Patient Positioning

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Patient positioning is an integral part of operative planning. It can prevent pressure-related injuries, expand the operative corridor using gravity retraction and minimize surgeon's fatigue.

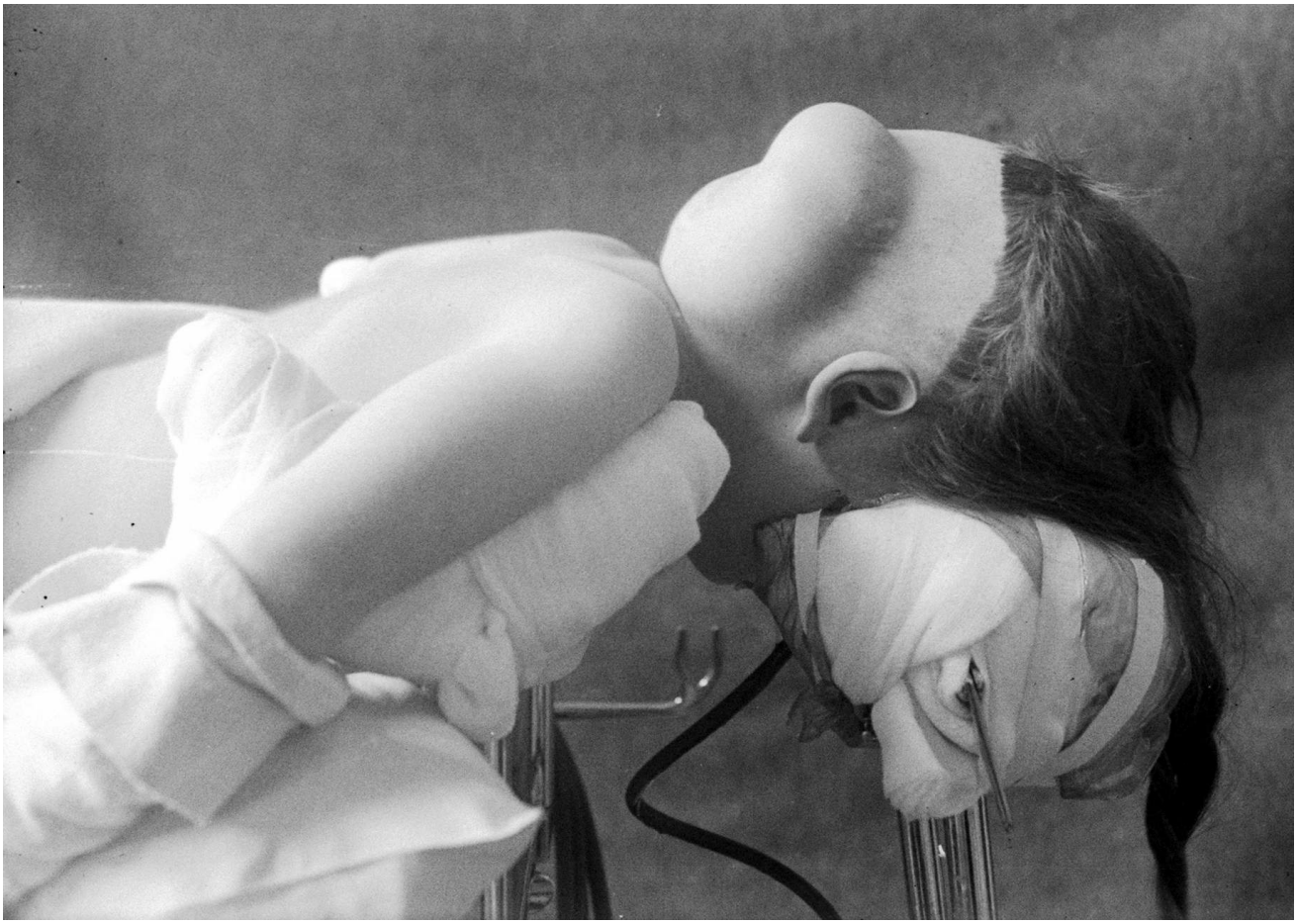

Figure 1: Patient positioning for one of Cushing's pediatric patients suffering from a recurrent posterior fossa tumor. Please note the growth over the area of suboccipital decompression performed during the initial operation (Courtesy of Cushing Brain Tumor Registry at Yale

University).

Patient positioning for surgery often does not receive the attention it deserves. Small openings leading to deep operative fields require ergonomic patient positions to ensure a precise operative trajectory.

Several principles can be crucial in determining appropriate patient positioning. Usually there is no single factor, but rather a combination of factors deciding the desired operative trajectory. The patient's body habitus and the surgeon's preferences play important roles in the final choice of position. The multifactorial decision-making process for choosing the appropriate position needs to be carefully planned and shared with all of the operating room team members so the room layout can be accordingly adjusted.

Ideally, the lesion should be the highest point in the operative field, but with the exceptions of some cortical and superficial lesions, this is often not feasible because gravity retraction can be exploited for mobilization of the overlying brain for deep-seated lesions. Furthermore, the exposed surface of the patient's skull and perimeter of the craniotomy should preferably be parallel to the floor.

The torso should be positioned before the head, because head fixation by the skull clamp precludes further significant changes in the position of the torso, except for tilting or Trendelenburg and reverse Trendelenburg movements.

I prefer to use a skull clamp for almost all microsurgical procedures, and I reserve the use of padded doughnut and horseshoe-shaped clamps for nonmicrosurgical operations involving resection of superficial tumors and evacuation of primary hematomas.

The most appropriate patient operative position should:

1. allow the least obstructed intradural trajectory toward the target lesion while minimizing risk of injury to the normal cerebrovascular structures,
2. keep the patient as close to the physiological body position as possible to minimize pressure-related musculoskeletal and peripheral nerve injuries,
3. enable the surgeon to maintain an ergonomic body posture to conduct relaxed microsurgical maneuvers in order to minimize surgeon's fatigue.

