

Lateral Suboccipital Approach (Retrosigmoid)

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Senanur Gulec, Francesca Spedicato,
Ferry Senjaya, and Julius July

7.1 Introduction

After first description by Fedor Krause in 1903 [1], the unilateral approach to the cerebellopontine angle (CPA) have been developed and modified further by many surgeons. These include the transmastoid-translabyrinthine approach, the transtemporal extradural approach, and the lateral suboccipital (retrosigmoid) approach.

Many good achievements by surgeon from various different operative approaches, which more determined by the familiarity and experience of individual surgeon rather than the approaches

themselves. Still, an ever-growing amount of evidence suggests that the goals of CPA surgery are best achieved with the retrosigmoid approach [2]. One of the advantages of retrosigmoid approach is that it provides a good exposure to the cranial nerve, brainstem, lateral cerebellum, and the vessels; also it can be extended inferiorly by combining with the far-lateral transcondylar approach [3] or far-lateral retrocondylar approach. The retrosigmoid approach also can be extended superiorly and combined with the intradural suprameatal approach [1].

Vascular lesions and other pathology at this area can be exposed adequately by doing the classical retrosigmoid approach or its modifications [4]. This approach enables the surgery to be performed under visual control, due to wide panoramic view, and it is essential to have a clear exposure while doing dissection near brainstem. Additional to that, the retrosigmoid approach is the best technique for patients with big vestibular schwannoma (VS).

When the intraoperative neurophysiological monitoring becomes available, it provides a basis for a much safer surgery [5]. Nowadays this monitoring is done starting from the very beginning of the surgery until the very end of surgery. Various monitoring systems are available nowadays; in some cases the monitoring system is absolutely important, such as the somatosensory evoked potentials to detect spinal cord compression while doing semi-sitting position [4].

S. Gulec
Department of Neurosurgery,
Faculty of Medicine Universitas Pelita Harapan
(UPH), Neuroscience Centre Siloam Hospital
Lippo Village, Tangerang, Indonesia

Marmara University School of Medicine,
Istanbul, Turkey

F. Spedicato
Department of Neurosurgery,
Faculty of Medicine Universitas Pelita Harapan
(UPH), Neuroscience Centre Siloam Hospital
Lippo Village, Tangerang, Indonesia

Universita Degli Studi. "A.Moro" School
of Medicine, Bari, Italy

F. Senjaya · J. July (✉)
Department of Neurosurgery,
Faculty of Medicine Universitas Pelita Harapan
(UPH), Neuroscience Centre Siloam Hospital
Lippo Village, Tangerang, Indonesia

7.2 Steps of the Approach

7.2.1 Positioning of the Head

Patient can be positioned in semi-sitting, lateral, or $\frac{3}{4}$ lateral position (park bench), or even some surgeon prefers supine position and the head rotated to contralateral side [5–7]. Each of these positions has its advantages and disadvantages from the points of providing sufficient access and avoiding complications. However, the surgeon preference and familiarity is the most important part while deciding the patient position. We prefer to use the park bench position for many reasons and arguments that we think safer for the patient and easy for anesthesia monitoring. Head and neck position is almost neutral if we consider the cervical stenosis in to the risk factor if we turn and flex the neck. The disadvantage part is requiring slightly longer time to put the patient in to such position. We do not describe sitting position in this chapter, simply because it requires specific monitoring system to detect air embolism such as trans-esophageal echocardiography, end-tidal carbon dioxide, and precordial Doppler echocardiography [8]. All those monitoring systems might not be always available.

The positioning has to start with the body in the lateral position, and we like to put it slightly prone to push the shoulder away from the surgical field. The front and back of the patient body

were held with body holders. The contralateral arm is positioned lower than the body, sitting on the arm rest. The contralateral armpit is supported with silicon bolster, just at the edge of the table. We can use Mayfield or Sugita head pin fixation system, but *do not* fix the head until the body is in good position and well held (Fig. 7.1). The head is fixed with three pin fixations and slightly flexed. Remember to avoid any occlusion of venous jugular outflow. The ipsilateral arm is kept aligned with the body, and the contralateral arm is always wrapped with waterproof and soft pad to avoid skin burn.

7.2.2 Skin Incision: Craniotomy

Shave the hair behind the ear just enough to identify the anatomical landmark. The incision is planned according to the need, but usually the skin incision is tailored according to the bone opening. Surgical landmark on the skin projection is important. At the level of acoustic meatus should be the vestibular-facial nerve region, and 1 cm (one finger) superior to it would be the projection of transverse sigmoid junction. If we draw a line from this junction to the protuberantia occipitalis externa, the line would represent the transverse sinus (Fig. 7.2).

