

Practice Point

Prone Positioning in Neurosurgery: Brief Description of Practice Points and Concerns

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The prone position is commonly used for posterior fossa and spinal cord surgery. Prone positioning allows optimal exposure of the spine to optimize visualization of the disc space and prevent unnecessary retraction of neural structures.¹ We should be aware of its adverse effects on the surgical procedure and the patient and should be physically and physiologically safe for the anesthetized patient. Knowledge improves our preparedness. A common positioning device employed for this purpose is the Wilson frame. The authors describe their experience in validating Wilson frame-induced prone position.

- Main Concerns: raised intracranial pressure, causes may be ↑ intraabdominal pressure; kinking of ETT & venous congestion due to IJV compression. Head below the level of the heart.
- Main Concerns: venous congestion: ↑ brain swelling & ↑ venous bleeding. Insufficient abdominal bolstering ↑ PEEP Hyper rotation/flexion of the neck may be the cause.
- Main Concerns: airway compromise, hyperflexion, kinking of ETT. Keep a distance of one or two finger breadths between chin & chest during flexion. Better use armored tubes.
- Our Concerns: prolonged pressure on pressure points; stretching of nerves; especially brachial plexus., corneal abrasions, thromboembolic complications.
- Head-Up for cranial procedures, almost invariably, some head-up posturing [15-20°] is appropriate. Exceptions: After evacuation of SDH [↓ Re-accumulation]. After CSF shunting [to avoid too rapid

collapse of ventricles]

- FRAMES: POSITIONING AIDS AND SUPPORTS: Wilson Frame; Relton-Hall [four-poster], Andrews (hinder binder) type frame; Horseshoe headrest with foam head support, vacuum/foam mattress; frames optimize venous return; risk of air embolism.
- PIN FIXATION DEVICES: Radiolucent pin (Mayfield) head holder. Skull block before application; placed in a band-like area just above orbits & pinna. Avoid over thin temporal bone; caution when over frontal sinus.
- PIN FIXATION DEVICES: e.g. Mayfield head holder. Complications: malposition; poor fixation movement over-tightening, incorrect pin, soft skull injury, infection with delayed abscess, epidural hematoma, skin necrosis, skull fracture; slippage of joints to the operating table, clamp breakage bleeding.



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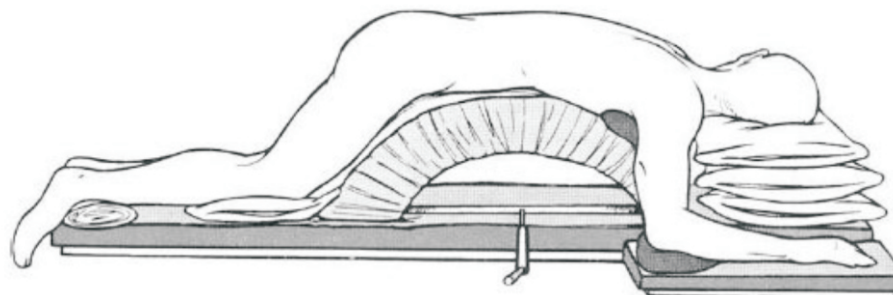
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PRONE POSITION

