be kept in mind that the natural morphology of the parent artery should remain for avoiding stenosis and kinking. Intra-operative rupture most frequently occurs at the time of aneurysmal preparation. Temporary or

tentative clipping under the administration of cerebral protective drugs facilitates the surgical procedure. The full circumference of A1 at the side of the temporary clip must be separated. Usually an average of eight perforating arteries branch from the posterior surface of A1. Because disorders of the anterior hypothalamus cause emotional change, personality disorder and intellectual deficit, damage to it must be avoided. The absence of involvement of branch by clipping or neck residual must be confirmed by dome puncture and coagulation following neck clipping. Attention must be paid to the occlusion of the contra lateral A2 in the case of aneurysm facing supero-laterally and that of the contra lateral A1 in the case of aneurysm facing antero-inferiorly. Care must be taken to prevent occlusion of the perforating arteries arising from the AcomA, particularly the hypothalamic artery, in the case of an aneurysm facing posteriorly. In this situation trapping should be avoided as much as possible. The recurrent artery of Heubner runs in the reverse direction along the A1 around the AcomA or from the origin of the A2. A large recurrent artery of Heubner may be confused with the A1. Care must also be taken to avoid confusing the fronto-orbital artery originating from the proximal side of the A2 with a recurrent artery because it also runs on the inferior surface of the frontal lobe.

Closure: The dura mater is sutured watertight; sometimes fibrin glue with an antibiotics may be sprayed for the purpose of preventing leakage of the cerebrospinal fluid. A drain is kept extradurally and bone flap is fixed at several sites with titanium mini-plates which were marked during craniotomy. The temporalis muscle and the fascia are sutured from the pterion and the scalp is sutured in bilayered pattern. Because the pterional approach is a common craniotomy procedure to the anterior circulation and to the tip of the basilar artery, surgeons should become experts in the procedure, so that these operations will proceed smoothly.

## Superior pointing aneurysm

When the fundus points superiorly, craniotomy in the side of A2 of posterior displacement may be advantageous for catching the aneurysm and both ACAs on the same plane. Sometimes, however, surgeons have to deliberately select a “contralateral” craniotomy to deal with other lesions in the same operative session <sup>12)</sup>.

The aneurysm may exist on the extension line of the A1. This type of aneurysm projects to contra lateral side along the Acom A. The aneurysm is observed parallel to A2; if an approach from the side on which the A2 faces anteriorly, (i.e., the side on which the A2 fork is closed), is selected, the aneurysm is covered by A2 and the contra lateral A1-A2 junction is concealed behind the aneurysm.

In a anatomic study, a three-dimensional arterial tree was demonstrated, an anterior communicating artery region aneurysm model was prepared, and pictures were taken at various angles. According to the observations, 30-degree head rotation was found to be the most suitable position for the anterior and superior projected aneurysms. <sup>13)</sup>

In the case of aneurysms directed superiorly, the A1 is bilaterally secured before approaching the aneurysm. Therefore entry into the open part of the A2 (i.e. the side of A2 facing posteriorly) facilitates clipping .

Suzuki et al., treated superiorly projecting aneurysms through the side of aneurysm fundus projection <sup>14)</sup> .

Hyun et al., investigated surgical results based on craniotomy sidedness in patients with superiorly projecting anterior communicating artery (ACoA) aneurysms to evaluate decision-making on the

surgical approach based on the anatomical planes of both A2 vessels. Among 99 patients treated surgically, 19 (19.2%) ACoA aneurysms projected superiorly. They analyzed the associations between surgical outcomes and the planes containing both A2 vessels (anterior or posterior displacement of A2 in relation to the aneurysm). Surgery in nine patients was approached from the side of the A2 posterior displacement, while surgery for ten patients was approached from the side of anterior displacement. A higher requirement for gyrus rectus aspiration was found in patients approached from the plane of A2 anterior displacement ( $p=0.041$ ). All aneurysms were successfully secured without any surgery-related complications, except in two patients. Approaches from the side of posterior displacement of A2 in patients with superiorly projecting ACoA aneurysm allowed the aneurysmal necks to be secured safely and prevented postoperative complications <sup>15)</sup>.

