

Craniotomy

Overview

Craniotomy is a surgery to cut a bony opening in the skull. A section of the skull, called a bone flap, is removed to access the brain underneath. A craniotomy may be small or large depending on the problem. It may be performed to treat brain tumors, hematomas (blood clots), aneurysms or AVMs, traumatic head injury, foreign objects (bullets), swelling of the brain, or infection. The bone flap is usually replaced at the end of the procedure with tiny plates and screws.

What is a craniotomy?

Craniotomies are named according to the area of skull (cranium) to be removed (Fig. 1). After the surgeon repairs the problem, the bone flap is then replaced or covered with plates and screws. If the bone flap is not replaced, the procedure is called a craniectomy.

Craniotomies vary in size and complexity. Small dime-sized craniotomies are called burr holes; "keyhole" craniotomies are quarter-sized or larger. Stereotactic frames, image-guided computer systems, or endoscopes may be used to precisely place instruments through these small holes. Burr holes and keyholes are used for minimally invasive procedures to:

- insert a shunt into the ventricle to drain cerebrospinal fluid (to treat hydrocephalus)
- insert a deep brain stimulator (DBS)
- insert an intracranial pressure (ICP) monitor
- remove a sample of tissue cells (needle biopsy)
- drain a blood clot (hematoma aspiration)
- insert an endoscope to remove tumors

Complex skull base craniotomies involve the removal of bone that supports the bottom of the brain where delicate cranial nerves, arteries, and veins exit the skull. Reconstruction of the skull base may require the additional expertise of head-and-neck, otologic, or plastic surgeons. Surgeons often use image-guidance systems and endoscopes to plan the access for difficult-to-reach lesions to:

- remove deep tumors or AVMs; clip aneurysms
- remove tumors that invade the bony skull

While most skull openings are made as small as possible, large decompressive craniectomies are

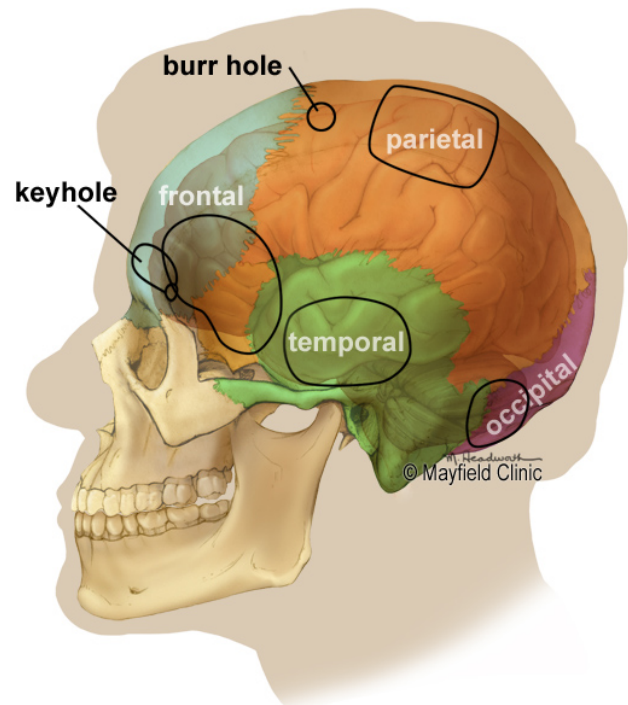


Figure 1. Craniotomies are often named for the bone being removed. Some common craniotomies include fronto-temporal, parietal, temporal, and suboccipital.

made to allow the brain to swell after a head trauma or stroke. The bone flap is frozen and replaced months later after recovery (cranioplasty).

Awake craniotomies are performed when a lesion is close to critical speech areas. The patient is asleep for the bone opening and then awakened to help the surgeon map areas at risk. A probe is placed on the brain surface while you read or talk. Called brain mapping, this process identifies your unique brain areas for speech and helps the surgeon avoid and protect these functions.

There are many kinds of craniotomies. Ask your neurosurgeon to describe where the skin incision will be made and the amount of bone removal.

Who performs the procedure?

A craniotomy is performed by a neurosurgeon; some have additional training in skull base surgery. A neurosurgeon may work with a team of head-and-neck, otologic, plastic, and reconstructive surgeons. Ask your neurosurgeon about their training, especially if your case is complex.

What happens before surgery?