- **PRONE POSITION:** For spinal canal surgery, suboccipital approach/occipital lobe, craniostomy, and posterior fossa procedures. Can cause hemodynamic changes, impairment of ventilation, and spinal cord injury.² Anesthesiologist should have a plan for detaching and reattaching monitors in an orderly manner to prevent excessive monitoring window. Needs coordination of members.
- **PRONE POSITION:** The prone position also has been preferred for cervical spine and posterior fossa procedures, the final position commonly entails neck flexion, reverse Trendelenburg, and elevation of the legs. This orientation brings the surgical field to a horizontal position.
- **PRONE POSITION:** How to achieve; Move the patient trolley parallel & adjacent to the operating table. All lines: ensure length & secure 2 assistants stand on the free side of table & another 2 on the free side of the trolley. One manages feet If the cervical spine is stable; anesthesiologist to manage head & coordinate turn; if unstable, neurosurgeon; arms of the patient kept alongside the body.
- **PRONE POSITION:** How to achieve; connect lines/monitoring leads and secure the signal from the person managing head, disconnect the patient from anesthesia machine; turn him gradually onto the outstretched arms of the receiving assistants hold the arms alongside the body & head in the sagittal plane during the turn. Reconnect, auscultate the chest and confirm ETT position. Don't lose your tape to saliva; ensure fixity of ETT tape; antisialogogue; benzoin-adhesive.
- **PRONE POSITION:** How to achieve; Patient placed on frame or two bolsters or a support device with arms to the side of the body; bolsters should be sufficiently far apart, to avoid compressing abdominal & femoral venous return; to allow adequate diaphragmatic excursion.³
- **PRONE POSITION:** How to achieve; patient remains supported by appropriate chest rolls which should support the lateral edge of the torso from head to foot. Rotate head toward the anesthesia machine & place it on a headrest. Take care of the downside eye and ear; Arms alongside/in front of the patient.⁴
- **PRONE POSITION:** breast & genitalia placed medially in frames/between chest rolls. Eyes taped; head supports should be spaced wide enough; pin-based holder better; downside ear kept flat and unfolded. Chin is tucked in the suboccipital approach; 2 Finger breadths distance between chin-mandible, sternum-clavicle; no pressure over the preauricular area- VII nerve superficial.⁵
- **PRONE POSITION:** Ensure even pressure over face / Intermittently check for orbital compression; Arms and knees padded; Ankles elevated so that toes are hanging freely. A rolled gauze bite block instead of an oral airway can avoid compression/ ischemia while preventing trapping of tongue in between teeth.⁴
- **PRONE POSITION:** Cardiovascular System [CVS] adapts well; Venous pooling may reduce cardiac filling pressures and cardiac output; Improper position-obstruct femoral vein / IVC; ↓BP/venous return; wrapping legs with elastic/pneumatic stockings can maintain the filling pressures.⁶
- **PRONE POSITION:** Respiratory System: The entire thoracic mass off sternum to expand pleural cavity. The

weight of the dorsal trunk pushes abdominal contents cephalad, which push diaphragm↑ WOB. If rolls correctly placed, chest and abdomen hang free; ventilation is accomplished with normal pressures. FRC decrement seen in the supine position is not seen with the prone position.²

- **PRONE POSITION:** Central Nervous System-Vertebral venous plexus have anastomotic connections with IVC & femoral vein. Compression of IVC→ diversion of blood to vertebral venous plexus, ↑ bleeding, ↓visibility in spine surgery. If properly positioned on chest roll; free abdomen, ↓barotrauma. Less CSF flux → less bleeding.¹
- **TAKE CARE OF BRACHIAL PLEXUS:** In the 'stick-em up' position arms shouldn't be abducted >90°; elbows shouldn't be extended >90° [90-90 position]. Elbow should be anterior to the shoulder to prevent the wrapping of the brachial plexus around the head of the humerus. Pronation makes the ulnar nerve very vulnerable, while supination keeps it in a more protected position.³
- **Reverse Trendelenburg:** increase in head and neck venous drainage, reduction in intracranial pressure, and reduced likelihood of passive regurgitation. Elevation of the head 15 to 30 degrees will also encourage venous drainage. Head is important; but don't forget upper limbs, usually at the sides. Don't abduct shoulder > 90° [Brachial plexus], foam padding to elbow & wrist [ulnar and median nerve]. Knee elevated [↓ tension on the lower part of the back]. Heels padded.
- **AWAKE PRONATION:** For patients with compromised spinal canal and when there is the possibility of worsening of neurologic function with handling. The patient can indicate pain. Progression of Neurological deficit: YES/NO. If progression can correct the faulty position. Needs adequate sedation and topical anesthesia.
- **THREE-QUARTER PRONE POSITION OR PARK-BENCH POSITION:** Used in far lateral approaches placing the patient sufficiently superiorly on the operating table such that the dependent arm is hanging over the edge of the table & secured with a sling. The trunk is rotated 15° from the lateral position into a semi-prone position & supported with pillows. I/L shoulder

is pulled inferiorly. Head is flexed @ the neck and then rotated to look toward the floor [120° from vertical & laterally flexed at 20°]. Axillary roll placed under dependent chest. Avoid too much tension on the shoulder [Brachial plexus]. Considerable rotation & flexion of the neck; kinking of ETT, IJV (use Flexometallic ETT).

- **MODIFICATION OF PRONE POSITION.** Used for cervical spine & posterior fossa procedures. Neck flexion, reverse Trendelenburg, also known as 'head-up tilt', arms tucked alongside to trunk & elevation of legs → this orientation brings the surgical field to a horizontal position. Complication necrosis of chin & obstruction of cerebral venous outflow.
- Wilson frame significantly increases flexion at L4/5 and L5/S1 by 47% and 21%, respectively and optimizes the exposure.⁷

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