5.5. RETROSIGMOID APPROACH

The retrosigmoid approach provides good access to the cerebellopontine angle. It is by far simpler and faster with much less need for bone removal than other more extensive lateral posterior fossa approaches. The craniotomy is small and depending on how cranially or caudally it is placed, different cranial nerves and vascular structures can be accessed. The retrosigmoid approach is classically used for vestibular schwannoma surgery but with small variations it can be equally well used for microvascular cranial nerve decompressions, aneurysms and skull base tumors of the lateral posterior fossa. The main difficulty in the proper execution of the retrosigmoid approach is correct patient positioning for an optimal surgical trajectory into the steep posterior fossa, placement of the craniotomy lateral enough so that cerebellum is retracted as little as possible, and good microanatomical knowledge of all the structures in the posterior fossa, as there is much less room for manipulation than in the supratentorial space.

Figure 5-5 (a). Retrosigmoid approach. See text for details.

5.5.1. Indications

The most common use for retrosigmoid approach is in vestibular schwannoma surgery. Other common pathologies include vertebral artery – PICA aneurysms, microvascular cranial nerve decompression of the V or VII nerve and meningiomas of the lateral posterior fossa. In general, the lesions that can be approached via the small retrosigmoid "tic" craniotomy should be located at least 10 mm cranially from the foramen magnum. If located more caudally, such as low-lying vertebral aneurysms, some modification more towards the far lateral approach is needed, with the craniotomy extended towards the foramen magnum and dissection of the extracranial vertebral artery. But for lesions well above the foramen magnum a straight incision with a small craniotomy is all that is needed. Cranial to caudal location of the bone flap depends on the exact location of the lesion in question. The most cranial craniotomy, with its upper border above or at the level of the transverse sinus, is usually made for fifth nerve microvascular decompression. Craniotomy for vestibular shwannomas is located slightly little more caudally and the most caudal craniotomies are typically for vertebral aneurysms at the origin of the PICA. Lesions located inside the cerebellar hemisphere, such as tumors, intracerebral hematomas or cerebellar infarctions can be also approached using a modification of the retrosigmoid approach. In such cases, with no need for the lateral extension towards the sigmoid sinus, both the skin incision as well as the craniotomy are placed more medially preventing opening of the mastoid air cells.

