

CRANIOTOMY

A guide for patients

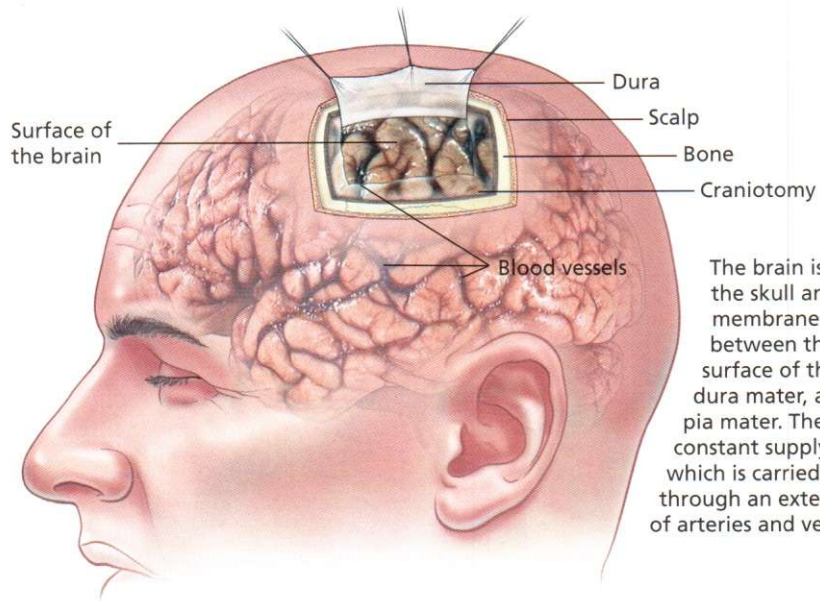
A craniotomy is an operation to temporarily open part of the skull in order to expose the brain for surgery. Craniotomy may be the first line of treatment for some conditions and injuries affecting the brain.

Advances over the past 20 years have made craniotomy safer, simpler and increasingly successful.

Neurosurgeons are now able to operate in areas of the brain that were once thought impossible to reach.

Craniotomy is performed as a part of the surgical treatment of many different conditions. These include:

- a growth or tumour within the brain or from the membranes that surround the brain. The brain fits so precisely inside the skull that an abnormal growth that takes up space can raise intracranial pressure. This often manifests as headache. Rarely, an increase in intracranial pressure may reduce blood flow in crucial parts of the brain and can be life threatening.
- a blood clot (haematoma) pressing on the brain. This may result from a head injury. The clot can develop between the dura membrane that lines the inside of the skull and the brain (a subdural haematoma) or between the skull and the dura (an extradural haematoma).
- a weakness in the wall of an artery (cerebral aneurysm). An aneurysm is formed when the weak spot bulges like a bubble. In some patients, the aneurysm may enlarge over time, increasing the risk that it may rupture and cause major bleeding into and around the brain. Many aneurysms can now be treated with endovascular techniques performed through the leg. In some cases, a neurosurgeon may place a permanent titanium clip across the neck of the aneurysm to seal it from the normal



The brain is protected by the skull and three membranes (meninges) between the skull and the surface of the brain: the dura mater, arachnoid and pia mater. The brain needs a constant supply of oxygen, which is carried in the blood through an extensive network of arteries and veins.

artery. An untreated aneurysm may eventually burst and cause life-threatening bleeding into the brain.

- an infection or abscess that needs to be drained.
- epilepsy, when not controlled by medication, can occasionally be treated by removing the site (within the brain) that is causing seizures.
- Certain pain syndromes, such as trigeminal neuralgia, may be treated by decompressing a nerve being compressed by an artery
- a swelling of the brain (oedema) due to inflammation, which may be caused by a range of diseases
- a fractured skull caused by acute trauma
- a foreign object that has penetrated the brain.

In size, craniotomies can vary widely from a few millimetres (keyhole or burr-hole craniotomy) to several centimetres in width, depending on the problem and the treatment needed.

Talk to your Neurosurgeon

This pamphlet provides general information. It is not a substitute for advice from your neurosurgeon. Read this pamphlet carefully, and save it for reference. Some terms may require further explanation. Write down questions you want to ask. Your neurosurgeon will be pleased to answer them.

Although patients should be as informed as possible about the surgery, every aspect cannot be covered in this pamphlet. Every case is different. Discuss all aspects of your surgery with your neurosurgeon, including:

- the diagnosis
- whether all non-surgical treatment options have been considered
- risks, benefits and limitations of surgery
- the chances of success and failure
- the patient care needed around the time of surgery and any restrictions (such as driving) over the coming weeks
- The expected range of outcomes in the short term and long term.

Your neurosurgeon cannot guarantee that surgery will meet all your expectations or that surgery has no risk. If you are uncertain, you may wish to seek the opinion of another specialist. This pamphlet should be used only in consultation with your neurosurgeon.

Consent form: If you decide to have treatment, your neurosurgeon will ask you to sign a consent form. Read it carefully. If you have questions, ask your neurosurgeon.

