Characteristics and use of ultra-long aneurysm clips

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Ultra-long aneurysm clips, 21 to 40 mm in length, are described, and their characteristics and application delineated. These clips have been used in 30 procedures for various kinds of aneurysms. They are useful not only for wide-necked and giant aneurysms but also for deeply located aneurysms such as those on the vertebrobasilar artery.

KEY WORDS : intracranial aneurysm • giant aneurysm • vertebrobasilar aneurysm • aneurysm clip • instrumentation

Improvements in instrumentation can make previously difficult or impossible operations easy and successful.1 The application of the standard and fenestrated aneurysm clips has been reported previously.3–7 We have developed seven different kinds of aneurysm clip with ultra-long blades, and have used them effectively in 30 clinical cases over the past 5 years. We report some of these cases and describe the characteristics and application of these clips with ultra-long blades.

Description of Ultra-Long Clips

Besides the 55 varieties of Sugita clips of various shapes reported previously, seven kinds of ultra-long straight clip, 20, 22, 24, 30, 35, and 40 mm in length, and one 21-mm bayonet clip are available (Fig. 1).* The closing force of their blade tips is classified into two groups: one group, with blade lengths of 20, 21, 22, and 24 mm, has a closing force ranging from 150 to 180 gm, and the other, with blade lengths of 30, 35, and 40 mm, has a force from 180 to 200 gm. The first and second groups have a blade diameter at the tip of 1.4 mm and 1.6 mm, respectively. The most important characteristic of the ultra-long clips in the second group

* Clips manufactured by Mizuho Ikakogyo Co., Ltd., Hongo 3-29-10, Bunkyo, Tokyo, Japan.
is that the force at the clip bottom ranges from 800 to 1100 gm, two or three times more than in usual clips (Fig. 2).

We present here four representative cases to illustrate the advantages of this kind of clip.

Illustrative Case Reports

Case 1: Giant MCA Aneurysm

This 54-year-old carpenter suffered a subarachnoid hemorrhage (SAH) 16 days before the operation. A left carotid angiogram revealed a giant aneurysm (Fig. 3A and B) at the trifurcation of the left middle cerebral artery (MCA). A left frontotemporal craniotomy was performed, and the neck of the aneurysm was found to have the same diameter, about 18 mm, as the body. Both the walls of the trifurcation of the MCA and the aneurysm neck were very hard, with yellowish arteriosclerotic changes. An ultra-long clip, 24 mm in length,
Ultra-long aneurysm clips

was applied to the body of the aneurysm, about 5 mm distant from the trifurcation. When in place, the blades of the clip were found to open with pulsation. A second clip of the same length was added parallel to and partially crossing the first clip to reinforce the pressure applied, and the pulsating of the clip stopped. On the postoperative left carotid angiogram (Fig. 3C and D), the aneurysm and the residual neck, which had purposely not been included in the clip, disappeared. Postoperatively, the patient developed slight aphasia which gradually improved.

Case 2: Right MCA Aneurysm

This 44-year-old man suffered a severe SAH. Right carotid angiography showed a large aneurysm with a neck 18 mm in width arising from the right MCA (Fig. 4A and B), and a computerized tomography (CT) scan revealed a large intracerebral hematoma in the right temporal lobe. A right frontotemporal approach was made on the 15th day after SAH. After dissection around the neck of the aneurysm of the right MCA, a temporary Sugita clip with a closing force of 70 gm was applied to the right proximal MCA. Although the temporary clipping reduced the tension of the aneurysm dome by about 50%, a clip 20 mm in length slipped to the side of the trifurcation, causing narrowing of the parent arteries. At this point, the dome was punctured and it shrank. A second clip was placed on the dome side, then the first clip and the temporary clip were removed. The clipping period had been 8 minutes. The bifurcation was found sufficiently wide, but a residual

![Image of Case 2](attachment:image.png)

**Fig. 4. Case 2.** Upper: A and B: Preoperative right carotid angiograms, anteroposterior view (A) and oblique anteroposterior view (B), showing a large right middle cerebral artery aneurysm. C: Postoperative angiogram, anteroposterior view, after clipping of the residual aneurysm neck. Lower: Operative drawings showing clip placement. 1: Placement of a temporary clip. 2: The first clip has slipped toward the parent artery. 3: The second clip is applied after puncture of the dome but before removal of the first clip (not shown). 4: An additional clip is used to occlude the residual aneurysm neck.
Case 3: Basilar Artery Bifurcation Aneurysm