If the patient is placed in an optimal position, the surgeon will have an opportunity to expand the operative corridor through safe mobilization of the cerebrum or cerebellum using gravity retraction. The extension of the patient's head to mobilize the frontal lobe away from the anterior skull base during a pterional craniotomy is an example of this principle. In addition, an optimum head position can improve visualization of the deep operative field by clearing blood through gravity. The lateral head position used during a suboccipital craniotomy illustrates this point.

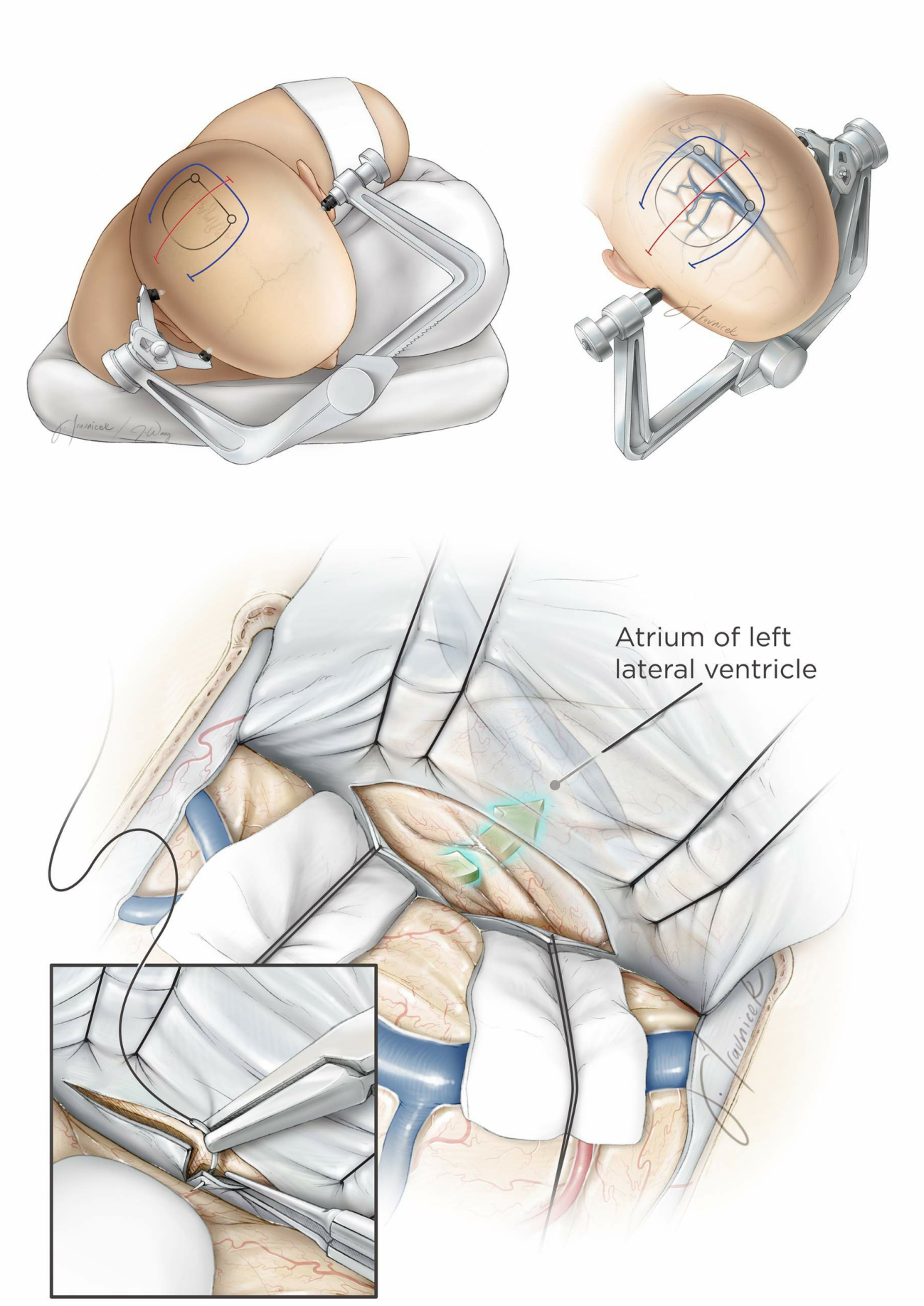

Figure 2: The patient' head position during a contralateral transfalcine approach to the atrium is an example of an

algorithmic approach to patient positioning. Various principles are considered for the final patient position. The patient is placed in a park-bench position and gravity retraction is used to mobilize the normal hemisphere, expanding the interhemispheric corridor. To improve the operative angles toward the contralateral atrium, the patient's head is turned 45 degrees toward the floor as a compromise to use gravity retraction and to prevent a nonergonomic uncomfortable and acute inferior-to-superior operative trajectory for the operator toward the atrial lesion.

Surgeon's fatigue is often under-recognized, but it can be a crucial factor in outcome during lengthy operations on skull base tumors and arteriovenous malformations. An inappropriate position of the patient's head or an inadequate armrest can force the surgeon to assume an awkward arm posture that results in hand tremor. This can cause the surgeon to lose composure and patience during the later critical parts of the operation. For example, the surgeon should use an armrest during a supracerebellar craniotomy when the patient is in the park-bench position.

Figure 3: I prefer head positions that minimize the risk of a venous air embolism (the patient's head is not significantly elevated compared with the heart). For posterior parietal craniotomies, I place the patient in the park-bench position (right image) rather than in the supine position with the neck acutely flexed (semisitting-left image).