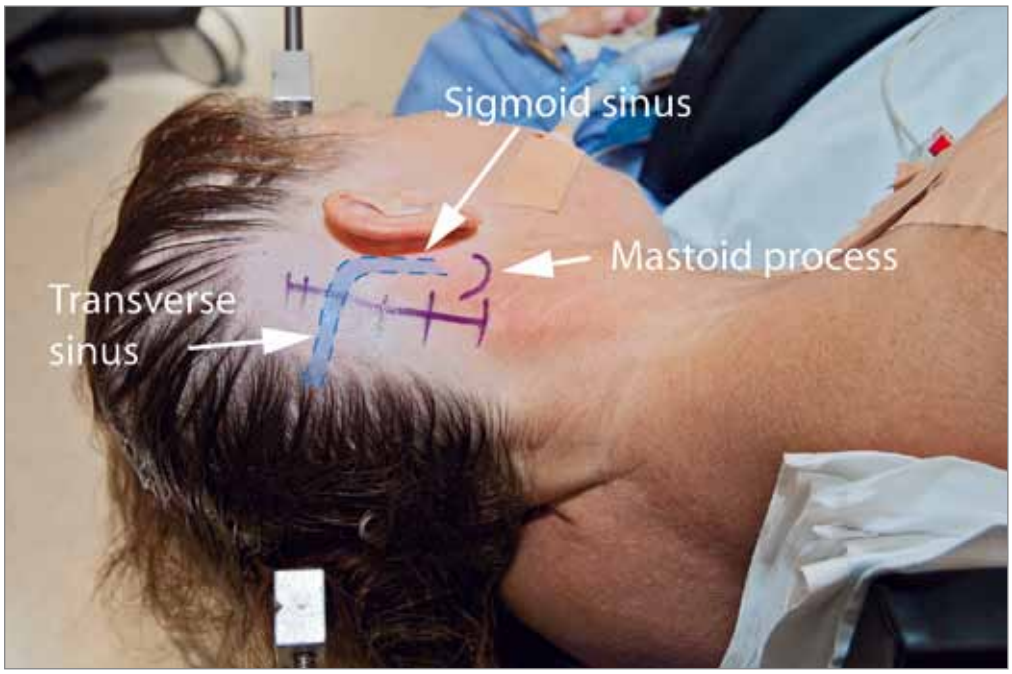

Figure 5-5 (b). Retrosigmoid approach. See text for details.

5.5.2. Positioning

For the retrosigmoid approach the patient is placed in lateral park bench position with the head and upper torso elevated so that the head is about 20 cm above the heart level (Figure 5-5a). Two side supports are placed on the dorsal side, one below the level of upper shoulder and the other at the level of pelvis. The shoulder support must not extend cranially from the retracted shoulder as it would get in the way of the surgical trajectory. One ventral side support together with a large pillow is placed to support the thorax and the belly. The upper arm can be placed on this pillow to rest comfortably. The side supports need to be stable and high enough to allow lateral tilting of the operating table during the procedure without the patient sliding off the table. The upper body is rotated slightly (5–10°) backward so that the upper shoulder can be more easily retracted caudally and posteriorly with tape (see Figure 5-4c in previous section). The head, fixed in head frame, is: (a) flexed a little forward; (b) tilted laterally; and if needed (c) slightly rotated towards the floor. The lateral tilt should not be too extreme to prevent compression of the jugular veins. The most important trick in executing the retrosigmoid approach is to prevent the upper shoulder from obstructing the surgical trajectory. The floor of the posterior fossa drops very steeply towards the foramen magnum, so that the actual approach trajectory is much more from the caudal direction than one usually expects. This is the reason why it is so important to open the angle between the head and the upper shoulder as much as possible. This is achieved with: (a) proper head position (the flexion and the lateral tilt); (b) the slight counter rotation of the upper body;

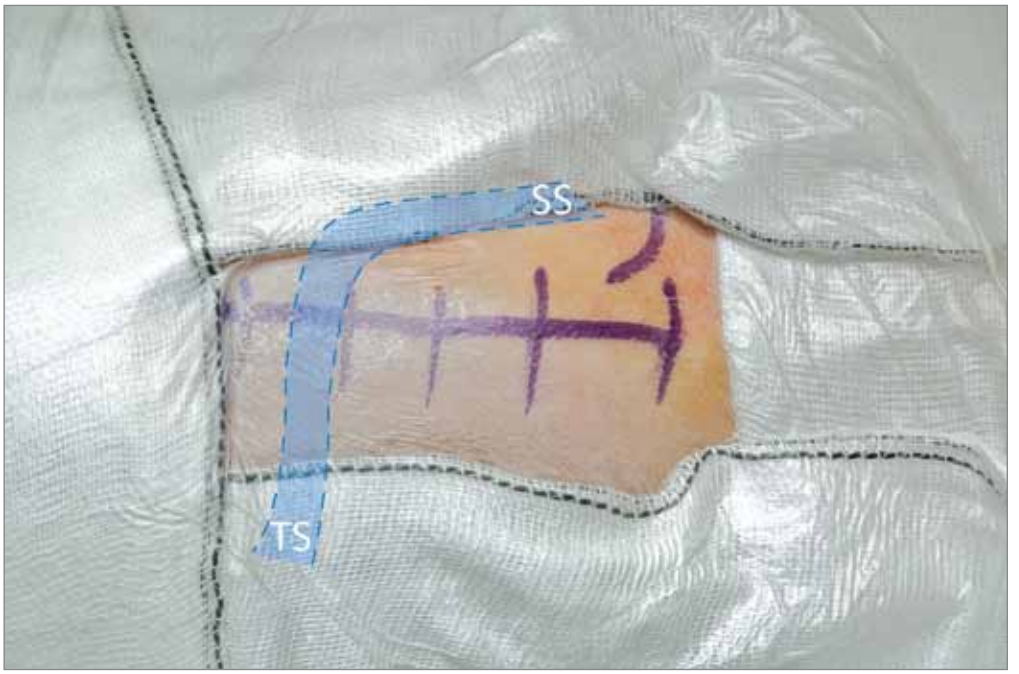

Figure 5-5 (c). Retrosigmoid approach. See text for details.