This 62-year-old woman had two SAH's, and an operation was carried out 14 days after the second attack. Vertebral artery angiography revealed an aneurysm arising from the bifurcation of the basilar artery (Fig. 5A). Through a right frontotemporal craniotomy, a transsylvian approach was made to the aneurysm. The intradural carotid artery was sclerotic and protruded considerably in the lateral direction, which made an approach to the aneurysm lateral to the carotid artery difficult. In addition, an unruptured aneurysm was present in the right MCA. Therefore, an approach was made between the right optic nerve and right carotid artery, where the space was very narrow, even with medial retraction of the optic nerve. Although dissection around the aneurysm neck was difficult, a space was made around the neck that was barely sufficient for the clip blade. The distance between the optic nerve and the carotid artery was, however, too narrow for insertion of the head of the clip applier if a clip with a usual-sized blade were used. The only possibility in this instance was to use an ultra-long clip of 24 mm. Clipping was successful without the need to insert the applier head into the space between the optic nerve and the carotid artery (Fig. 5 left). The postoperative course was uneventful.

Case 4: Left Vertebral Artery Aneurysm

This 58-year-old woman had a severe SAH, and angiography revealed two aneurysms at the left vertebral artery and basilar artery (Fig. 6A). First, the aneurysm at the left vertebral artery, which had apparently ruptured, was approached through a left lateral suboccipital craniectomy. The aneurysm was located deep in the midline. Insertion of a clip applier was impossible because of the narrow operating field surrounded by the medulla, the fibers of the lower cranial nerves, and the clivus. Clipping of the aneurysm was possible only with a 24-mm long clip. The other aneurysm at the basilar artery was clipped through a transsylvian approach at a second procedure 2 weeks after the first operation (Fig. 6B and C). The patient recovered well.

Discussion

In the actual application of these ultra-long clips, two points should be taken into consideration. On the mechanical principle of a lever, the force at the blade bottom becomes extremely high when the clip is manu-
factured so as to provide a sufficient force at the blade tip. Therefore, repeated trials of clipping with the bottom portion of the long blades must be avoided because of the possibility of injury to the aneurysm wall or tearing off of atheroma, which is more of a risk than with a shorter clip. The second consideration is the tendency of large wide-necked aneurysms, for which ultra-long clips are normally used, to have a thick atheromatous wall at both the neck and parent artery. The aneurysm dome must therefore be obliterated at a certain distance from the parent artery. The diameter of the newly reconstructed parent artery after clipping should be greater than the diameter of its normal proximal artery, in proportion to the hardness of the neck wall and the width of the neck.

Although the number of different kinds of clips is limited, the blade lengths and angles that can be formed by using two clips or more are quite varied. To obliterate a wide aneurysm neck in a curved parent artery or at a bifurcation or trifurcation, it is essential that the blades of two clips are correctly placed, with the best possible combination of blade length and angle, in order to form a residual neck necessary to avoid stenosis of the parent artery. Trouble with clipping too close to the parent artery is likely to occur when using a single clip.

Another beneficial procedure is temporary clipping. Large aneurysms generally have a high intraluminal pressure in proportion to their diameter. Temporary clipping at the proximal portion of the parent artery reduces the aneurysm pressure by about one-half so the aneurysm clip can be placed appropriately without slipping toward the parent artery; furthermore, puncture of the dome makes clipping easier. However, we have applied a temporary clip in only a few cases and for as short a time as possible. When temporary clipping of the parent artery is needed for more than 10 minutes, as in the case of anterior circle of Willis aneurysms, the clip is intermittently loosened for periods of 5 minutes so as not to compromise the cerebral blood circulation.

One of the technical difficulties in surgery of basilar artery aneurysms is the deep location of the artery at the bottom of a narrow cylindrical operating field in a pterional approach, although the operating field in a subtemporal approach has a slightly larger, cone-shaped space. The optic nerve and carotid and posterior communicating arteries render it difficult to make enough space for insertion of a clip applier, especially in a pterional approach. When using a clip with a blade shorter than 20 mm, the head of the clip applier often blocks the surgeon’s vision or does not fit through a narrow space. In the case of a vertebral artery aneurysm located close to the midline, advancing the clip applier may also be impractical due to a narrow field surrounded by the medulla, pons, bone, and lower cranial nerves. The ultra-long clip is well suited in these instances.

Although an ultra-long clip appears grotesque on the postoperative x-ray picture and produces a marked artifact on CT scans, we have not experienced actual complications due to its length. Some surgeons might worry about the clip damaging important surrounding tissues; to avoid this we pack a piece of muscle between the spring portion of the clip and the surrounding critical tissues such as the optic and oculomotor nerves and the carotid artery.

Another application of the ultra-long clip is in the temporary obliteration of an arteriovenous malformation (AVM) at the final stage of a corrective procedure. We often place the clip on the body of the remaining nidus or on the largest draining vein before removal or
section of the AVM, to check whether the nidus swells. This trial is often beneficial in deeply seated AVM's in a narrow operating field.

References


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