I prefer to sit during the microsurgical intradural part of surgery. I use only two distinct patient positions for nearly 90% of my operations. I use the supine position for lesions located from the nose up to the level of the parietal eminence (bossing). I use the modified park-bench position (often referred to as the "lateral" or "lateral oblique" position in this Atlas) for lesions located from the parietal eminence to the occipitocervical junction.

The other 10% of my cases require the patient to be placed in a sitting or prone position. The sitting position is used for surgeries on pineal region masses in morbidly obese patients, and the prone position is used for emergency posterior fossa cases since it can be arranged more expeditiously than the park-bench position.

The supine position is used for endoscopic transnasal, pterional, frontal, temporal, interhemispheric, and anterior parietal craniotomies. I also use the supine position for anterior and middle skull base osteotomies.

The modified park-bench position is ideal for posterior parietal, occipital, all posterior fossa and posterior skull base

corridors, and craniocervical junction operations. I avoid placing patients in the supine position for posterior fossa operations since the neck torsion required for the operative head position is nonphysiologic. This neck posture may cause significant postoperative neck pain.

Patients with significant cervical degenerative stenotic changes or morbid obesity are best served in the modified park-bench position if any moderate neck turn is necessary. Patients with lesions near the parietal eminence are also frequently placed in the modified park-bench position.

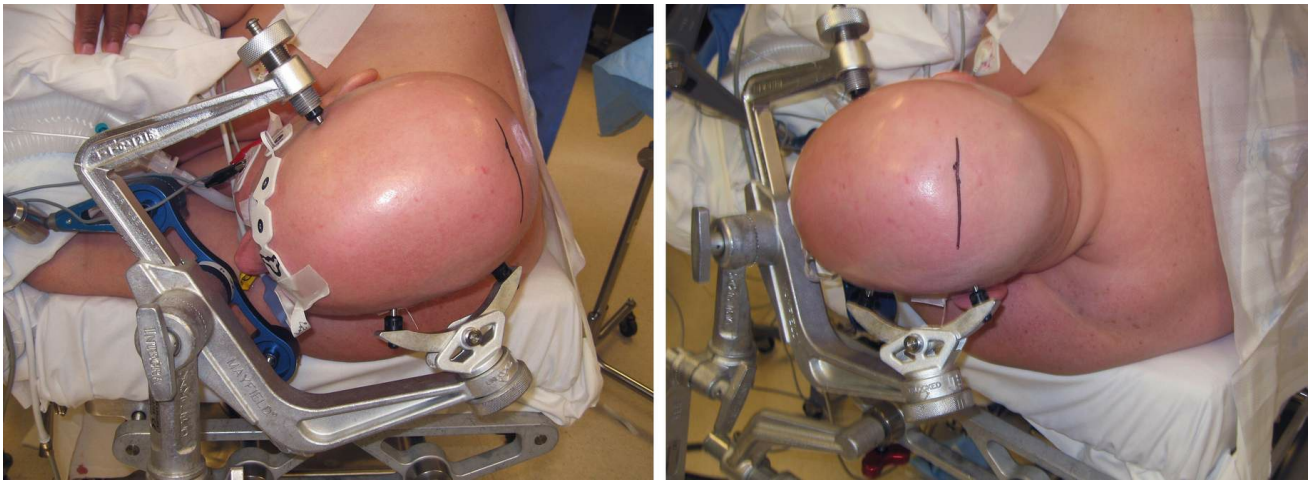

Figure 4: The modified park-bench position has many advantages and is a physiologically sound posture.

The patient's arms and legs should be positioned in anatomically neutral/slightly flexed positions and all bony prominences should be well padded.

Supine Position

The supine position is flexible and can be adjusted to cater to a number of anterior and middle fossa craniotomies. Foam cushions, gel pads, pillows, and padded armrests are advised.

Figure 5: Patient positioning for the pterional craniotomy is demonstrated. Before fixation of the skull clamp, the back of the bed is raised (“back up”), “reflexed,” and the patient’s legs are flexed at the knee (“leg down”). This configuration prevents downward slippage of the patient on the table during surgery and avoids tension on the nerves at the knees.

Figure 6: The position of the head for pterional and orbitozygomatic craniotomies is shown. The single pin is

placed behind the ear (left lower image) over the mastoid bone. The double-pin arm is situated over the contralateral superior temporal line (right lower image). This setup implants the pins furthest away from the incision. The malar eminence is the highest point on the head, so that the frontal lobe is mobilized away from the anterior fossa floor using gravity. The pins should not be placed within the temporalis muscle to avoid fixation failure.

The closer the lesion to the midline (anterior communicating artery aneurysm and tuberculum sella meningioma), the less the head is turned (30 degree turn). The more the lesion is away from the midline (middle cerebral artery aneurysm and lateral sphenoid wing meningioma), the more the head is turned (45 degree turn). This algorithm minimizes the risk of the temporal lobe obscuring the operative trajectory.

Excessive head extension will complicate the operative trajectory toward an anterior cranial base lesion.

Figure 7: For patients who require extensive incisions ("trauma" flap), this mode of skull clamp placement allows minimal interference from the single pin while keeping the

pins outside the forehead region for cosmetic reasons.

Figure 8: For an awake craniotomy, patient comfort is critical. The patient is placed in a supine position with the most physiologic neck posture possible while also accommodating the surgeon's operative needs. Before finalizing the position, the patient should confirm that he or she can easily swallow and is very comfortable.

Figure 9: For patients who are not obese, the supine position may be modified to include a "semi-lateral" position by placing a bulky shoulder roll under the ipsilateral shoulder to rotate the patient's head more aggressively without placing the neck under significant torsion and compromising venous drainage. This modification allows access to the posterior parietal region (left image). Alternatively, the patient may be

placed in a modified park-bench position-my preferred choice (right image).