IMPORTANT: FILL IN ALL DETAILS ON THE STICKER BELOW

DEAR SURGEON: When you discuss this pamphlet with your patient, remove this sticker and put it on the patient's medical history or card. This will remind you and your patient that this pamphlet has been provided. Some surgeons ask their patients to sign the sticker to confirm receipt of the pamphlet.

TREATMENT INFORMATION PAMPHLET

PROCEDURE: _____

PATIENT'S NAME: _____

DOCTOR'S NAME: _____

EDITION NUMBER: _____ **DATE:** DD / MM / YYYY

Your Neurosurgeon

A special metal frame is often used to hold the head steady during the operation. Usually, only a small section of the scalp is shaved. The surgeon makes an incision through the scalp, over the affected area of the brain, to the skull.

The size, shape and exact location of the incision can vary greatly, depending on the underlying problem and results of scans and other investigations.

One example of a craniotomy is shown in Figures 1 to 4.

The surgeon uses a surgical drill to make a series of small burr holes in the

skull. A special bone-cutting instrument is used to cut from one burr hole to the next, creating a bone flap (Figure 2). The bone flap is removed and kept in a sterile environment during the operation.

The membranes covering the brain are opened, and the area of the brain to be treated is exposed. Surgical instruments are used to operate on the particular condition, disease or trauma.

An operating microscope is used so the surgeon can see the fine structures. Often a “neuro-navigation” device is used to allow for more accurate localisation of the struc-

tures and abnormalities of the brain. For many conditions (such as aneurysms), the surgery is on the surface of the brain rather than deeper within the brain.

At the end of the procedure, the dura mater is sutured closed. The bone flap is usually replaced (Figure 3) and secured with small metal plates and screws. If a section of skull has been drilled away, then acrylic bone cement is needed to restore a skull defect. Repairing a skull defect is known as cranioplasty.

Finally, the scalp incision is closed with sutures or surgical staples (Figure 4).

The size, shape and location of the scalp incision depend on the diagnosis and location of the intracranial problem. The surgeon will attempt to keep the scalp incision above the hairline, but an incision may sometimes extend into the facial area and may be visible.

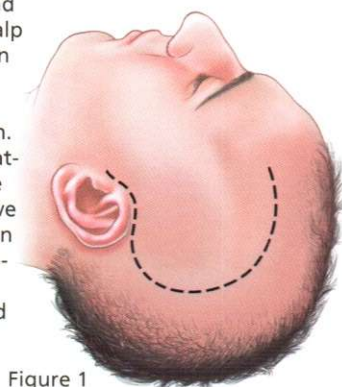


Figure 1

The bone flap is removed, and the brain is exposed for surgery.

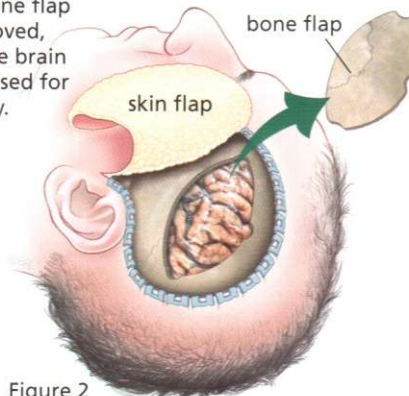


Figure 2

The bone flap is usually replaced after the surgery.

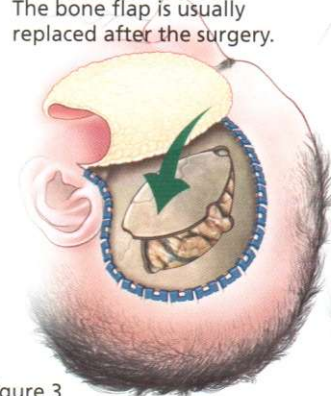


Figure 3

DIAGNOSTIC IMAGING

Advanced imaging techniques and improved computer technology have led to more accurate diagnosis, exact locating of the problem, and precision surgery. The diagnostic imaging tests most commonly used prior to neurosurgery are:

- computed tomography (CT), a non-invasive technique that provides images or “slices” of body organs by scanning them with X-rays. A computer is used to construct cross-sectional scans.
- magnetic resonance imaging (MRI), a non-invasive, non-X-ray technique that produces detailed, two-dimensional images or “slices” of body organs, particularly the brain and spinal cord. With some MRI scans, a three-dimensional image can be produced.
- angiography, which provides images of normal and abnormal blood vessels after arterial injection of a dye that is opaque to X-rays. Modern CT and MRI scans can produce high-quality angiograms, with or without injections of radio-opaque dye.
- standard X-ray examination, which produces X-ray films.

Less commonly, ultrasound studies may be used. Your neurosurgeon or radiologist can explain which diagnostic tests are needed in your case.

IMAGE GUIDANCE

Prior to surgery, it can be helpful to have a further MRI or CT scan to allow neuro-navigation or computer-guided localisation during the operation. This may involve placing small adhesive dots on the scalp followed by a brief scan. Images are then transferred to the operating room to assist the surgeon.

