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Lateral supraorbital approach as an alternative to the classical pterional approach

J. Hernesniemi[1], **K. Ishii**[1,2], **M. Niemelä**[1], **M. Smrcka**[3], **L. Kivipelto**[1], **M. Fujiki**[1,2], and **H. Shen**[1,4]

[1] Department of Neurosurgery, Helsinki University Central Hospital, Helsinki, Finland
[2] Department of Neurosurgery, Oita University Faculty of Medicine, Oita, Japan
[3] Department of Neurosurgery, Brno University Hospital, Brno, Czech Republic
[4] Department of Neurosurgery, Shenzhen Nanshan Hospital, Shenzhen, China

Summary

Objective. The standard pterional approach has been used to approach aneurysms of the anterior circulation and the basilar tip, suprasellar tumors, cavernous lesions. The senior author (JH) established a lateral supraorbital approach as an alternative to the pterional approach after continuous trial and error. We describe the techniques of this approach based on clinical experiences.

Methods. The lateral supraorbital approach is more subfrontal and anterior than the pterional approach. This approach has been regularly used by the senior author (JH) in the last decade in more than 2000 operations for mostly aneurysms of anterior circulation, but also for tumors of the anterior fossa and parasellar area as well as the sphenoid wing area.

Results. This approach can be used to operate on most cases, in which the classical pterional approach would be used. There are almost no craniotomy-related complications with this approach. This approach is not suitable in certain lesions which need to be exposed from a more temporal perspective.

Conclusion. This approach is simpler, faster, safer and less invasive than the classical pterional approach.

Keywords: Approach; supraorbital; pterional; cerebral aneurysm; intracranial aneurysm; subarachnoid hemorrhage; surgery.

Introduction

The standard pterional approach introduced and established by Yaşargil is widely recognized and has been a gold standard to approach lesions in the sellar and suprasellar region, Circle of Willis, Sylvian fissure and even the superior part of the clivus and basilar artery [7–9]. This approach has been proved of great benefit for safe microsurgery, and can be successfully used for both tumors and vascular pathologies. The senior author (JH) has established and developed a modified approach which is simpler and faster than the standard pterional approach [4]. We call this the lateral supraorbital approach which is different from the so-called "eye-brow incision" with a very small bone flap and more anterior location used in some institutions [1–3, 5, 6]. The lateral supraorbital approach is more subfrontal and located more anteriorly than the pterional approach. This approach is simple, less invasive and useful as an alternative to the classical pterional approach. This approach has been regularly used by the senior author (JH) in the last decade in more than 2000 operations, mainly in aneurysm surgery, but also in tumors of anterior fossa – parasellar – sphenoid wing area.

Operative procedure

The patient is positioned supine, the head elevated above the cardiac level to reduce bleeding. Head is fixed with three or four pins in the head frame (Mayfied or Sugita) and is rotated 15–45 degrees towards the opposite side and tilted slightly dependent on the precise location of the lesion. Hair shaving should be minimal still allowing a large enough oblique frontotemporal skin incision behind the hairline if possible. The skin incision is short and does not even go down in front of the ear to the level of zygomatic arch (Figs. 1, 2A). The line of skin incision is usually behind the hair line, but its medial part can be done in a skin wrinkle in bold or partially bold patients. The one layer skin-galea-muscle flap is dislocated after detachment from the bone by diathermy, thus avoiding any injury of the branches of facial nerve, and spring hooks are used to retract the flap anteriorly until the superior orbital rim and the anterior zygomatic arch are exposed (Fig. 2B). The temporal muscle is split only in its superior and anterior part. Only one burr hole is

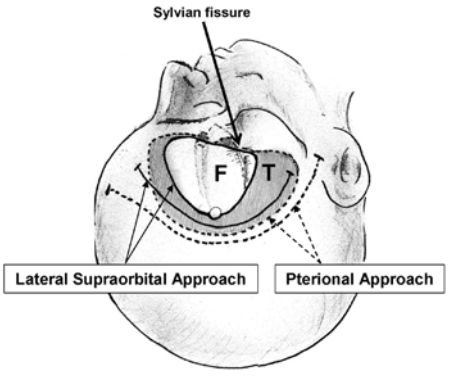


Fig. 1. A drawing illustrating the skin incision, the craniotomy margins, and the location of the Sylvian fissure in lateral supraorbital approach (a solid line) compared to pterional approach (a dotted line). *F* frontal lobe, *T* temporal lobe