For further details about the supine position and corresponding incisions, please refer to the chapter on Scalp Incisions.

Lateral Oblique or Park-Bench Position

This position is adaptable by tilting the table. I like this position because it allows me to keep the patient in a relatively physiologic posture while I am seated during the microsurgical portion of the posterior fossa operations. The patient's neck is flexed and an "armored endotracheal tube" is used to avoid kinking of the tube during neck flexion. Neck flexion should leave at least two-fingers width between the patient's chin and chest (thyromental distance).

Figure 10: The axillary roll is necessary with the patient in a park-bench position. Alternatively, the down-side arm may

extend over the edge of the table and be held in a sling. Two pillows support the other arm. The head and thorax are elevated about 15 degrees to facilitate venous return. Placement of a lumbar puncture or drain is readily possible. The patient's upper shoulder is retracted caudally using adhesive tape and allowed to fall forward. This maneuver is essential for accessing the suboccipital space, especially for patients with short necks.

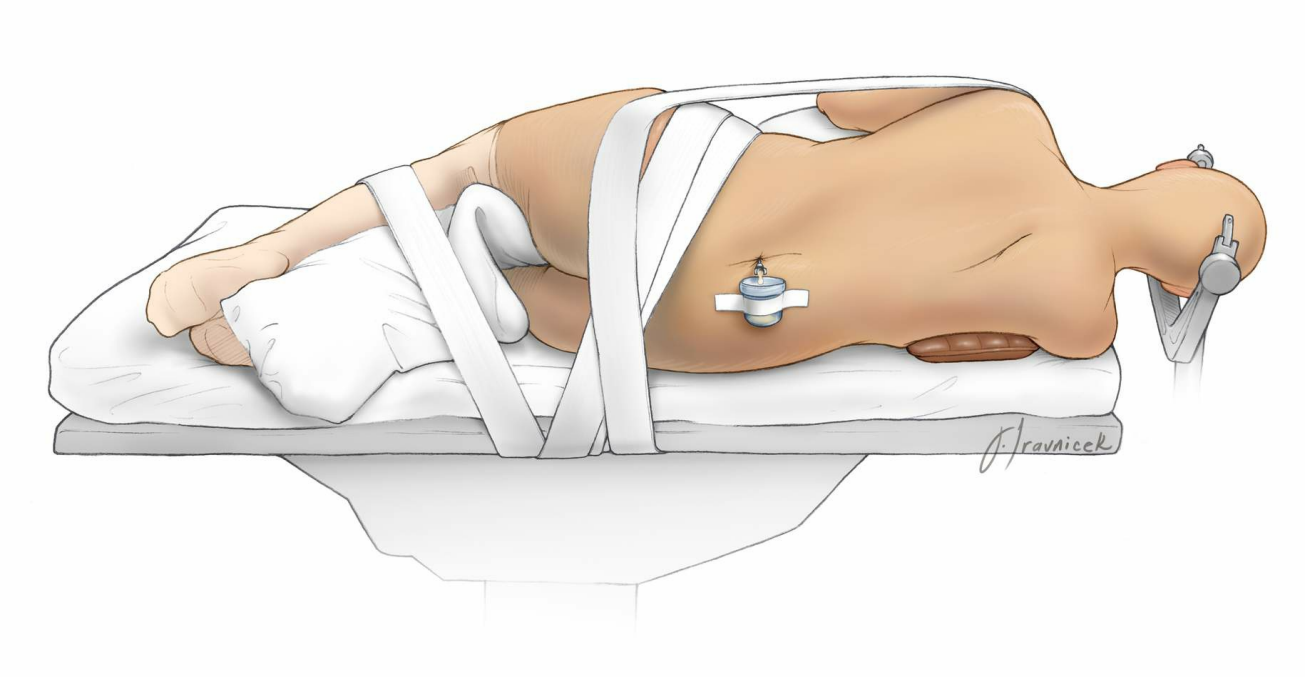

Figure 11: The lateral oblique position requires careful padding of all pressure points and meticulous fixation of the patient 's body to the table. Obese patients are especially at risk of migration or displacement. The adhesive tape should not compress the peroneal nerve near the head of the fibula.

