

Burrhole Craniotomy

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Introduction:

Burrhole craniotomy is an operation that allows easy access to the epidural and subdural spaces. They can also be used to place ventriculostomy catheters, ventriculoperitoneal shunts, or to drain abscesses on or near the surface of the brain. In all cases, but especially for intracranial abscesses, proper positioning the burrhole is of critical importance.

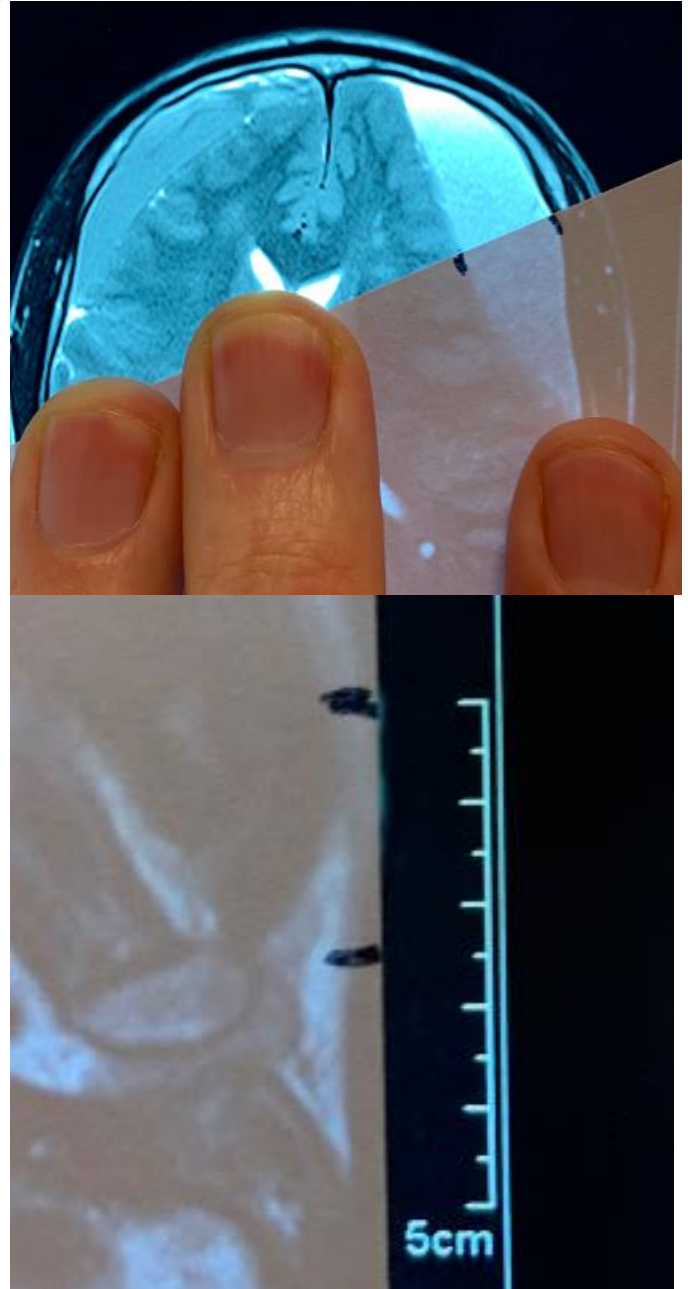
Epidural hematomas, loculated chronic subdural hematomas, and some subacute subdural hematomas will not be drained adequately through a burrhole and will require a craniotomy. This decision-making process is based on history and imaging findings. It is described in more detail in the Section Introduction chapter.

The operation proceeds with the following general steps.

- Review of the imaging and decision on incision placement
- Scalp, galea and pericranium incision
- Burrhole and visualization of the dura
- Incision of the dura and drainage of the subdural fluid collection
- Irrigation until return is clear
- Placement of a drain
- Wound closure

Steps:

1. Carefully review the imaging and correlate the intracranial pathology with externally palpable landmarks. Orient your incision using landmarks that are visible on both imaging and physical examination, such as the middle of the orbit, the auditory canal, the earlobe, and the palpable bony ridge along the origin of the temporalis muscle.