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Superior direction of aneurysm appears associated with postoperative olfactory dysfunction. Olfactory protection using gelfoam and fibrin glue could be a simple, safe, and useful method to preserve olfactory function during A-com aneurysm surgery <sup>16)</sup>.

## Case series

### 2016

A total of 102 patients who underwent a pterional or superciliary keyhole approach to clip an unruptured ACoA aneurysm from 2006 to 2013 were included in a study. Those patients who complained of permanent olfactory dysfunction after their aneurysm surgery, during a postoperative office visit or a telephone interview, were invited to undergo an olfactory test, the Korean version of the Sniffin' Sticks test. In addition, the angiographic characteristics of ACoA aneurysms, including the maximum diameter, the projecting direction of the aneurysm, and the height of the neck of the aneurysm, were all recorded based on digital subtraction angiography and sagittal brain images reconstructed using CT angiography. Furthermore, the extent of the brain retraction was estimated based on the height of the ACoA aneurysm neck.

Eleven patients (10.8%) exhibited objective olfactory dysfunction in the Sniffin' Sticks test, among whom 9 were anosmic and 2 were hyposmic. Univariate and multivariate analyses revealed that the direction of the ACoA aneurysm, ACoA aneurysm neck height, and estimated extent of brain retraction were statistically significant risk factors for postoperative olfactory dysfunction. Based on a receiver operating characteristic (ROC) analysis, an ACoA aneurysm neck height  $> 9$  mm and estimated brain retraction  $> 12$  mm were chosen as the optimal cutoff values for differentiating anosmic/hyposmic from normosmic patients. The values for the area under the ROC curves were 0.939 and 0.961, respectively.

In cases of unruptured ACoA aneurysm surgery, the height of the aneurysm neck and the estimated extent of brain retraction were both found to be powerful predictors of the occurrence of postoperative olfactory dysfunction <sup>17)</sup>.

### 2015

Between January 2005 and June 2012, 305 patients with anterior communicating artery (Acom) aneurysms were treated using the pterional approach. Among them, 113 who underwent



microsurgery with an unruptured Acom aneurysm were enrolled in this study. Every patient was evaluated with digital subtraction angiography preoperatively and CT scans were taken several times postoperatively. Surgical outcomes and complications were evaluated at discharge using the Glasgow Outcome Scale and at 6 months after surgery with CT angiography.

Enrolled patients included 55 males and 58 females with a mean age of 56.3 years (range: 30-75 years). The mean diameter of the aneurysm was 5.8mm (range: 1.9-24.1). Left A1 dominance was found in 71 patients (62.8%) whereas right A1 dominance was found in 20 patients (17.7%), and right pterional craniotomies were performed in 92 patients (81.4%) while left pterional craniotomies were performed in 21 patients (18.6%). Complete clip application was achieved in 94.9% of patients (74 of 78) in right-side approach group but in only 81.3% of patients (13 of 16) in left-side approach group. Despite a left A1 dominance and approached from the right, more than 90% of the patients had an excellent outcome at discharge (GOS 5) and more than 90% a complete aneurysm clipping at the 6-month follow-up CT angiography although it was not statistically significant.

Microsurgical clipping of the unruptured Acom aneurysm through a right-side surgical approach showed favorable postoperative clinical and anatomical outcomes, especially aneurysms smaller than 10mm <sup>18)</sup>.

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Before the surgery, three-dimensional-DSA (3D-DSA) was performed to study the regional anatomy of ACoA complexes in 15 patients with ACoA aneurysms. According to 3D-DSA, the aneurysms and ACoA complexes could be satisfactorily exposed by the microsurgery through the pterional approach contralateral to the supply of dominant blood. And then the microsurgery through the pterional approach contralateral to the supply of dominant blood was performed in 15 patients with ACoA aneurysms.