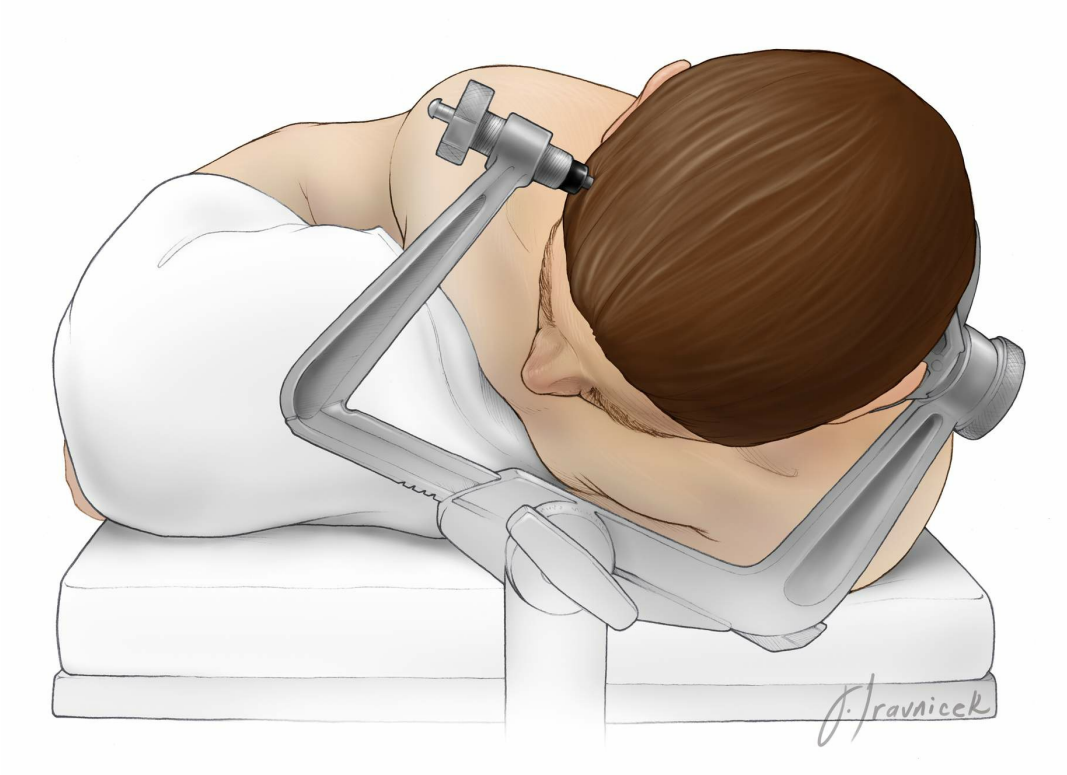

Figure 12: The exact extent of head rotation is dependent upon the location and size of the lesion. I typically rotate the patient's head 20 degrees toward the floor and continue to adjust the turn intraoperatively by tilting the table. While this maneuver facilitates "going around" the cerebellum to reach the cerebellopontine angle, the medial extension of the tumor toward the brainstem can be resected through less head turn. Note the location of the pins away from the incision and the forehead.

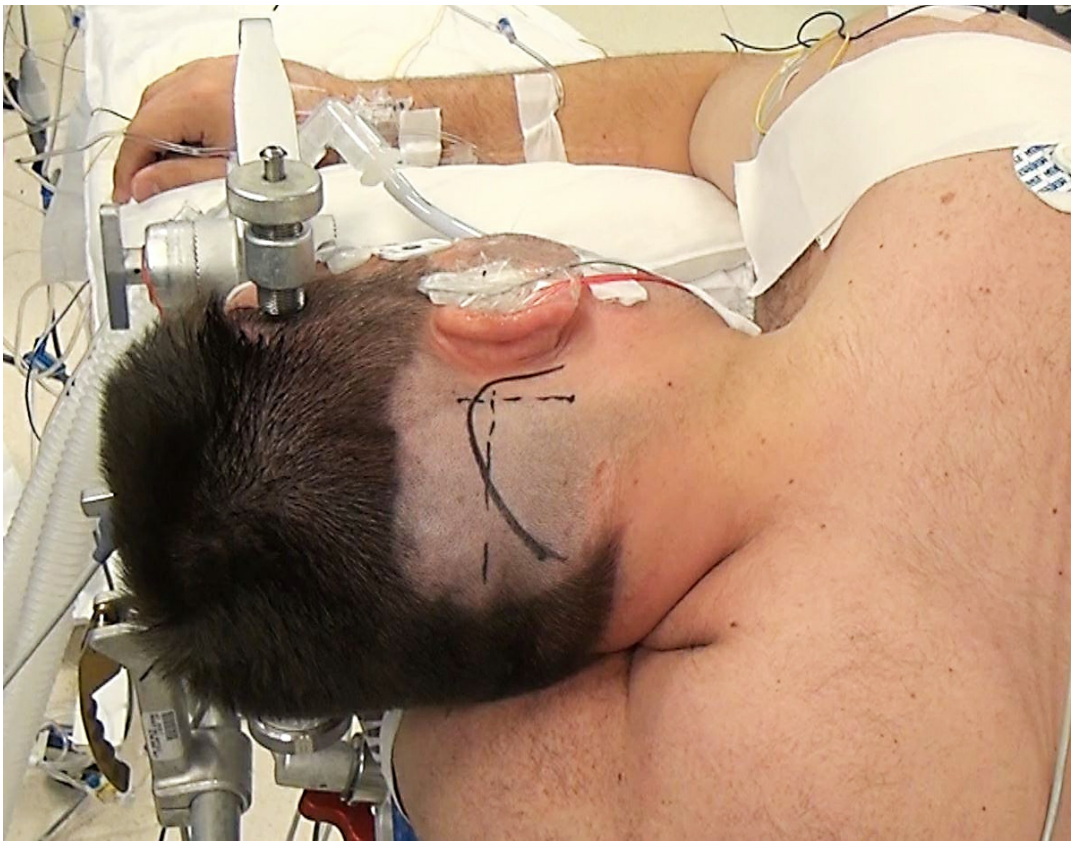

Figure 13: For paramedian and retromastoid craniotomies, I tilt the vertex of the patient's head slightly toward the floor to open the angle between the shoulder and neck. This maneuver expands the working zone for the surgeon in patients with short necks. This patient underwent an extended retromastoid craniotomy for resection of a giant acoustic neuroma. The locations of the transverse sinus and mastoid groove (hashed lines) for planning of the incision and burr hole are illustrated.