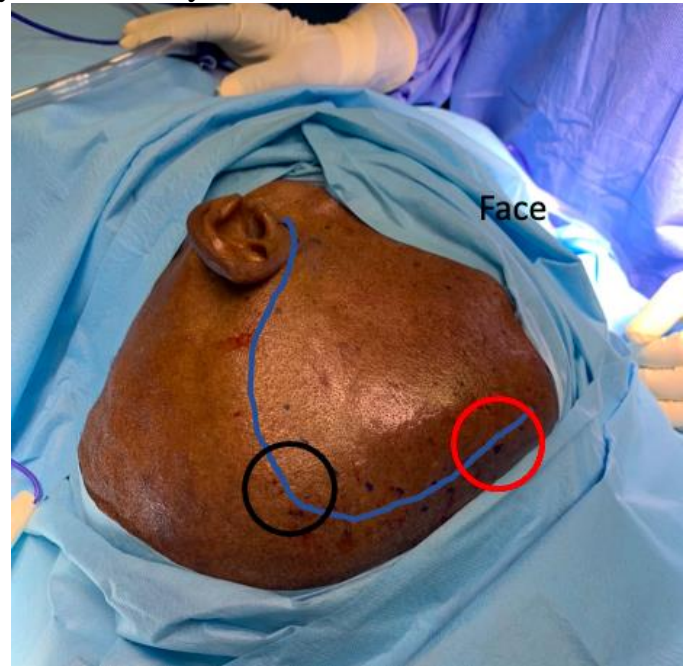
On tomography films, distances can be measured by marking them with a piece of paper (Top) and then checking that distance against a distance marker that is usually found on the far right of the film (Bottom.) On this axial MRI, the maximum thickness of the subdural hematoma is measured at 2.5cm.

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On digital images, a ruler function is usually available. On this Coronal CT scan, the maximum thickness of the subdural hematoma is 8.5cm above the external auditory canal.



The Blue Line indicates the scalp incision for a craniotomy. A burrhole placed in the area of the Red Circle should be horizontal. A burrhole placed in the area of the Black Circle should be vertical. If conversion from burrhole to craniotomy is necessary, the incisions could easily be integrated into the scalp flap.

2. General anesthesia is preferred, although in extreme cases it is possible to perform a burrhole under local anesthesia. The patient's head is secured with a head ring.
3. Position: The patient lies supine and the head is rotated away from the surgical side. The head ring prevents excessive rotation or angulation of the neck.
4. The patient's head is shaved and the location for a lateral craniotomy incision is marked. Burrhole incisions will be within this line, so that if it is necessary to convert to craniotomy they can be incorporated in the flap incision.
5. The areas of planned incision are injected with local anesthetic with epinephrine, then the surgical site is prepared and draped.
6. The burrhole incision is made with a scalpel and extended with electrocautery. Slow even progress is made assuring hemostasis. Even with prior vasoconstrictor injection, scalp bleeding will occur and should be controlled. While it is possible to cut straight through the scalp and then control bleeding with the self-retaining retractor, this technique assures the scalp will bleed during closure, increasing the chances of entrapping the drain as described further below.

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Technique for incising the scalp. The surgeon holds pressure on one side of the incision with the non-dominant hand while using electrocautery to divide the subcutaneous tissue. The assistant holds pressure on the opposite side with the non-dominant hand while using the Frazier suction to keep the field clear.

7. Once the pericranium is reached, a self-retaining retractor is placed.
8. The pericranium is incised and elevated laterally. The self-retaining retractor is repositioned to hold the elevated pericranium as well.



With a self-retaining retractor such as the Weitlaner, the incised scalp is retracted over the periosteum. The periosteum

is then incised and elevated laterally with a periosteal elevator. The retractor is then repositioned to hold the periosteum as well.

9. The burr and Hudson Brace is used to perforate the skull. Irrigate during this process to avoid overheating the bone and killing osteoblasts. Progress is slow and steady, with frequent checks. At all costs, the burr must not be allowed to “break through” the skull.

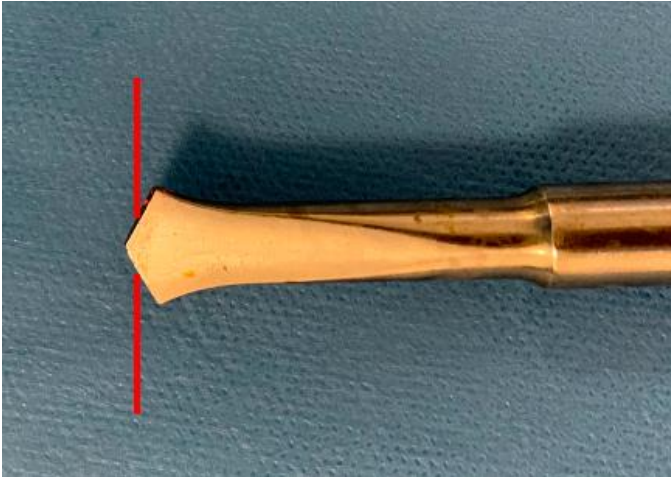


The table is set to a height such that the surgeon can comfortably lean on the Hudson Brace while rotating the handle. The assistant steadies the head so that there is no excessive movement or tension on the neck.

10. Once the inner table is breached, the operator of the Hudson Brace will feel that progress becomes less “smooth.” This is because the blade of the burr is now engaging the edge of the inner table of the skull rather than cutting evenly through bone. An experienced operator will feel this change and stop when this happens.