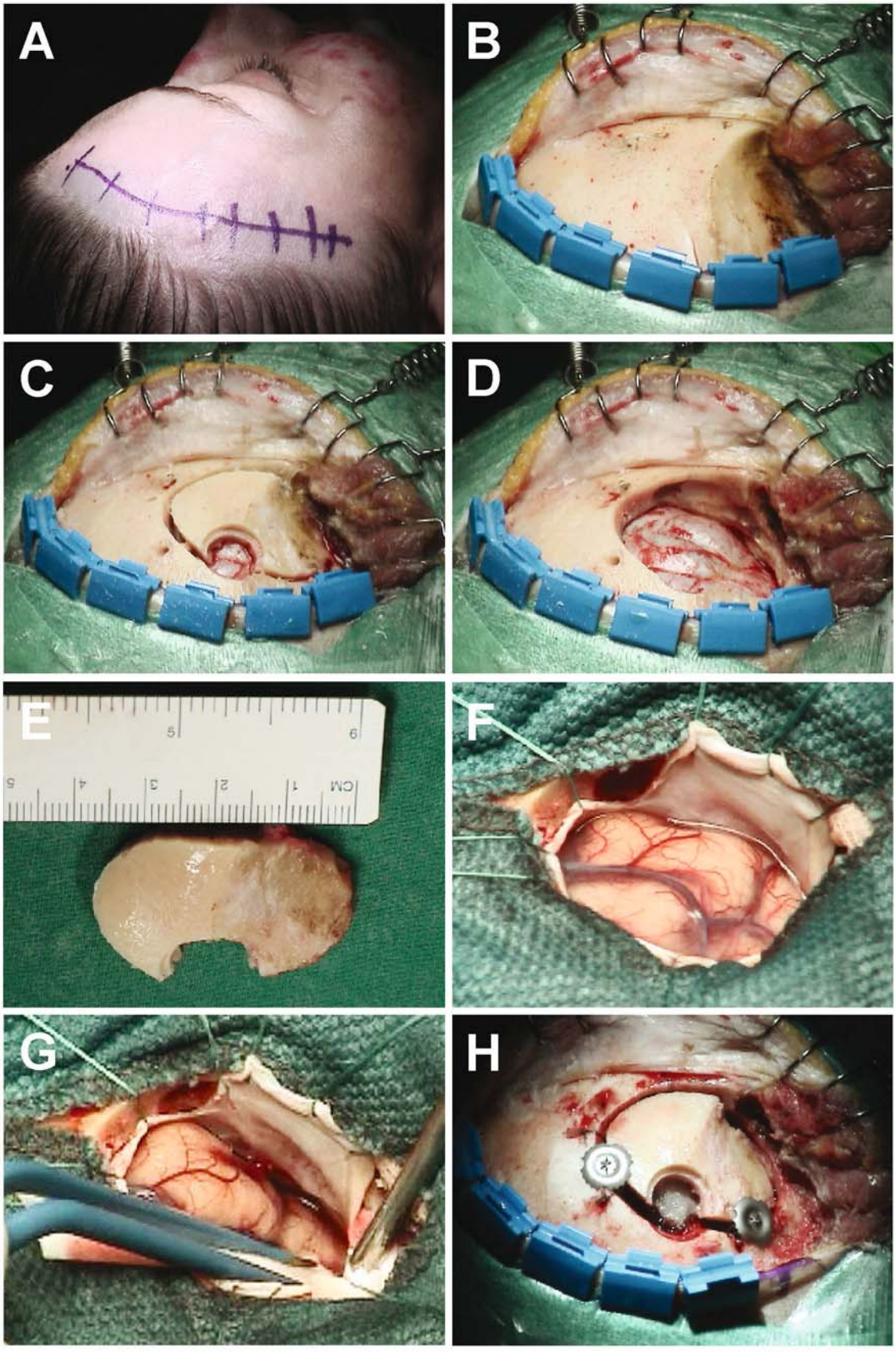
placed posteriorly just below the insertion line of the temporal muscle (Fig. 2C). If necessary, depending on the size of the flap, thickness of the bone and adherence of the dura in elderly patients, another burr hole may be added over the pterion. The bone flap is detached mainly by side-cutting craniotome, but basal part is drilled off before lifting the flap (Fig. 2C). The bone flap is sized from 3×3 to 4×4 cm (Fig. 2E). The lateral sphenoid ridge and vertical bone on its both sides is drilled off until the bony exposure is along the skull base (Fig. 2D). Oozing from the bony surfaces is controlled by hot drilling (without saline irrigation) with diamond tipped drill. The dura mater is opened in a curvilinear incision pointing anterolaterally, and elevated with stitches (Fig. 2F). The operating microscope is brought in place. The Sylvian fissure is just on the temporal edge of the craniotomy and all the work to open the fissure is done from the frontal side (Fig. 1, 2G). After opening the Sylvian fissure minimally, it is filled with water injection technique and opened proceeding towards the aneurysm site. During these maneuvers, the Sylvian fissure is dissected with move towards midline of the opening. The use of retractors for brain dislocation is not necessary in most cases. In closure, the fixation of the bone flap with two Caniofix^{O,R} is used (Fig. 2H).

