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Supraorbito - orbital Approach for Anterior Communicating Artery Aneurysm

Anusak Liengudom, MD
Division of Neurosurgery, Prasat Neurological Institute, Bangkok, Thailand

Abstract **Base on "minimally invasive and key hole concept", a supraorbito-orbital keyhole approach to the anterior communicating artery aneurysms is described. The main advantages of this technique are that it involves simple and rapid craniotomy, a short distance to the aneurysm, less brain retraction, better surgical orientation, and gaining control of both A_1 segments before disturbing the aneurysm. This approach has been used in 57 consecutive cases during the year 1998-2000. The overall results were excellent and good in 42 cases, fair in 5 cases, poor in 2 and death supervened in 8 cases. The mortality rate in 4 acute operation cases was 7.0 percent and 7.0 percent in 4 delayed cases.**

Microsurgical management of the anterior communicating artery (ACoA) aneurysm is one of the most exciting challenges in neurosurgery. Since Dott[1] reported the operation for intracranial aneurysms through the subfrontal approach in 1933, various modified craniotomy approaches[2-7] had been proposed with promising results (Figure 1). The most popular approach is the "microtechnical pterional approach" proposed by Yasargil[2] in 1967. Perneczky[8] opened a new innovative chapter in neurosurgery by introducing "keyhole concept and approach" with successful results in treating various intracranial lesions including aneurysms.

Materials and Methods

During the period between 1998-2000, the supraorbito-orbital keyhole approach has been used to treat 57 ACoA aneurysms at Prasat Neurological Institute. Their ACoA aneurysms were clipped through a supraorbito-orbital keyhole route. Patients' ages ranged from 22-89 years with a mean of 54.64 years. There were 24 males and 33 females in the series. Preoperatively, patients were in the following Hunt & Hess[9] grades: I - 20 patients; II - 10 patients; III - 15 patients; IV - 12 patients. Fisher[10] grades: I -10 patients; II -10 patients; III - 18 patients; IV -19 patients. Early surgery was performed in 40 cases (70.17 %), 17/40 (42.50%) within 3 days, 23/40 (57.50%) in 4 to 7 days. Delayed surgery occurred in 17 patients (29.82%).

Operative Technique

Terminology Supraorbito-orbital approach represents a one-piece craniotomy of the frontal bone-supraorbital ridge-proximal 1/3 of the orbital roof.

Preparation A lumbar spinal catheter is inserted

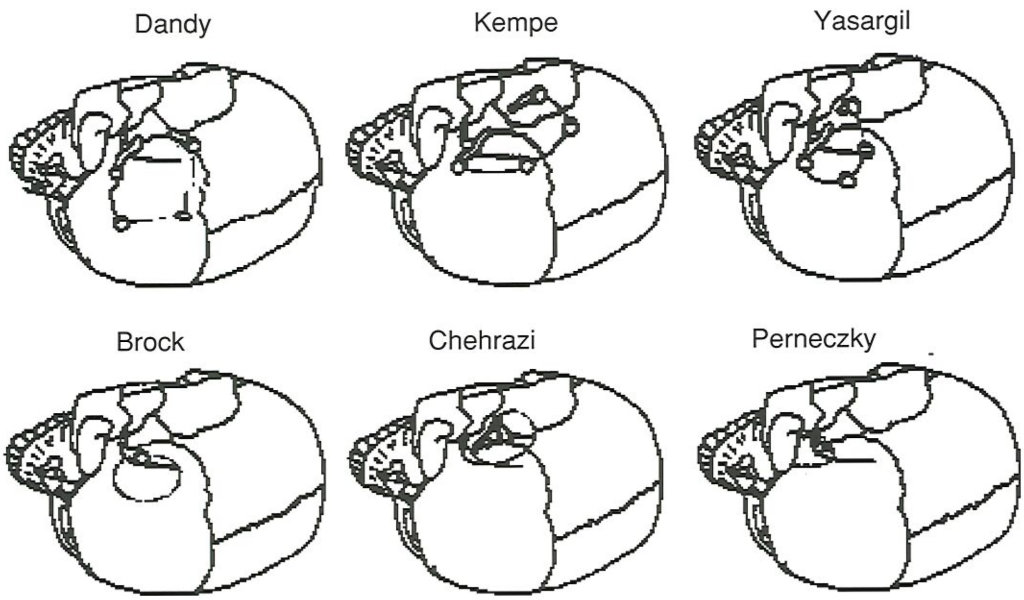

Fig. 1 Various selected craniotomy for intracranial aneurysm

for intraoperative drainage of cerebrospinal fluid (CSF). The drainage of CSF from the indwelling lumbar subarachnoid catheter is started when the dura is being opened. This maneuver facilitates the retraction of the frontal lobe.