Clipping of ACoA aneurysms were successfully performed in all patients. The aneurysms and ACoA complexes were satisfactorily exposed via 3D-DSA. Among 15 patients with ACoA aneurysms, 14 cases were cured and 1 case need further care.

The ideal side of pterional approach may be choose via simulation of pterional approach with 3D-DSA. The ACoA complex and aneurysm can be clearly exposed, and the aneurysm may be smoothly clipped safely by the microsurgery through the ideal side pterional approach contralateral to supply of dominant blood in the patients with ACoA aneurysms <sup>19)</sup>.

## 2010

Hyun et al., investigated surgical results based on craniotomy sidedness in patients with superiorly projecting anterior communicating artery (ACoA) aneurysms to evaluate decision-making on the surgical approach based on the anatomical planes of both A2 vessels. Among 99 patients treated surgically, 19 (19.2%) ACoA aneurysms projected superiorly. They analyzed the associations between surgical outcomes and the planes containing both A2 vessels (anterior or posterior displacement of A2 in relation to the aneurysm). Surgery in nine patients was approached from the side of the A2 posterior displacement, while surgery for ten patients was approached from the side of anterior displacement. A higher requirement for gyrus rectus aspiration was found in patients approached from the plane of A2 anterior displacement ( $p=0.041$ ). All aneurysms were successfully secured without any surgery-related complications, except in two patients. Approaches from the side of



posterior displacement of A2 in patients with superiorly projecting ACoA aneurysm allowed the aneurysmal necks to be secured safely and prevented postoperative complications <sup>20)</sup>.

## 2009

Between January 2004 and January 2006, 93 cases with AComA aneurysms were treated through pterional approach. They were classified as Type I, II (IIa, IIb), III and IV, based on the various projections and size of aneurysm. The principle for the choice of operative side was designed based on the type of aneurysm and the A2 fork orientation (the interrelations between the plane of bilateral A2, AComA, and mid-sagittal plane).

There were 55 aneurysms of Type I, 10 of Type IIa, 14 of Type IIb, 12 of Type III, and 2 of Type IV. In Types I and IIa, the side posteriorly placed to A2 was chosen for the approach. In Type IIb, the side of the dominant A1 was selected. In Type III, the side anteriorly placed to A2 was chosen. Type IV aneurysms were difficult to handle even if approached from the dominant A1. There were 11 cases treated from the side of non-dominant A1. The overall outcome in the treatment of AComA aneurysms were considered excellent in 90.8% of cases according to the Glasgow Outcome Scale, with complete occlusion of aneurysms and complete patency of parent or perforating arteries.

Applying three-dimensional computed tomography and magnetic resonance angiography, we classified AComA aneurysms as four types and undertook surgical clipping from the chosen side of approach, according to the type of aneurysm and the A2 fork orientation. The selective side of approach on the basis of individual decision-making has led to favourable outcomes <sup>21)</sup>.

## 2008

Inferiorly projecting aneurysms were treated through the dominant A1 side, and superiorly projecting aneurysms were treated through the side of aneurysm fundus projection. Suzuki et al., analysed postoperative outcome and surgical complications, and the correlations between the anatomical factors such as position (high or low), projection (dorsal or anterior), and the plane containing both A2 vessels (open A2 plane defined as the A2 of the approach side located more posteriorly than the contralateral A2; closed A2 plane as the ipsilateral A2 located more anteriorly than the contralateral A2), to assess the surgical requirements of approaches in patients with superiorly projecting aneurysms.