The surgeon will explain the procedure, its risks and benefits, and you will have time to ask questions. Consent forms are signed and paperwork completed to inform the surgeon about your medical history (e.g., allergies, medicines, anesthesia reactions, previous surgeries). Presurgical tests (e.g., blood test, electrocardiogram, chest X-ray) may need to be done several days before surgery. Consult your primary care physician about stopping certain medications and ensure you are cleared for surgery.

Stop taking all non-steroidal anti-inflammatory medicines (ibuprofen, Advil, etc.) and blood thinners (Coumadin, aspirin, Plavix, etc.) 7 days before surgery. Stop using nicotine and drinking alcohol 1 week before and 2 weeks after surgery to avoid bleeding and healing problems.

If image-guided surgery is planned, an MRI will be scheduled before surgery. Fiducials (small markers) may be placed on your forehead and behind the ears. The markers help align the preoperative MRI to the image guidance system. The fiducials must stay in place and cannot be moved or removed prior to surgery to ensure the accuracy of the scan.

You may be asked to wash your skin and hair with Hibiclens (CHG) or Dial soap before surgery. It kills bacteria and reduces surgical site infections. (Avoid getting CHG in eyes, ears, nose or genital areas.)

Morning of surgery

- No food, drink, gum or candy.
- Shower using antibacterial soap. Dress in freshly washed, loose-fitting clothing.
- Wear flat-heeled shoes with closed backs.
- If you have instructions to take regular medication the morning of surgery, do so with small sips of water.
- Remove make-up, hairpins, hair extensions / weaves, contacts, body piercings, nail polish.
- Leave all valuables and jewelry at home.
- Bring a list of medications with dosages and the times of day usually taken.
- Bring a list of allergies to medication or foods.

Patients are admitted to the hospital the morning of surgery. The nurse will explain the preoperative process and discuss any questions you may have. An anesthesiologist will talk with you to explain the effects of anesthesia and its risks.

What happens during surgery?

Depending on the underlying problem being treated, surgery can take 3 to 5 hours or longer.

Step 1: prepare the patient

You will lie on the operating table and be given general anesthesia. Once you are asleep, your head is placed in a 3-pin skull fixation device that attaches to the table and holds your head

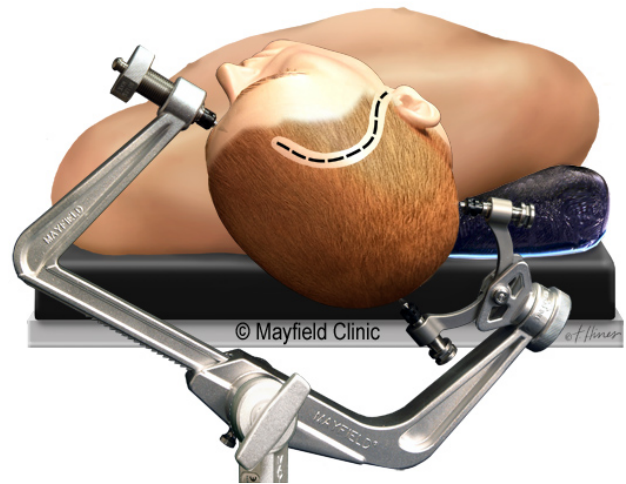


Figure 2. The patient's head is placed in a three-pin Mayfield skull clamp. The hair is shaved along the skin incision line (dashed line).

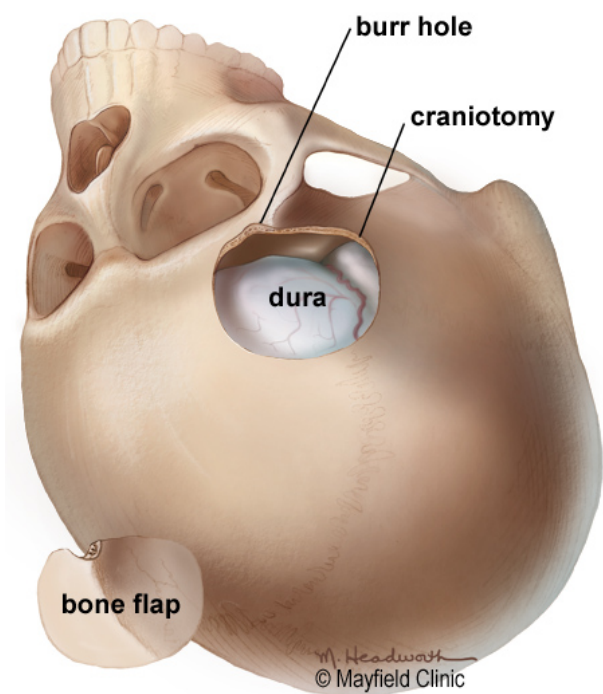


Figure 3. A craniotomy is cut with a special saw called a craniotome. The bone flap is removed to reveal the protective covering of the brain called the dura.

absolutely still during surgery (Fig. 2). A brain-relaxing drug called mannitol may be given.