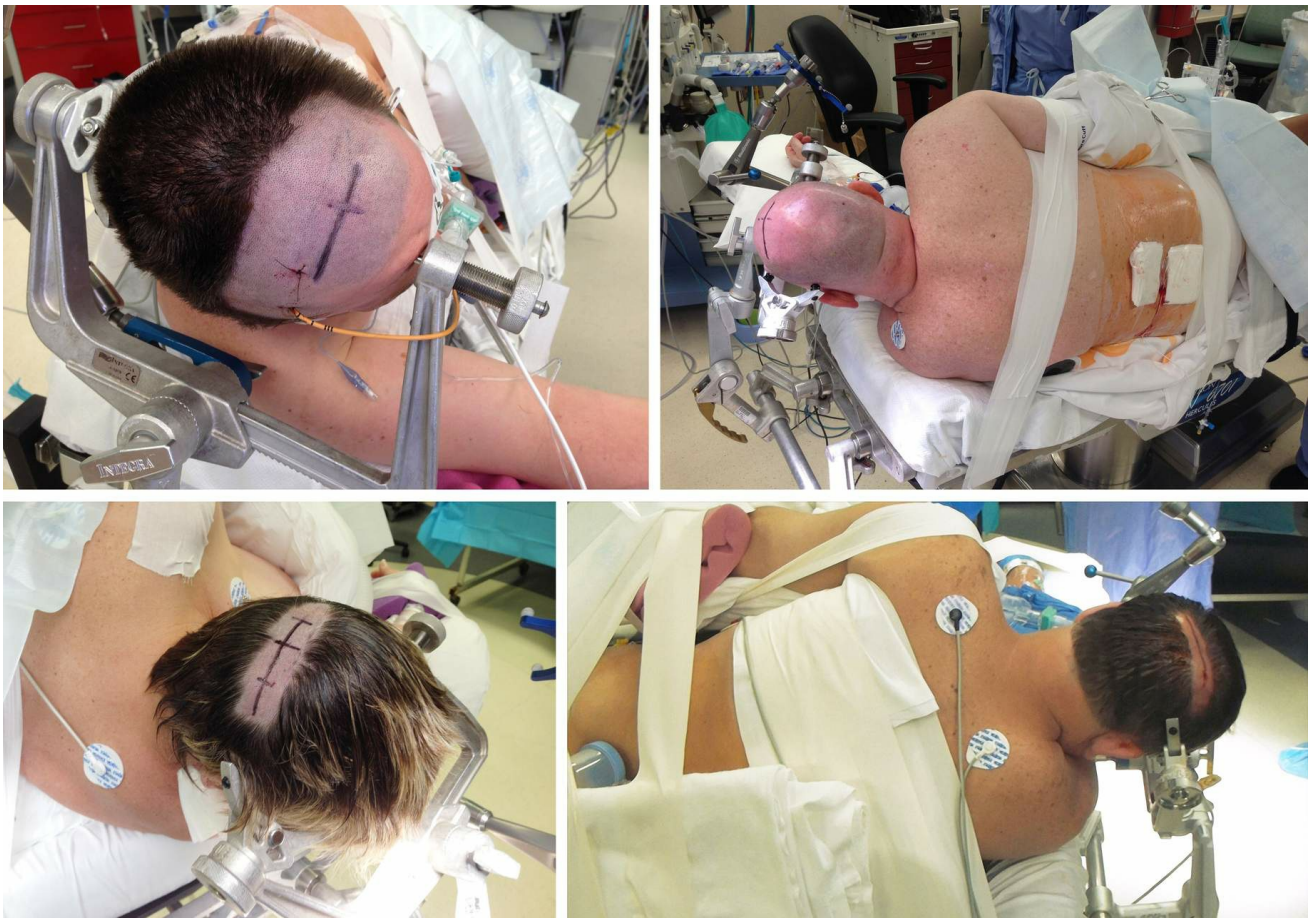

Figure 14: For an interhemispheric approach (anterior interhemispheric route for a third ventricular tumor: upper images) and (posterior interhemispheric route for a splenial arteriovenous malformation: lower images), the patient may be placed in the park-bench position to mobilize the dependent hemisphere through gravity retraction.

I have had my own share of learning experiences with patient positioning. For example, I did not mobilize the shoulder of one obese patient effectively and faced an impossible task of working through the supracerebellar transtentrorial approach to remove a petrous apex meningioma. In this case, the patient's shoulder obstructed my inferior-to-superior operative trajectory.

Sitting Position

There are clear advantages to placing the patient in the sitting position. The surgeon's visualization is improved through the dry and clear operative field associated with this position, and gravity assists with cerebellar retraction. Resection of acoustic neuromas with the patient in the sitting position can be advantageous because of a clear operative field and use of atraumatic bimanual dissection around the facial nerve. Because gravity keeps the field clear, intermittent irrigation minimizes the use of the suction apparatus around the brainstem and cranial nerves, so these structures may undergo less traumatic manipulation.

The sitting position can be potentially beneficial for morbidly obese patients undergoing posterior fossa operations. Cranial venous drainage and ventilation may be significantly compromised when the prone or park-bench position is used for these patients.

However, there are numerous drawbacks to the sitting position that have restricted its use to only select patients. Venous air embolism can be life threatening and is a real risk when the patient is in this position. Other rare complications include subdural hematoma, brachial plexus injury, cervical quadriplegia, and sciatic nerve injury. Operator's hand fatigue and unsteady arm positions are problematic. Also, the preparations for placing the patient in the sitting position can lengthen operative times.

Figure 15: The set-up for a sitting position is illustrated. The location of the burr hole for placement of a ventricular catheter (if necessary) is marked. Please note the use of transesophageal echocardiography and transthoracic doppler sonography. The head of the operating room table is used as an armrest.

Other Considerations

All of the assistants and surgical technicians who handle the instruments should have adequate access to the monitors that show the view of the operative field through the microscope.

Prolonged pressure on the radial nerve in the spiral groove of the humerus, on the ulnar nerve at the epicondylar groove, and on the peroneal nerve at the fibular head should be avoided.