The patient is placed in the supine position with the head elevated above the level of the heart and turned 45 degrees toward the left side. The head is secured in a standard Mayfield skull clamp.

Incision The skin incision extends over the upper border of the eye brow starting medially from supraorbital notch to the external ocular process laterally (Figure 2). The incision is carried down deep to the pericranium and is reflected both anteriorly and posteriorly under traction with rubber band stay-sutures. The temporalis muscle is incised along its anterior border just behind the frontal process of the zygomatic bone.

Craniotomy A single burr hole craniotomy is made to remove the frontal bone - supraorbital ridge - proximal 1/3 of the orbital roof in one piece (Figure 2). The size of the bony removal is $3 \times 2 \times 1$ cm^3. In the case of high and spiky orbital roof, it can be flattened extradurally by using high speed drill to enhance the working space and decrease the retraction to the frontal lobe as well.

The dura is opened in an U - shaped fashion with its base located over the orbital roof. The dural flap is reflected anteriorly to overlie the periorbital fascia as to prevent the orbital fat from protruding out in case there is a tear in the periorbital fascia.

Aneurysm exposure Once the cerebrospinal fluid is drained, the retractor is gently placed on the subfrontal surface to expose the arachnoid overlying the optic nerve and the carotid artery, the low - lying angle of approach along the skull base minimizes the need for brain retraction. The operative microscope is now brought in, the arachnoid adhesions are taken down, the carotid cistern is opened, and the carotid artery is isolated. Then further dissection of the arachnoid is directed medially across the optic nerve, lamina terminalis to the opposite optic nerve and the carotid artery. With further dissection of the arachnoid adhesions and removal of subarachnoid blood as needed, both A_1 are clearly seen for proximal control. The ACoA region is then exposed by gentle lifting the frontal lobe.

The isolation of aneurysm neck is carried out with strict microsurgical technique. The direction of dissection depends on the direction of aneurysm fundus. Preoperative careful evaluation of the MRA or angiography to ascertain the dome projection and neck configuration is mandatory since it dictates the direction of dissection. Basically, avoiding premature