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A variety of perforators are available for the Hudson Brace. All have a center that penetrates deeper than the sides. Progress is slow with frequent stops to check that the inner table has not been breached with the tip of the perforator. When the inner table of the skull (represented by a Red Line) is breached, the sharp edge of the perforator is now engaging the edge of the bone. The surgeon feels that resistance to turning the Hudson Brace suddenly becomes less "smooth." Stop at this point to avoid the possibility of the burr plunging through the bone into the brain parenchyma.

11. At this point there is a wide circular defect in the skull with a smaller defect at its base that communicates with the inside of the skull. The Kerrison rongeur is passed through this defect and used to widen it to about 12-14mm.



Once the tip of the perforator has breached the inner table of the skull, the most superficial part of the burrhole will be as wide as the widest part of the perforator, with a small defect at the base. The Kerrison rongeur (Inset) is a side-biting rongeur that can be used to widen the base of the burrhole until it is of a uniform width throughout.

12. The dura is inspected carefully; occasionally a blood vessel will be running through it directly below the burrhole. If the cut edges of the bone are bleeding and obscuring your view, apply bone wax to the bleeding site.
13. With the assistant ready with the Frasier suction, make a cruciate incision in the dura, avoiding any nearby blood vessels. The dura is thick. Proceed in layers, making all of the incision through the outer layer before cutting through to the inner layer. A rush of dark red or brown fluid is seen.



Burrhole with cruciate incision in the dura.

14. Suction the fluid until the flow decreases. If the flow does not decrease or changes from dark to bright, consider whether the dura incision lacerated a vessel. Bipolar cautery can usually stop bleeding from dural vessels. If not, enlarge the burrhole with a rongeur until it can accommodate a suture and ligate the vessel.
15. Insert a soft pediatric feeding tube and irrigate with warm saline until return is clear.

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The subdural space is gently irrigated with warm saline through a soft pediatric feeding tube.

16. Insert a drain through a separate incision and pass it through the dura. A small Foley catheter or red Robinson drain with extra side holes cut in it is acceptable. Make sure to not narrow the catheter too much while cutting the side holes, so it is less likely to fracture while being removed. Irrigate and aspirate gently on this drain to make sure that it is patent, as it can kink during insertion. The drain is placed to gravity.



A drain is fashioned by cutting off the tip of a Foley catheter (including the balloon) and adding side holes.

17. Close the skin and galea. Using a single layer of running monofilament Nylon suture is more hemostatic. Using two layers, closing the Galea with interrupted absorbable suture and the skin subcuticular, has a superior cosmetic appearance. Take care not to entrap the drain in any of the suture.



The scalp can be closed in one or two layers. Care is taken to close the Galea and to avoid incorporating the drain in the closure. Direct visualization of each pass of the needle is mandatory.

18. The drain can be removed in 1-3 days after surgery.

Pitfalls

- The brain can be injured through careless use of the perforator. Impatience and excessive pressure while using the perforator is inappropriate. Stop frequently to check the progress. Switch to a rongeur to widen the hole as soon as the tip of the burr has passed through the inner table of the skull.
- A loculated or clotted subdural hematoma, or an epidural hematoma, will not evacuate through a burrhole alone. The preoperative imaging, as well as increasing experience, will help avoid “surprises” where the hematoma does not fully

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evacuate as expected. Do every burrhole with the head fully prepared and draped so that you could convert to craniotomy if necessary.

- Recurrence of a hematoma may require a second burrhole operation to evacuate it again. While this is a known complication, the surgeon must be certain that the patient has a true recurrence, and not just failure to evacuate the first hematoma because it was clotted or loculated. Removal of less fluid than expected at initial operation should prompt the surgeon to convert to craniotomy to fully inspect the subdural space.
- A drain should always be left in the subdural space after burrhole evacuation. This makes a recurrence less likely, though still possible. If the hematoma is truly recurrent (rather than inadequately treated, as described above) a repeat operation through the same burrhole is acceptable.
- Recurrence of a subdural or epidural abscess after burrhole evacuation is possible and should be watched for. A craniotomy will be required if this occurs; a repeat burrhole is not adequate.
- Patients whose subdural hematoma has been present for a long time, especially if there was significant midline shift, brain compression, or advanced age, may not recover neurologic function despite a successful operation. Ipsilateral pupillary dilation in a longstanding subdural hematoma is a particularly ominous sign.
- Careless skin closure can entrap the drain tube easily, since it runs directly underneath the incision. Make sure that each pass with the needle is visualized. Avoid “blind” suturing through both edges of the wound at the same time. If entrapment of the drain occurs, the sutures can be removed and replaced under local anesthesia with meticulous sterile technique.
- Avoid placing the drain to strong suction, as this can damage the brain underneath. Gravity drainage is quite sufficient in this situation.

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