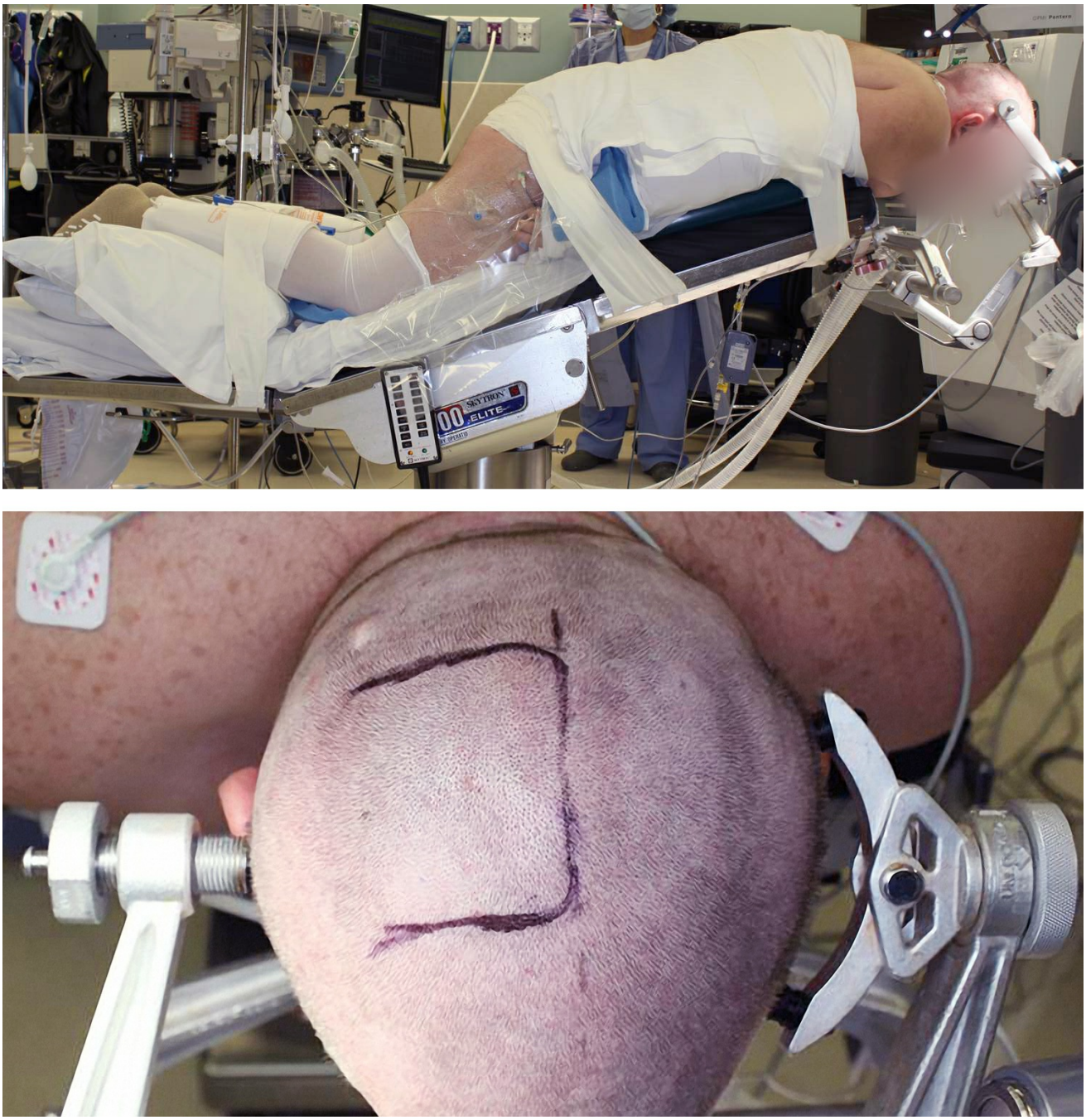

Figure 16: The prone position may be used for patients with superficial lesions (in this case, a parietal arteriovenous malformation). Note the flexed posture of the torso and lower extremities to avoid stretch injuries. Venous return may be compromised because of increased intra-abdominal pressure. Large gel pads for padding the chest allow proper protection of the pressure points in the region. Female breasts and nipples should be mobilized medially. Male genitalia should hang freely.

Figure 17: I avoid placing patients in the semisitting or similar positions that increase their risk of air embolism. These positions also lead to uncomfortable arm and hand postures for the surgeon during microsurgery.