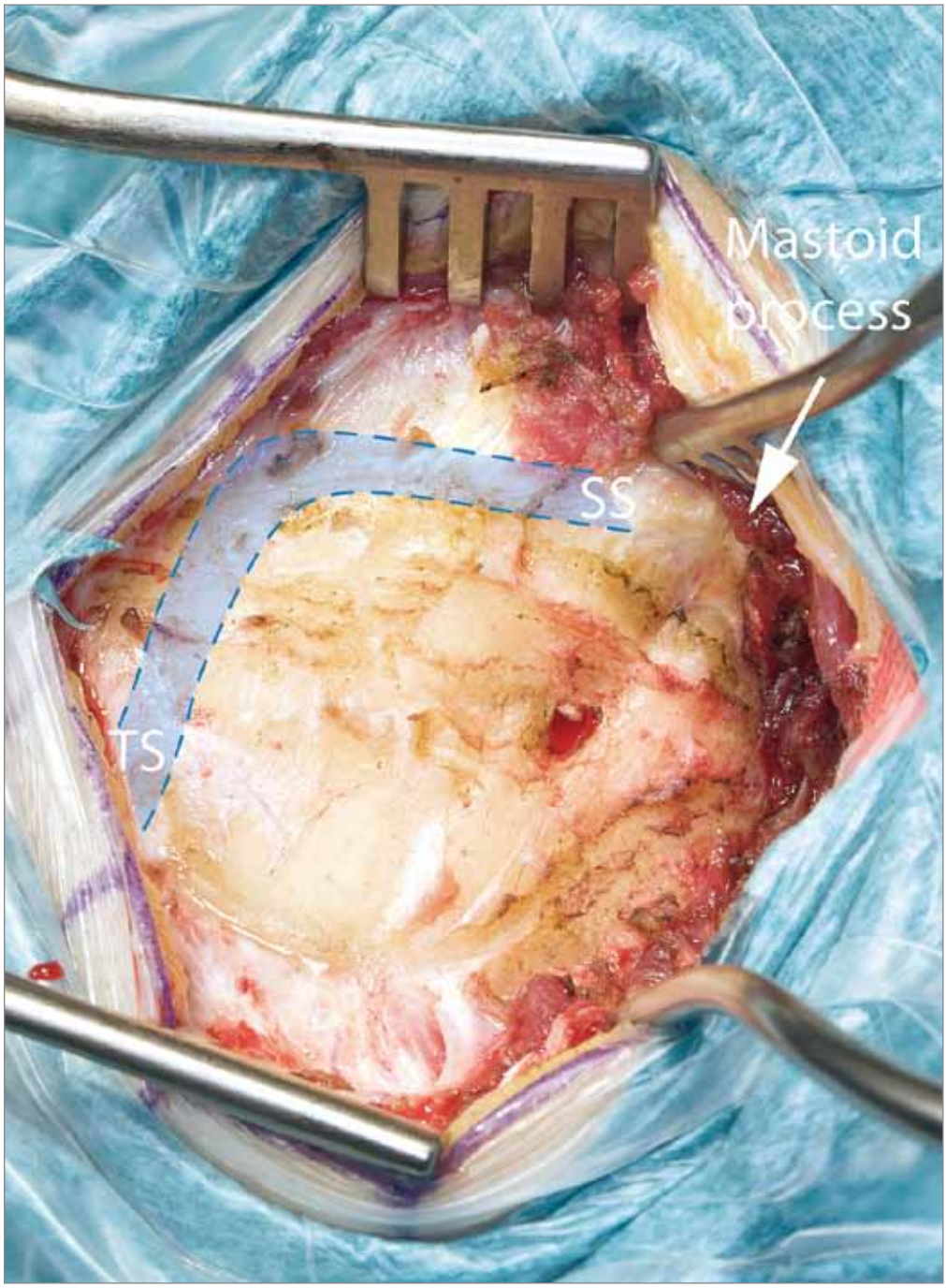

Figure 5-5 (d). Retrosigmoid approach. See text for details.

Figure 5-5 (e). Retrosigmoid approach. See text for details.

and (c) retraction of the upper shoulder with tapes caudally without damaging the brachial plexus. This shoulder retraction is the key point of the positioning. The lower arm is supported in place by being partially wrapped in the bed sheet under the patient, and the sheet clamped in place using towel clips. In addition, all the vulnerable pressure areas (elbow joints, ulnar nerves, hands, shoulders and brachial plexus) need to be protected with gel pillows. Once the positioning is ready, the lumbar drain is placed and 50–100 ml of CSF is released before the dura is opened.

5.5.3. Skin incision and craniotomy

A linear skin incision is placed about one inch behind the mastoid process (Figure 5-5b). The exact cranial to caudal location of the incision varies depending on how high or low from the foramen magnum the pathology lies. To access the highest located structures of the lateral posterior fossa (e.g. during microvascular decompression of the fifth nerve or high-lying meningioma) the junction between the transverse and sigmoid sinuses needs to be exposed and identified, whereas, for accessing the area close to the foramen magnum a more caudally placed incision suffices. The junction of the sigmoid and the transverse sinus is usually located just caudal to the zygomatic line (a line drawn from the origin of the zygomatic arch towards the external occipital protuberance) and posterior to the mastoid line (a cranial to caudal line running through the tip of the mastoid process). When planning the skin incision, it is important to have it extend caudally enough (Figure 5-5c). If the incision is too short and too cranial the stretched muscles and skin will prevent an optimal view into the posterior fossa and the use of craniotome, which is coming from the caudal and lateral direction, not just lateral as one might initially expect. So the skin incision has to extend several centimeters below the level where caudal border of the craniotomy is planned.