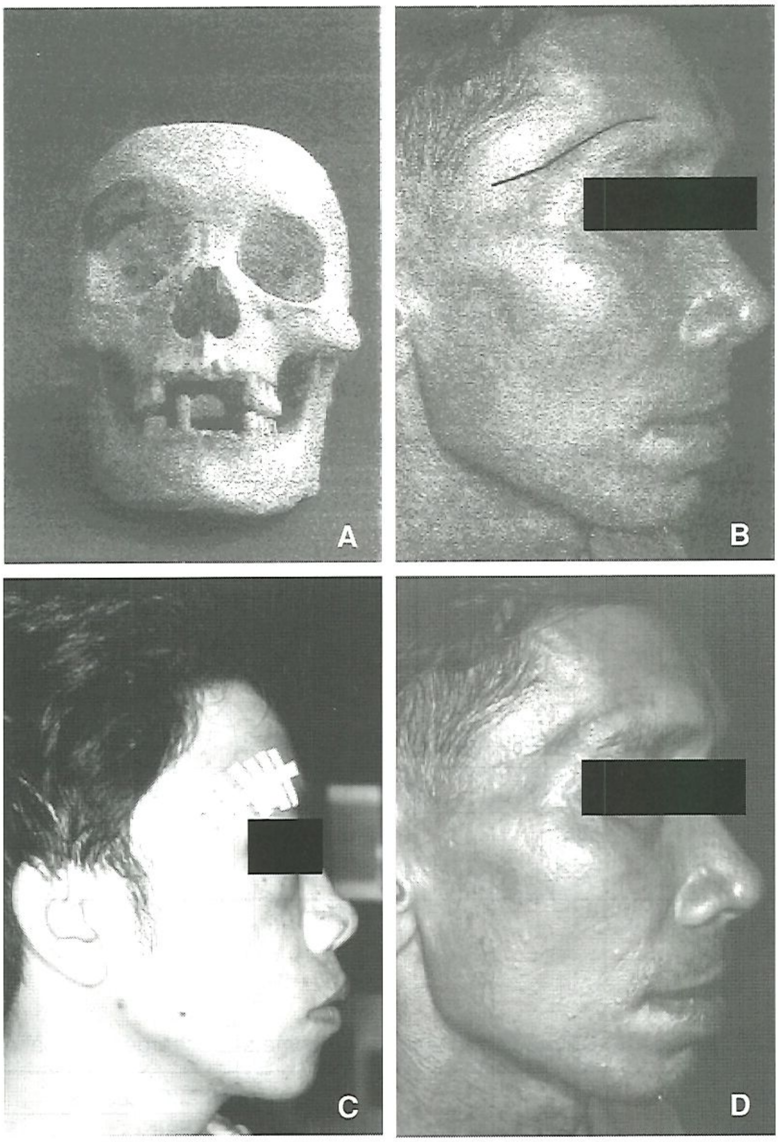

Fig. 2 A supraorbito-orbital craniotomy site
B skin incision along upper eye brow
C 1 day appearance
D 8 weeks appearance

rupture of aneurysm is pivot by subpial dissection and keeping distance from the white thrombus covering the ruptured site. In superior and posterior pointing aneurysm the Heubner's artery may obstruct the view of the aneurysm neck and hypothalamic artery may adhere to the aneurysm neck and may interfere with the aneurysm clipping. The contralateral A_2 is usually found after complete isolation of the aneurysm.

After confirming all the vascular anatomy, the final clipping is made with particular care to obliterate the aneurysm neck completely and to preserve perforators. The direction of the operating microscope may need to be readjusted during clip application so the view of the aneurysm neck and the clip blades are not obstructed. We routinely use Mini Yasargil clip. To avoid clipping the contralateral A_2, side-bending clip is useful for posterior and superior pointing aneurysm. Straight clip is suitable for anterior and anterosuperior pointing aneurysm. Straight fenestrate clip is also useful for clipping posterior and inferior pointing aneurysm.

Closure After closure of the dura, the free bone flap is secured in place. The skin incision is closed in cosmetic fashion with a local wound dressing (Figure 2).

Results

According to the angiographic finding in 57 cases, the aneurysm were fed from the left A_1 in 26 (45.6%), the right A_1 in 26 (45.6%), both A_1 in 5 (8.8%) cases. Various aneurysmal projection types were encountered (Table 1). The most frequent type was the superior projection (52.6%) which was rather difficult to gain exposure because the Heubner's artery and/or hypothalamic artery frequently adherent to the neck or the lateral aspect of the aneurysm. The second type was the anterior projection (19.3%) which was the easiest for placing the clip. The third type was the bilobe aneurysm.

Table 1 Dome projection types and frequency of ACoA aneurysms

	Anterior	Superior	Bilobe	Posterior	Inferior	Azygos
No. Case	11	30	6	4	5	1
%	19.3	52.6	10.5	7.0	8.8	1.7

Table 2 Surgical outcome at discharge in 57 patients*

	Excellent	Good	Fair	Poor	Dead
No. Case	32	10	5	2	8
%	56.1	17.5	8.8	3.5	14.0

**For description of outcome categories see text.*

Table 3 Preoperative grade and surgical outcome at discharge in 57 patients*

Preop Grade	No. Cases	Surgical Outcome				
		Excellent	Good	Fair	Poor	Dead
I	19	18	0	0	1	0
II	11	9	0	2	0	0
III	15	3	7	1	1	3
IV	12	2	3	2	0	5

**Preoperative grading was according to the system of Hunt and Hess[9].*
For a description of outcome categories see text.