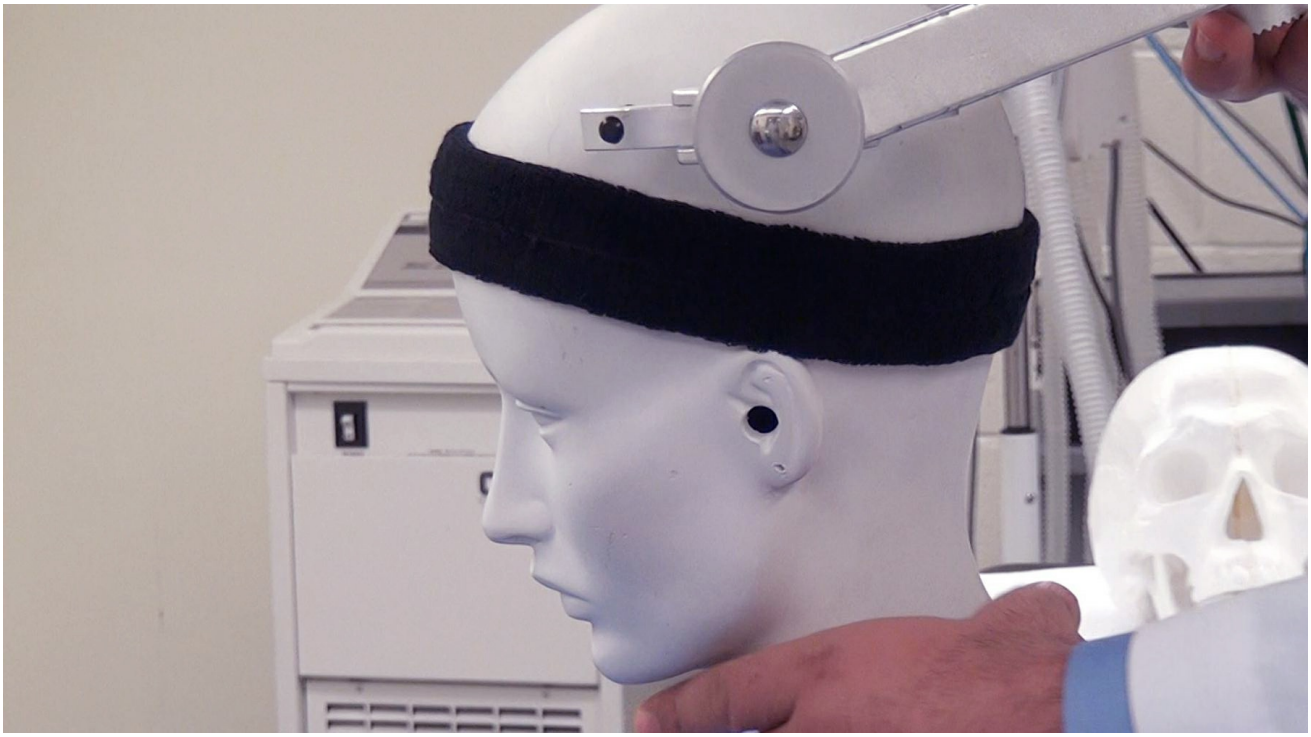

Figure 18: The pins should be implanted on the “sweat band” zone around the head. Their placement outside of this zone, as seen in this image, risks fixation failure. Patients who are younger than 3 years of age should not be placed in pins and a cerebellar headrest is used. Children younger than 10 years of age should undergo head fixation using dedicated

pediatric pins. Adult pins are used for patients older than 10 years. For further details, please refer to the chapter on Skull Clamp Placement.

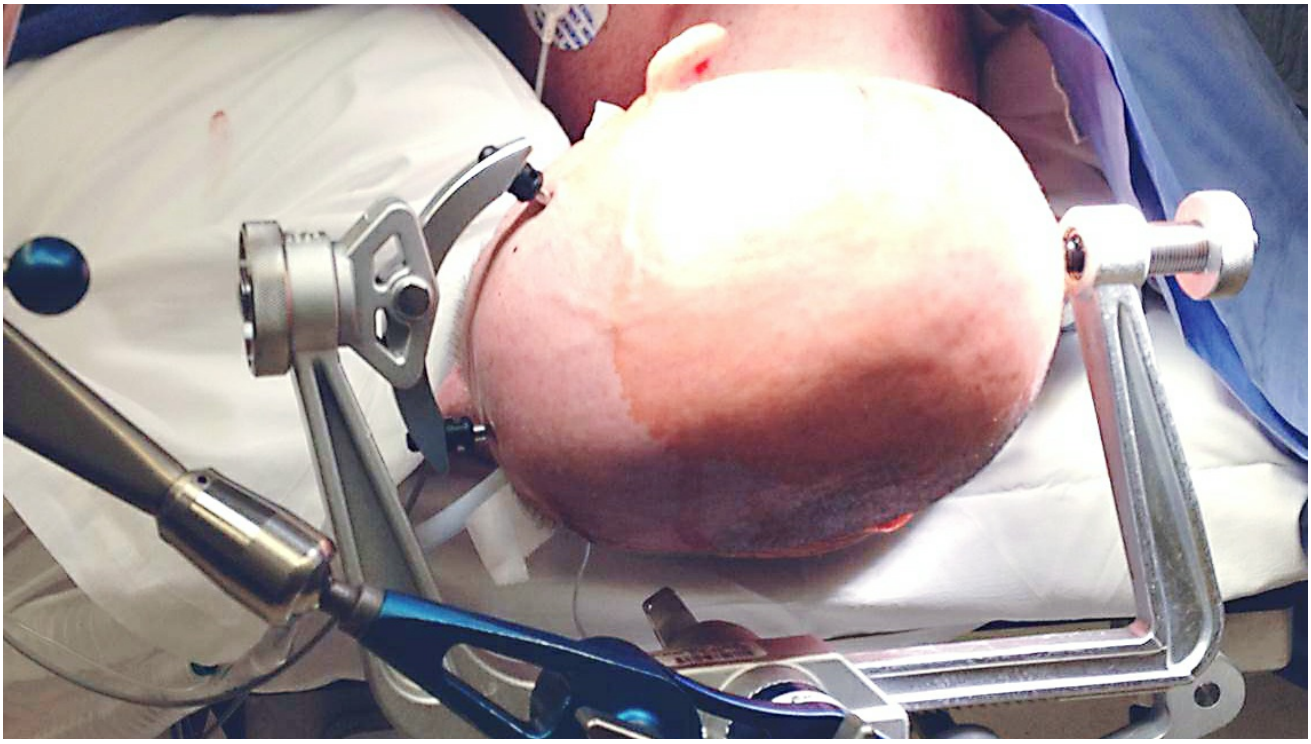

Figure 19: The horizontal line extending from the single pin should cross the space between the two pins of the swivel arm. If this principle is not completely satisfied as seen here, fixation failure is possible.

Pearls and Pitfalls

- The appropriate position, most importantly, should allow the least obstructed intradural trajectory to reach the target lesion while minimizing risk of injury to the normal cerebrovascular structures.
- The lateral or modified park-bench position is a versatile and obviates the need to place the patient in the prone position. It also allows the operator to sit during microsurgery.

- Numerous factors should be considered for selection of the final position. The use of ”rigid” protocols to streamline the decision-making process for selection of the suitable position should be avoided.
- Gravity can facilitate expansion of the operative corridor and should be exploited.
- The surgeon comfort is important, especially during long operations.

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