A large, curved retractor (wound spreader, also referred to as a mastoid retractor) under high tension is placed from the cranial side of the incision. If needed, a second, smaller curved retractor can be used from the caudal direction (Figure 5-5d). The subcutaneous fat and muscles are split along the linear incision with diathermia. The external occipital artery runs often across the incision. In practice, it is nearly always cut and has to be coagulated. After reaching the bone of the posterior fossa, the insertions of the muscles are detached from the bone and the bone is followed caudally. The level of the foramen magnum is determined with finger palpation. While progressing deeper and closer to the foramen magnum, a layer of yellowish fat is encountered. This should be taken as a warning sign, since the extracranial vertebral artery running on the cranial edge of the C1 lamina is usually close by at this point. For a simple tic craniotomy it is not necessary to proceed any deeper to expose the foramen magnum itself. That is reserved only for the extended approach where also the C1 lamina is exposed and the course of the extracranial vertebral artery is identified. Instead, a bony area of 3 to 4 cm in diameter is cleared from all the muscle attachments and the curved retractors are repositioned to gain maximal bony exposure. One burr hole is placed at the posterior border of the incision and the underlying dura is carefully detached with curved dissector without damaging the transverse or the sigmoid sinuses (Figure 5-5e). Two curved cuts with the craniotome are made anteriorly towards the mastoid, one cranially and the other caudally (Figure 5-5f). Finally, the bone is thinned down with a craniotome