A favorable outcome was achieved in 95.1% of patients with inferior type aneurysms and 85.2% of patients with superior type aneurysms ( $P = 0.088$ ). Surgical complications occurred in 8.9% of patients with inferior type aneurysms and 17.9% with superior type aneurysms. However, there was a distinct group of patients with superior type aneurysms characterised by a closed A2 plane, in which the ipsilateral A2 was located anterior to the contralateral A2, in whom the approach toward the neck was significantly more difficult, requiring A2 displacement or gyrus aspiration, and resulting in a neck remnant and more surgical complications such as vascular injury or cerebral contusion. This group also had a significantly high correlation with high position and dorsal projection of aneurysms causing more difficult dissection.

This policy provided good postoperative outcomes. However, use of skull base techniques or the interhemispheric approach, instead of the normal pterional approach, may further improve the postoperative outcome for closed A2 plane aneurysms <sup>22)</sup>.

## 2006

Hino et al., has operated on 111 patients with Acom aneurysms during the last 8 years; 26 aneurysms projected superiorly, and 7 were approached via contralateral craniotomy because of the aneurysm multiplicity. They reviewed surgical problems in the 7 upward projecting aneurysms approached from the “contralateral” side. All aneurysms were successfully secured without any surgery related complication. However, in each case, aneurysm and both ACAs formed a straight line in the narrow surgical field, and it was difficult to handle the aneurysm behind the ipsilateral A2, particularly when it tightly adhered to the A2. Anticipating this prior to surgery allows the surgeon to know the possible problems in aneurysm dissection that may occur. Practically, wide separation of interhemispheric fissure with removal of the gyrus rectus, and dissection of the posterior aspect of the ipsilateral A2 facilitates the mobilization of A2 and exposure of the aneurysm neck. When the aneurysm is tightly adherent to the A2, however, isolation of the entire aneurysm risks tearing the aneurysm at its A2 junction. An aperture clip should be considered to avoid serious bleeding during dissection <sup>23)</sup>.

## 2002

The safety and reliability of neck clipping of the anterior communicating artery (Acom) aneurysm via the pterional approach was evaluated in terms of craniotomy side in 39 consecutive cases operated on by the senior surgeon from April 1991 through March 2000. These aneurysms were approached in principle via the side where the proximal A2 portion of the anterior cerebral artery was located posteriorly, for the purpose of easier identification of all five arteries involved, i.e., A1 and A2 portions of the anterior cerebral arteries of both sides and Acom. All aneurysms were clipped safely irrespective of the approach side because it was possible prior to aneurysmal dissection to prepare both A1 portions of the anterior cerebral arteries for temporary clipping, but not as far as the place where the aneurysm projects inferiorly and its fundus adheres firmly to the optic chiasm. The security of perforating arteries, however, could not be confirmed even after the completion of neck clipping in 9 cases. Clipping was impossible in the other 2 cases. In 2 of these 11 aneurysms the difficulty in clipping was not based on what side was used for craniotomy but on their large size. In the remaining 9 aneurysms, the necks of which were all situated on the posterior wall of the Acom, the craniotomy side turned out to be inappropriate when they were approached via the side where the proximal A2 portion of the anterior cerebral artery was located posteriorly. It was concluded that the craniotomy side should be selected so that the surgeon can observe directly the neck of the aneurysm <sup>24)</sup>.

## Case reports

An 80-year-old female presented 5 months previous for nonspecific gait disturbance, during which an MRI was performed. A large based anterior communicating artery aneurysm was found independent of neurology. An interdisciplinary discussion favored surgical treatment, on which the patient insisted. Surgery was performed using standard anesthesia techniques with intraoperative burst suppression during surgery, neuromonitoring with MEP and SEP, as well as ICG angiography, microdoppler and neuronavigation. Successful clipping was performed with 2 fenestrated straight and one bayoneted straight Lazic clip. Temporary clipping was 6.1 minutes. Postoperative angiography showed exclusion of the aneurysm, and there was no neurological deficit. The video can be found here:

<http://youtu.be/WKjOHG8irFo> <sup>25)</sup>.

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