If image-guidance is used, your head will be registered with the infrared cameras to correlate the "real patient" to the 3D computer model created from your MRI scans. The system functions as a GPS to help plan the craniotomy and locate the lesion. Instruments are detected by the cameras and displayed on the computer model.

Step 2: make a skin incision

The incision area of the scalp is prepped with an antiseptic. Skin incisions are usually made behind the hairline. A hair sparing technique is used, where only a 1/4-inch wide area along the proposed incision is shaved. Sometimes the entire incision area may be shaved.

Step 3: perform a craniotomy

The skin and muscles are lifted off the bone and folded back. Next, small burr holes are made in the skull with a drill. The burr holes allow entrance of a special saw called a craniotome. Similar to using a jigsaw, the surgeon cuts an outline of a bone window (Fig. 3). The cut bone flap is lifted and removed to expose the protective covering of the brain called the dura. The bone flap is safely set aside and will be replaced at the end of the surgery.

Step 4: expose the brain

The dura is opened to expose the brain (Fig. 4). Retractors may be used to gently open a corridor between the brain and skull. Surgeons use magnification glasses (loupes) or an operating microscope to see the delicate nerves and vessels.

Step 5: correct the problem

Enclosed inside the bony skull, the brain cannot be easily moved aside to access and repair problems. Neurosurgeons use a variety of very small instruments to work deep inside the brain. These include long-handled scissors, dissectors and drills, lasers, and ultrasonic aspirators (uses a fine jet of water to break up tumors and suction up the pieces). In some cases, evoked potential monitoring is used to stimulate specific cranial nerves while the response is monitored in the brain. This is done to preserve function of the nerve during surgery.

Step 6: close the craniotomy

After the problem has been removed or repaired, any retractors are removed, and the dura is closed with sutures. The bone flap is put back in its original position and secured to the skull with titanium plates and screws (Fig. 5). The plates and screws remain permanently to support the area, and they sometimes can be felt under your skin. A drain may be placed under the skin for a couple of days to remove blood or fluid from the area. The muscles and skin are sutured back together. A soft adhesive dressing is placed over the incision.

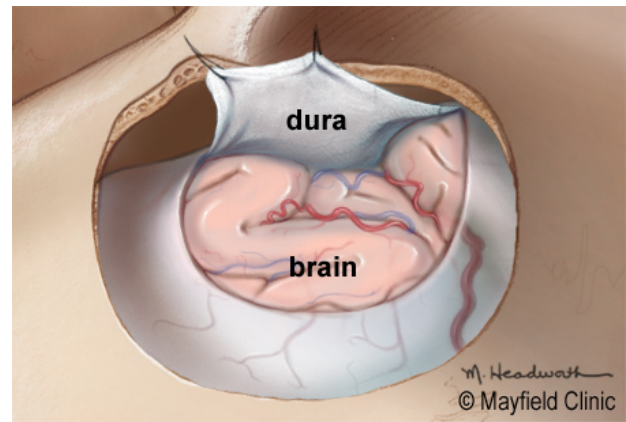


Figure 4. The dura is opened and folded back to expose the brain.

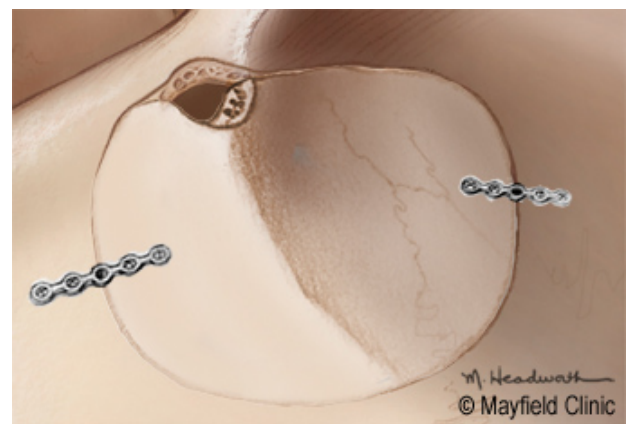


Figure 5. The bone flap is replaced and secured to the skull with tiny plates and screws.

What happens after surgery?