Discussion

The gold standard pterional approach has been used for many years to access both tumors and vascular lesions, located in the sellar and suprasellar area as well as Circle of Willis, Sylvian fissure, the superior part of the clivus and basilar artery in many institutions [7–9]. However, this approach is quite extensive and includes a lot of drilling of the skull base especially in the temporal region, including the sphenoid wing. Removal of the anterior clinoid may have complications: the sphenoidal sinus can be entered quite frequently causing CSF leak leading often to an infection, and optic or oculomotor nerve lesions are possible. Epidural hematoma and an injury of the upper branch of the facial nerve may be caused by this approach. All these complications are not frequent but do occur even in the best hands. Also the cosmetic effect after the pterional craniotomy is not always satisfactory because of possible temporal muscle atrophy.

The lateral supraorbital approach has been developed and established as an alternative to this classical approach. The development of this approach was gradual just to make the procedure as simple and fast as possible and to reduce the craniotomy-related complications. Our approach is different from the ''key-hole'' supraorbital approach with an ''eyebrow incision'' and a very small frontal bone flap [1–3, 5, 6]. We do not use it except for some rare cases. Eyebrow incision is not accepted by our Finnish patients for cosmetic reasons because they have thin, blond eye brows. In elderly patients without specific cosmetic needs who have been operated on mainly for olfactory meningiomas or some aneurysms, the eye brow incision has been used without difficulties but also with no advantages as compared to lateral supraorbital approach. The anatomy is different, and the distance to the optic nerve is longer from the eyebrow, and the small craniotomy may be risky if some difficult hemorrhagic complications occur. It is noted during the years, that a difficult aneurysm is usually operated on through a larger flap than necessary. It is the fear and respect of the lesion that makes a large flap seem safer.