We prefer to use the lazy “S” incision, because it’s simple and sufficient. The underlying neck muscles are incised in line with the skin. The skin

Fig. 7.1 The patient position. Right side (park bench), the chest and back are held with body holder and locked. The ipsilateral shoulder is tapped gently to the anterior and inferior of the patient to bring the shoulder away from the surgical field. The contralateral armpit is supported with silicon bolster at the edge of the surgical table. Then the head is fixed with Sugita pin fixation with the head slightly flexed



Fig. 7.2 The incision planning to expose the right CN VIII/VII complex and LCN (lower cranial nerve). *Ts* transverse sinus, *T-Sj* transverse sigmoid junction, *Ss* sigmoid sinus, *MT* mastoid tip, *BO* bone opening, *FM* foramen magnum, *IL* incision line

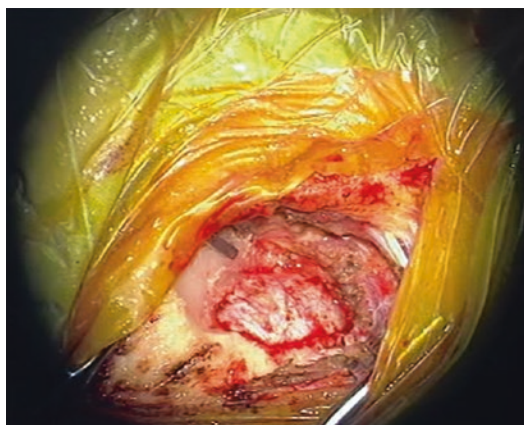


Fig. 7.3 The right side. The skin flap and muscles are retracted with self-retaining retractor. The bone opening is ellipsoid

flap and the muscles are split and held using a self-retaining retractor (Fig. 7.3).

Performing whether craniectomy or craniotomy is a matter of surgeon's choice, and they both have advantage and disadvantage. The size of the bone opening is according to how much the surgeon needs the exposure. The surgeon may expose the borders of transverse and sigmoid sinuses if necessary, but it is unnecessary to expose it routinely because it may lead to laceration and subsequent thrombosis [4].

The burr hole is placed half centimeter infero-medial to the asterion, and remember that the asterion may serve as a landmark where transverse

sinus curves and turns to be sigmoid sinus [5]. The transverse sinus and sigmoid sinus generally curve around the asterion. However, recent studies have proven that asterion is not an entirely consistent anatomical point; it may vary in cranio-caudal direction or in anterior-posterior direction [9].

Doing the opening of the dura with a curvilinear shape approximately 2 mm medial away from sigmoid sinus and 2 mm inferior away from transverse sinus. For protection of the cerebellum, leave the dural flap over the cerebellum. If necessary, additional dural incisions should be made laterally toward the curve between the transverse sinus and sigmoid sinus. The resulting curvilinear-shaped dural leave is sutured to the surrounding tissue (Fig. 7.4).

To relax the cerebellum, the inferior cerebellum is retracted gently, and the arachnoid that cover the cistern is opened to release CSF. The surgeon should be aware that excessive cerebellar relaxation may cause a venous tear near the tentorium or in the area of petrosal sinus, even some remote areas in the supratentorial area. Complications of remote bleeding such as subdural hemorrhage or even epidural hemorrhage have been incidentally reported.

The later steps of surgery depend on the underlying pathology. It is very important to be familiar with all the cranial nerves, vessels, and anatomical landmark in this area. The best is to

use the microvascular decompression case as a role case for normal anatomy. If we direct the microscope toward inferior lateral, we would be able to see the lower cranial nerve (IX, X, and XI); if we change the microscope slightly superior, we would be able to see the subarcuate artery, VIII and VII complex going to meatus acusticus internus (MAI), and the labyrinthine artery as a branch of anterior inferior cerebellar artery (AICA). If we dissect the prepontine arachnoid, we could see the VI nerve going in to the Dorello's canal (Fig. 7.5).

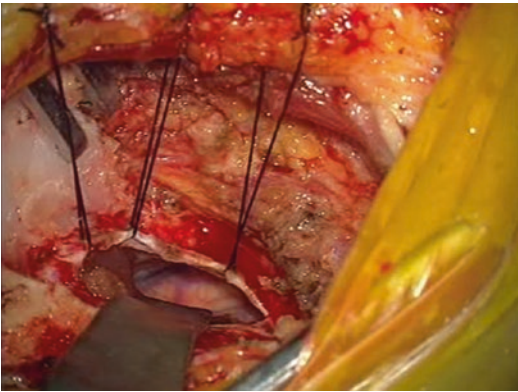


Fig. 7.4 The right side. The curvilinear shape dural leave is sutured to the muscle, providing 2–3 mm more visual field. The retractor is used gently just to hold the cerebellum to avoid jiggling movement to the brain

If we change the microscope more superior after viewing the VIII/VII complex, we should be able to see the V, sometimes IV, superior petrosal vein and the superior cerebellar artery (SCA) and of course the tentorium (Fig. 7.6).