Table 4 Surgical timing and surgical outcome at discharge in 57 patients*

		Surgical outcome				
		Excellent	Good	Fair	Poor	Dead
Acute (0-7days)	No	23	8	5	2	4
	%	40.3	14	8.8	3.5	7.0
Delayed(>7)	No	9	2	-	-	4
	%	15.7	3.5	-	-	7.0

**For description of outcome categories see text.*

The patient's preoperative condition was evaluated according to the classification of Hunt and Hess.[9] Surgical outcome was classified as follows: excellent (normal); good (mild neurological deficits, but normal social life still possible); fair (neurological deficits, normal social life not possible); poor (independent domestic life not possible); and dead.

Of the 57 patients in the series, 32 (56.1%) were judged as having an excellent outcome at discharge, 10 (17.5%) as good, 5 (8.8%) as fair, 2 (3.5%) as poor, and 8 (14%) had died (Table 2). The cause of death among the 8 patients who died was most commonly vasospasm (5 cases) followed by sepsis complication (3 cases). Analysis of the preoperative neurological status, base on Hunt and Hess grading system[9] showed that most of the excellent outcome were in grade I and II (Table 3). The patients' outcome based on surgical timing was summarized in Table 4. In 23 patients operated on in the acute stage, excellent and good results were obtain in 54.3 percent, fair in 8.8 percent, and poor in 3.5 percent. In delayed cases, excellent and good results were obtained in 19.2 percent and death in 7 percent.

Discussion

The "Microtechnical pterional approach" popularized by Yasargil et al[2] utilized a miniature of Kempe's[4] frontotemporal craniotomy by limiting its posterior extent and adding the extensive resection of the lateral aspect of the sphenoid wing. It employed a microscope for making a lateral subfrontal approach along the sylvian fissure, with an opening of the arachnoid over the medial aspect of the sylvian fissure to reduce the need for retraction on the frontal lobe. Generally, the pterional approach satisfies the principle of aneurysm surgery. The major principle of all cerebral aneurysm surgery is to obtain proximal and distal control before dissection of the aneurysm is begun. The reason for these principles are: (1) to eliminate the chance of intraoperative rupture that will worsen the outcome if it occurs; (2) also, proximal and distal control will allow temporary clipping; and (3) adequate dissection time for proper application of a clip to the aneurysm neck. Supraorbito-orbital approach proposed by Perneczky[8] serves this principle and adds some advantages. The advantages of this approach include simple and rapid craniotomy. The removal of

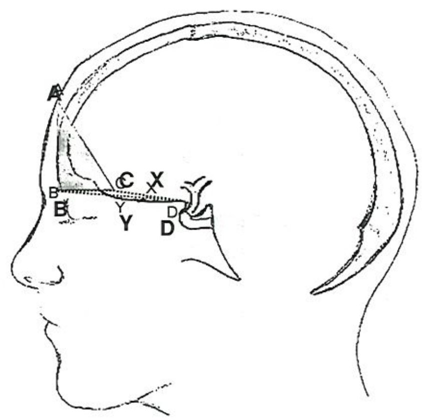

Fig. 3 The right angle triangle represents the supraorbito-orbital craniotomy. AB, representation of simple craniotomy, is shorter than AC resulted in smaller window compared with the supraorbito-orbital craniotomy. The another advantage is the short distance to the ACoA aneurysm, X is shorter than Y.

frontal bone included proximal part of orbital roof create a low - lying angle and upward trajectory to the ACoA complex resulting in minimal brain retraction, less retraction on olfactory tract and obviate the need for resection of the gyrus rectus. The removal of the orbital roof produces a short distance to the aneurysm and also a wide field of exposure (Figure 3) as oppose to the name "keyhole approach". The supraorbito-orbital approach is a more anterior route, compares with the pterional approach. In conjunction with the ability to widely open the arachnoid membrane from ipsilateral proximal sylvian fissure, carotid cistern, optic cistern to contralateral carotid cistern enable early exposure of both A_1 that resulted in surgeon orientation and control before starting precise dissection of the aneurysm. The contra lateral A_2 is also easier to identify and free from the aneurysm.

The disadvantage may be that the exposure is through the small window but can be overcome by the use of modern microscope and refined microsurgical instrument.

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