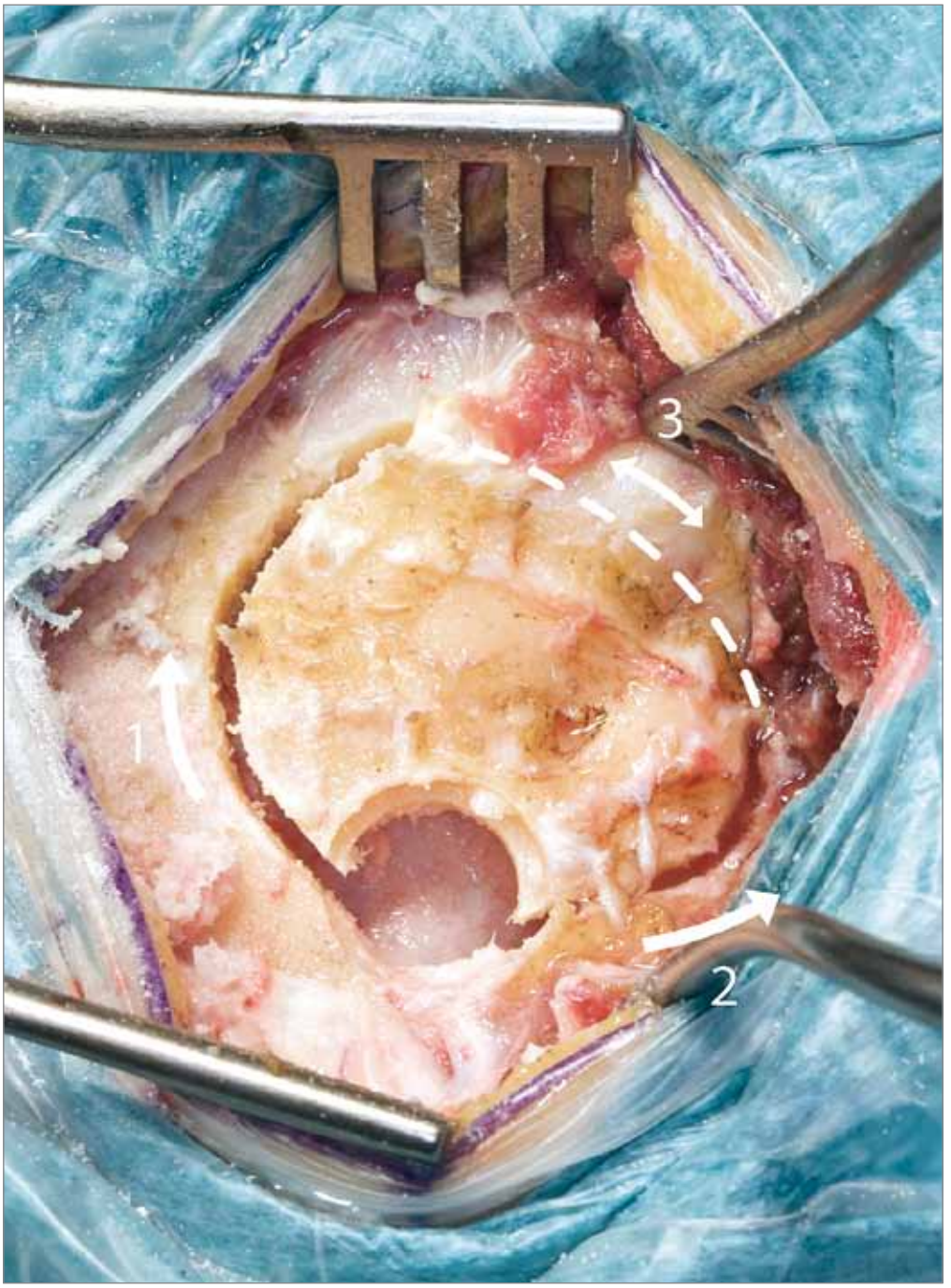

Figure 5-5 (f). Retrosigmoid approach. See text for details.

in a straight line along the anterior edge at the border of the mastoid air cells, the bone flap is cracked and detached (Figure 5-5g). A 2 to 3 cm bone flap is usually sufficient. A high-speed drill is used to extend the opening closer towards the temporal bone and to level the edges (arrows; Figure 5-5g). If mastoid air cells open these should be carefully waxed with bone wax and a fat or muscle graft can be used to cover the defect to prevent postoperative CSF leak. In case of injury to the sinus and large venous bleeding, the first measure is to get the head higher by tilting the table into anti-Trendelenburg position and then the bleeding site is covered with Surgicel or TachoSil and tamponated with cottonoids. A linear cut can be repaired with direct suture.