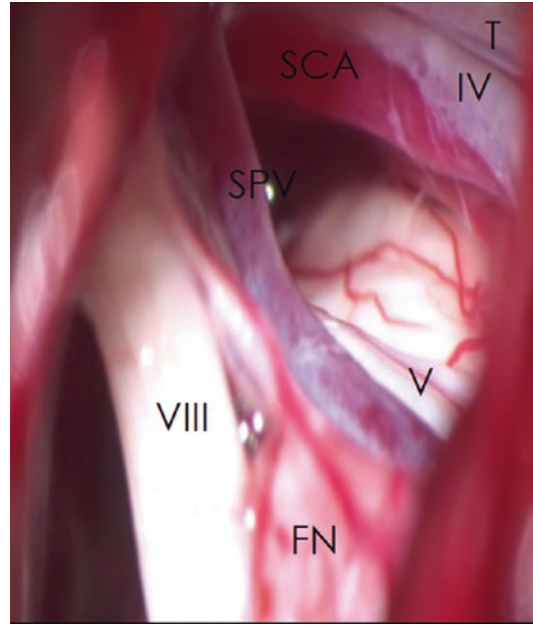


Fig. 7.6 Left retrosigmoid approach, exposing the upper part of the CP angle. *VIII* vestibular nerve, *V* trigeminal nerve, *SPV* superior petrosal vein, *IV* trochlear nerve, *T* tentorium, *SCA* superior cerebellar artery

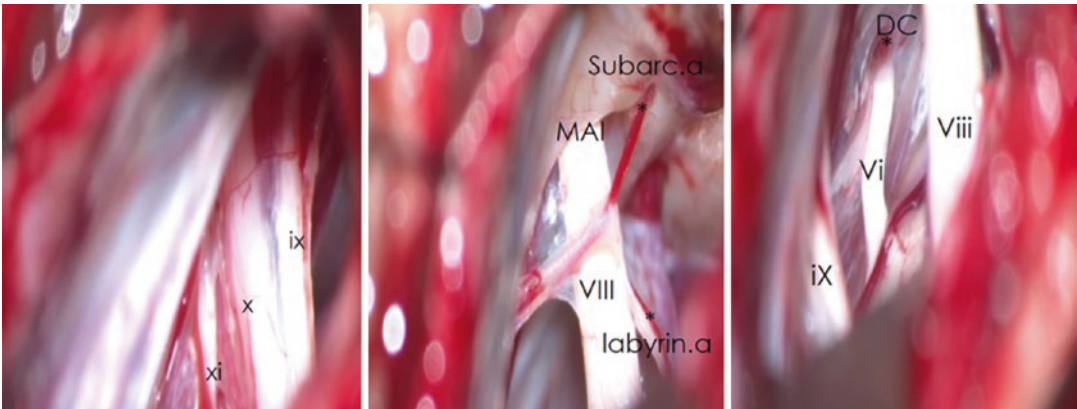


Fig. 7.5 Left retrosigmoid approach is exposing the left cerebellopontine angle anatomy. *Left*, inferiorly we expose lower cranial nerve (IX, X, XI); *middle*, more superior we could see the VIII/VII complex, MAI (meatus

acusticus internus), labyrinthine artery and subarcuate artery; *right*, after dissection of the prepontine arachnoid, we could expose VI nerve going into the DC (Dorello's canal)

7.2.3 Closure

When the mastoid air cells are opened during drilling of the bone, it is important to make sure they are occluded with muscle, fat, and fibrin glue. The dura should be closed with watertight suture and has to be done under the microscope, and if needed, the fat harvested from subcutaneous layer or muscle is necessary if watertight suture cannot be achieved. The fat or the muscle should be sutured to the suture line, and it will seal the leak. If there is significant bleeding from the edges of the bone, bone wax may be used to control the bleeding.

7.3 Indication of the Approach

This retrosigmoid approach is good to approach several vascular lesions such as resection of the pontine cavernoma, posterior inferior cerebellar artery (PICA) aneurysm, vertebral artery aneurysm, anterior inferior cerebellar artery (AICA) aneurysm, and cortical segment aneurysm of superior cerebellar artery (SCA). Of course this approach is more common to take out CPA tumor and for microvascular decompression of fifth and seventh nerve. If we extend to inferiorly in combination with far lateral approach, we may take out the lower brainstem cavernoma or prepare the proximal control for aneurysm surgery.

Lesion that is located in lateral or anterior part of foramen magnum area can be successfully approached by lateral suboccipital (retrosigmoid) approach, combined with C1 hemilaminectomy/laminectomy [10]. The foramen magnum needs to be opened widely, and additional C1 laminectomy will provide enough space for dissection. The vertebral artery can be identified and can be mobilized if necessary.

7.4 Limitation of the Approach

Limitation of the approach is defined by the limitations to viewing angles imposed on the surgeon by the operating microscope and several factors that could contribute to it such as the lesion itself (tumor or vessel) and the working space in the

CPA. Intraoperative use of endoscope may extend the view to the corner looking at the perforator that could not be provided by microscopic view.

7.5 Complication and How to Avoid

If craniectomy is performed, methyl methacrylate is used to reconstruct the posterior skull base. Complication such as pseudomeningocele should be avoidable by doing meticulous watertight closure of dura. The reconstruction of the posterior fossa with bone dust and held with fibrin glue is useful for small opening. But bigger bone opening needs substitute of methyl methacrylate to prevent adhesion between the dura and the neck muscles that may cause suboccipital headache [4] and also to have a better cosmetic result. In such case, subcutaneous infiltration with local anesthetic generally cures the headache. If the pain remains disturbing the patient and resistant to medication, a surgery to release the scar can be performed due to immediate beneficial effect [6].

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