Fig. 2. The skin incision is placed just behind the hairline and does not go so far down in front of the ear as in the pterional approach (A). Pterion is still the central point of the craniotomy (A). The soft tissues are retracted as one layer flap and the anterior attachment of the zygomatic arch and the superior orbital rim have to be exposed (B). Only a small frontal part of the temporal muscle is split and detached from the temporal line (B). One burr hole is made approximately 4 cm above the pterion in the temporal line (C). Small craniotomy is then made extending 2–3 cm anteriorly from the burr hole and 2–3 cm posteriorly from it, ending at the sphenoid wing (C, D, E). Skull base at the superior orbital rim needs usually only a little drilling (D). The anterolateral part of the frontal lobe is disclosed after dural opening, and the Sylvian veins are hidden just below the posterior and basal edge of the craniotomy (G). The bone flap fixation using two Craniofix^{O,R} is sufficient (H)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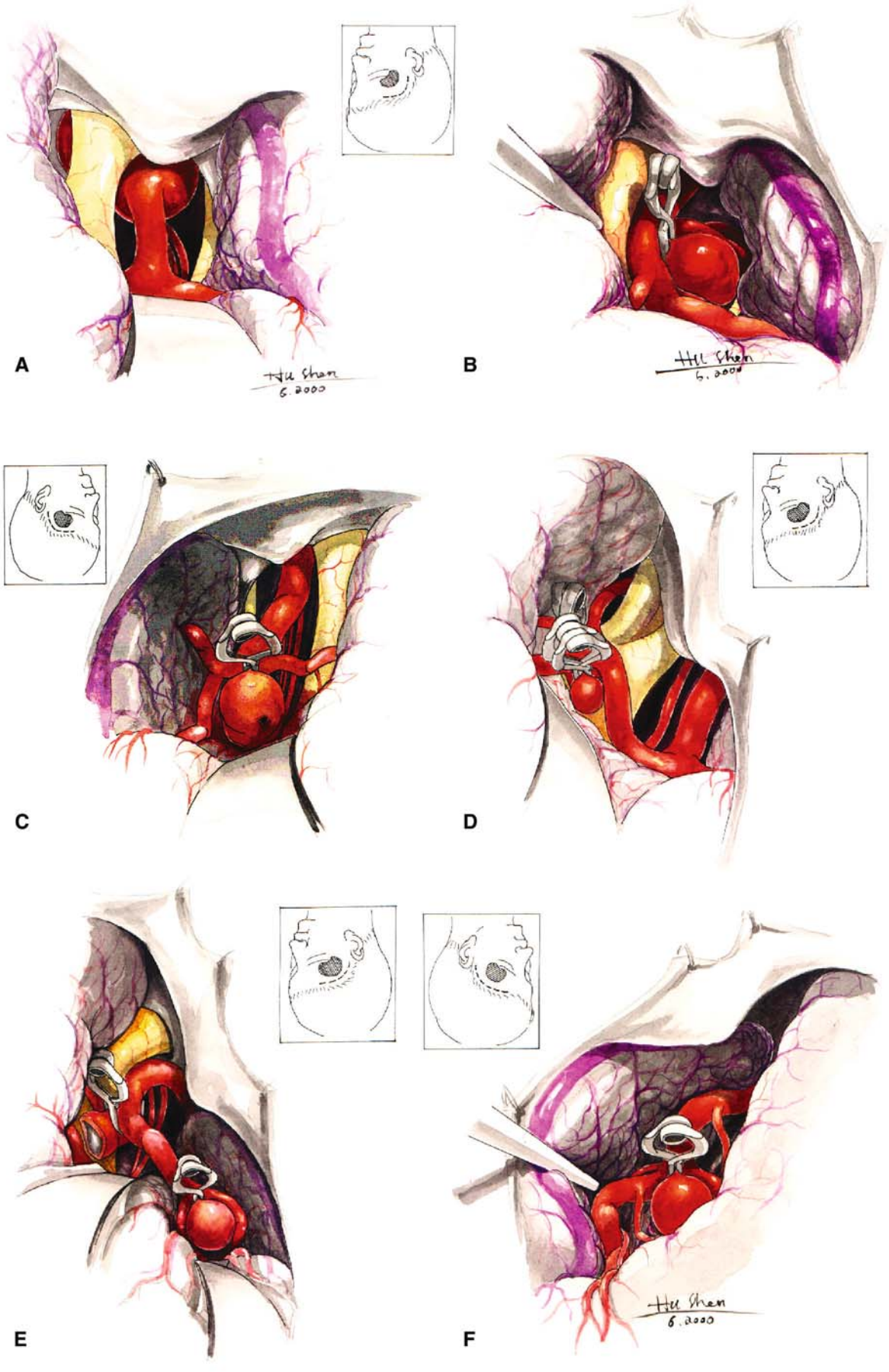
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The advantage and disadvantage of the lateral supraorbital approach is as follows. The craniotomy is very fast, can be performed in 5–10 minutes which substantially shortens the overall operation times (shortest operation time from skin-to-skin 25 minutes in an MCA aneurysm). The short skin incision does not even go down in front of the ear to the level of zygomatic arch as in pterional approach causing less trauma to the temporal muscle. There is no risk to injure the upper branch of the facial nerve, because the use of a combined skin and muscle flap. The cosmetic result of this incision is good since it is usually behind the hair line. The medial part of the incision can be done in a skin wrinkle in bold or partially bold patients. Even here the wound is at first visible, but after healing the cosmetic result is excellent. The temporal muscle is split only in its superior and anterior part which decreases the postoperative problems with chewing, and as mentioned earlier, late muscle atrophy is practically not seen. One burr hole is usually sufficient for the craniotomy, but if the dura mater is tightly attached to the bone it may be torn, particularly in elderly patients. The bone flap can be quite small which decreases the risk of craniotomy-related complications, particularly CSF leak, postoperative epidural hematoma, and also infection. The size of the craniotomy is absolutely sufficient to reach the whole anterior part of the Circle of Willis, sellar, suprasellar legion and also anterior part of the basilar artery if it is located superiorly from the posterior clinoid process. This approach has certainly some limitations, and is not suitable and not used for some lesions; certain lesions need to be exposed from a more lateral (temporal) perspective: posterior communicating artery aneurysms pointing posteriorly, large and giant middle cerebral artery (MCA) aneurysms, particularly those pointing laterally against the sphenoid wing and lower positioned basilar tip artery aneurysms. In these situations, a pterional or subtemporal approach (even combined) is necessary. The other approaches by a more temporal craniotomy are also required in MCA aneurysms with a large temporo-parietal intracerebral hematoma.

Conclusion

The pterional craniotomy is the classic approach to lesions in the anterior part of the Circle of Willis, the sellar and suprasellar area, the Sylvian fissure, and also to the upper part of the clivus and basilar artery. As a simple alternative we present the lateral supraorbital approach, which is useful in most of the indications where the pterional approach would be used. The lateral supraorbital approach is fast, simple and rather atraumatic, which are advantages as compared to other approaches. Notably, there are almost no craniotomy-related complications with this approach. We still have a classic pterional approach in our armamentarium, since some of the pathologies cannot be removed by the described approach.

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Correspondence: Juha Hernesniemi, Department of Neurosurgery, Helsinki University Central Hospital, Topeliuksenkatu 5, 00260 Helsinki, Finland. e-mail: juha.hernesniemi@hus.fi

Fig. 3. Drawing illustrating the operative various views in lateral supraorbiral approach. An aneurysm located at right proximal internal carotid artery (A), right posterior communicating artery (B), left internal carotid artery bifurcation (C), anterior communication artery (D), anterior communication artery and right middle cerebral artery bifurcation (E), and left middle cerebral artery bifurcation (F)