The dura is opened in a curvilinear fashion with the base towards the mastoid (Figure 5-5g). The dural edges are elevated with sutures extended over the craniotomy dressings (Figure 5-5h). Especially when close to the junction of the sigmoid and transverse sinus, the dura is opened in three-leaf fashion with one of the cuts directed exactly towards the junction to get better exposure. Even a small scissor cut into the sinus should be repaired immediately with a suture. Coagulation with bipolar makes such a hole only bigger and liga clips, although easier to apply, tend to slide away under manipulation, usually at a moment when least appreciated.

If a spinal drain was used and 50–100 ml of CSF has been removed, the brain should be slack after opening the dura and the drain can be closed. But if the brain remains tight, other strategies for releasing more CSF must be adopted. By tilting the microscope towards the caudal region one might be able to enter the cerebellomedullary cistern (cisterna magna) to release additional CSF. The other option would be to enter the cerebellopontine cistern and to remove CSF from there, but that usually requires more compression of the cerebellum and possible injury to the cranial nerves in situations with lack of space.

To enter the cerebellopontine cistern, compression and retraction on the cerebellum is increased gradually while simultaneously removing CSF with suction. To obtain optimal viewing angle, it might be necessary to tilt the table away from the neurosurgeon. Arachnoid limiting the cistern is opened with microscissors and now the cranial nerves can be inspected and the pathology identified. The tentorium is an excellent guide as a reference point for locating and identifying the cranial nerves. One should look for the bridging veins upon entering the cerebello-pontine angle, especially at the beginning of the dissection. If possible, the veins should be left intact, but if the procedure is significantly hampered by them, they should be coagulated. The petrosal vein is an area of debate and is the most common and prominent vein seen when approaching the tentorium or upper cranial nerves. It is safer to preserve this vein as some surgeons have observed complications after its occlusion.

For closure the area over the mastoid air cells is waxed after closure of the dura. Where the dura cannot be closed completely in a watertight fashion, a dural substitute covered with small amount of fibrin glue can be used to close the defect. What is far more important is to close the mastoid air cells and prevent postoperative CSF leak using a small muscle or fat graft and fibrin glue. There should be a three layer (muscle, subcutis, skin) firm closure of the wound, which helps in preventing CSF leakage. There is occasionally debate whether to do a craniectomy or craniotomy for suboccipital or midline cerebellar approaches. In Helsinki it is