You are taken to the recovery room where vital signs are monitored as you awake from anesthesia. You may have a sore throat from the tube used to assist your breathing. After you awaken, you'll be moved to the intensive care unit (ICU) for close monitoring. You are frequently asked to move your arms, fingers, toes, and legs. A nurse will check your pupils with a flashlight and ask questions, such as "What is your name?" You may experience nausea and headache after surgery. Medication can control these symptoms. Depending on the type of brain surgery, steroid medication (to control brain swelling) and anticonvulsant medication (to prevent seizures) may be given. When your condition stabilizes, you'll be transferred to a regular room where you'll begin to increase your activity level.

The length of the hospital stay varies, from only 2–3 days or 2 weeks depending on the surgery and any complications. When released from the hospital, you'll be given discharge instructions.

Follow the surgeon's home care instructions for 2 weeks after surgery or until your follow-up appointment. In general, you can expect:

Restrictions

- Don't lift anything heavier than 5 pounds.
- No strenuous activity including yard work, housework, and sex.
- Don't drink alcohol. It thins the blood and increases the risk of bleeding. Also, don't mix alcohol with pain medicines.
- Don't smoke or use nicotine products: vape, dip, or chew. It may delay healing.
- Don't drive, return to work, or fly air travel until your surgeon says it's OK.

Incision Care

- You may shower the day after surgery and wash your hair with mild baby shampoo. Gently wash the incision area with soap and water every day. Don't scrub or let the water beat hard on your incision. Pat dry.
- If Dermabond skin glue covers your incision, don't rub or pick at the glue.
- Don't submerge or soak the incision in a bath, pool or tub. Don't apply lotion/ointment on the incision, including hair styling products.
- You may hear strange noises (popping, crackling, ringing) inside your head. This is normal healing as air and fluid reabsorb.
- Don't color your hair for 6 weeks. If you cut your hair, use caution near the incision.

Medications

- Headaches are common after surgery. You may take acetaminophen (Tylenol).
- Take pain medicines as directed by your surgeon. Reduce the amount and frequency as your pain subsides. If you don't need the pain medicine, don't take it.
- Narcotics can cause constipation. Drink lots of water and eat high-fiber foods. Stool softeners and laxatives can help move the bowels. Colace, Senokot, Dulcolax and Miralax are over-the-counter options.
- Anti-seizure medicine may be prescribed. Some patients develop side effects such as drowsiness, balance problems, or rashes. Call the office if any of these occur.
- Don't take anti-inflammatory pain relievers (Advil, Aleve), blood thinners, or supplements without surgeon's approval.

Activity

- Get up and walk 5-10 minutes every 3-4 hours. Gradually increase walking as you are able.
- Swelling and bruising of the eye or face may

occur. It will take several weeks to go away.

- Sleep with your head elevated and apply ice 3-4 times per day for 15-20 minutes to help reduce pain and swelling.

When to Call Your Doctor

- Fever over 101.5° (unrelieved by Tylenol).
- Signs of incision infection, such as spreading redness, separation, or colored drainage.
- Increased drowsiness, weakness of arms / legs, increased headaches, vomiting, or severe neck pain that prevents lowering your chin to chest.
- New or worsening vision, speech or confusion.
- Swelling at the incision with leaking of clear fluid from your ear or nose.
- Swelling and tenderness in the calf of one leg.
- Seizure

Recovery

A follow-up appointment is made 10 to 14 days after surgery. The recovery time varies from 1 to 4 weeks depending on the underlying disease being treated and your general health. Full recovery may take up to 8 weeks. Walking is a good way to begin increasing your activity level. Do not overextend yourself, especially if you are continuing treatment with radiation or chemotherapy. Ask your surgeon when you can expect to return to work.

What are the risks?

No surgery is without risks. General complications of any surgery include bleeding, infection, blood clots, and reactions to anesthesia. Specific complications related to a craniotomy may include stroke, seizures, swelling of the brain, nerve damage, and cerebrospinal fluid leak.

What are the results?

The results of your craniotomy depend on the underlying condition being treated.

Sources & links

If you have questions, please contact Semmes Murphey at 901-522-7700.

Glossary

cerebrospinal fluid (CSF): a clear fluid produced by the choroid plexus in the ventricles of the brain that bathes the brain and spinal cord giving them support and buoyancy to protect from injury.

seizure: uncontrollable convulsion, spasm, or series of jerking movements of the face, trunk, arms, or legs.

stroke: an interruption of the blood supply to the brain; may cause loss of ability to speak or to move parts of the body.



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