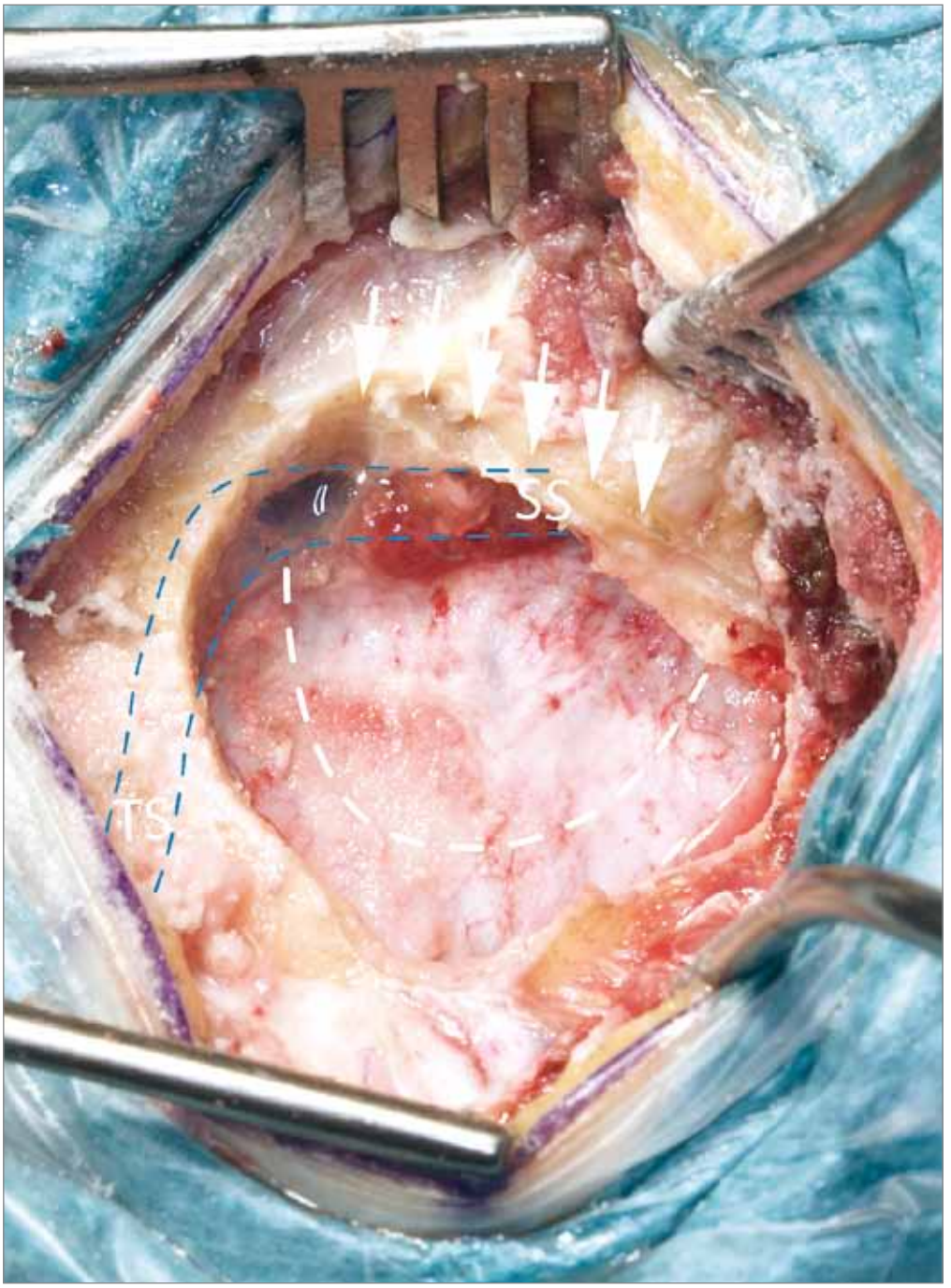

Figure 5-5 (g). Retrosigmoid approach. See text for details.

craniotomy! It decreases the chance of a pseudomeningocele or persistent headaches, and also makes any re-exploration and recurrence at a later date easier and safer to deal with. Without questions, filling the craniotomy defect with the patient's own bone or artificial material provides comfort and feel of security to the patient.

T&T:

- *Park bench position, spinal drainage except in very expansive mass lesions*
- *The upper shoulder retracted backwards and downwards with tape*
- *Short straight incision preferred*
- *After dural opening, release CSF from cisterna magna if the brain is still tight*
- *Start retracting the cerebellum and the tonsils medially and slightly upwards as if taking them in your hand*
- *VA, PICA and lower cranial nerves identified – their relation with the lesion determines the exact approach*
- *Out of all cranial nerves the IX-X deserve the highest respect, even temporary dysfunction can be dangerous*
- *If the lesion is 10 mm or more above the foramen magnum, only a simple tic craniotomy is needed*

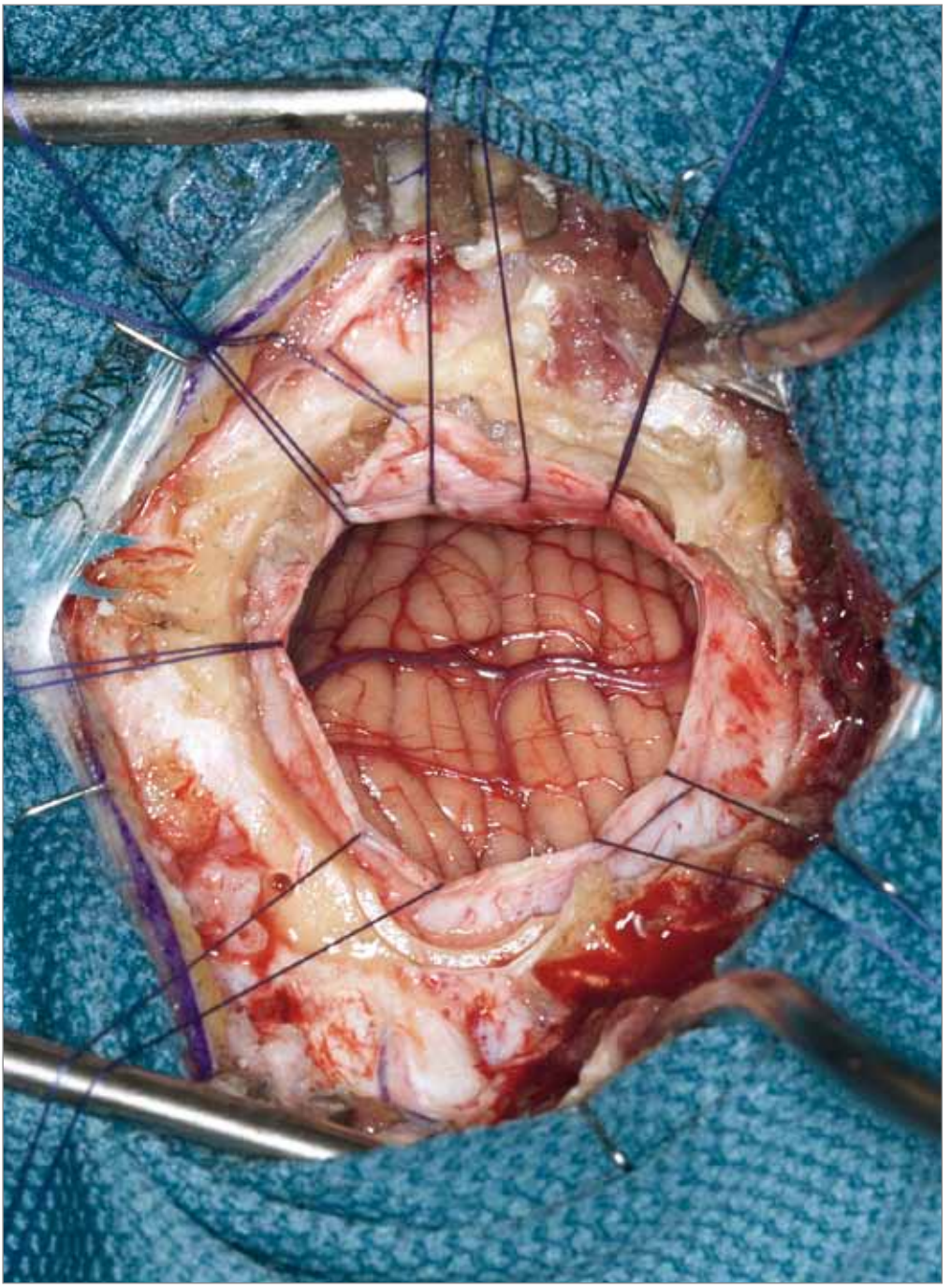

Figure 5-5 (h). Retrosigmoid approach. See text for details.