YOUR MEDICAL HISTORY

Your neurosurgeon needs to know your complete medical history to plan the best treatment. Tell your neurosurgeon about any health problems you might have, including:

- any allergy or bad reaction to antibiotics, anaesthetic drugs or other medicines, surgical tapes or dressings
- recent or long-term illness, including infections, and any previous surgery
- prolonged bleeding, excessive bruising when injured, or a family history of excessive bleeding
- previous problems with blood clots in the legs or lungs
- any personal or family history of deep vein thrombosis (DVT)
- thick, raised scarring or poor healing of scars after previous surgery.

Give the neurosurgeon a list of ALL



A cross-sectional image of the brain and head produced by magnetic resonance imaging (MRI). MRI provides precise, detailed images of the anatomy of the brain and head.

medicines you are taking or have recently been taking, such as:

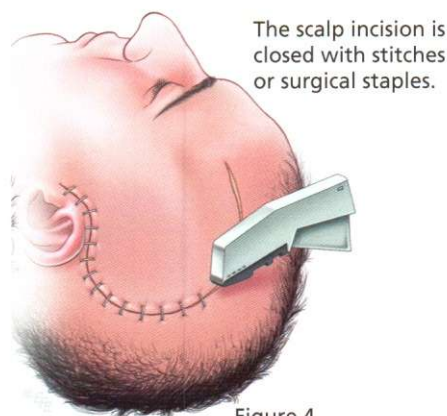
- medicines prescribed by your family doctor
- those bought “over the counter” without prescription, including “natural” medicines
- blood thinners, aspirin (including that contained in cough syrups), arthritis medication, insulin and anti-inflammatory medicines.

Some drugs and vitamins are blood thinners and can increase the risk of excessive bleeding during and after surgery. Your neurosurgeon will advise you whether doses of these medications should be altered,

Procedures

Depending on the type of procedure, the operation may take from two to five hours, and sometimes longer. In some cases, for example, if the patient has brain swelling, the bone flap is removed and not replaced during the initial operation. This allows decompression of the brain and lowers intracranial pressure. The removed bone is stored in a freezer and replaced in a second operation.

Prior to surgery, some patients may have a lumbar drain placed in the spinal canal of the lower back to remove a few millilitres of cerebrospinal fluid.



The scalp incision is closed with stitches or surgical staples.

Figure 4

Skull-base surgery and craniotomy

The bottom of the brain rests upon the skull base. This is where many delicate cranial nerves, arteries and veins enter and exit the skull. To remove some types of tumours, the surgeon must access the skull base and perform a craniotomy as close as possible to the site of the tumour.

The tumour is approached from the underside of the brain or from the side by opening the bone of the skull base and exposing the tumour. In some cases, the approach may occur through the nose.

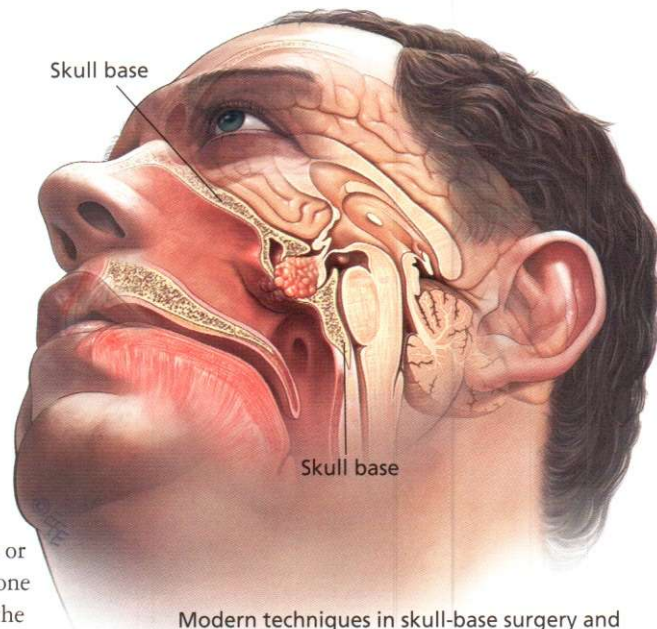
Although anatomically complex and usually requiring the use of computers to plan the craniotomy, skull-base surgery has advanced greatly in recent years, and the risks are more acceptable.

Small craniotomy for minimally invasive surgery

A small craniotomy only a few millimetres wide is called a burr hole or a keyhole craniotomy. Such craniotomies are important for minimally invasive surgery used to:

Modern techniques in skull-base surgery and craniotomy can expose tumours close to the skull base that previously were too difficult to reach.

- treat some cases of small tumours and small aneurysms
- drain blood and remove a blood clot
- affix a temporary intracranial pressure monitor
- remove a small sample of tissue for pathology testing (biopsy)
- insert a shunt (thin plastic tube) to drain cerebrospinal fluid and treat hydrocephalus.



stopped or remain unchanged. Many patients are advised to stop taking all non-steroidal anti-inflammatory medicines (such as ibuprofen), aspirin, aspirin-containing medicines, and prescription blood thinners such as clopidogrel and warfarin, among others.

However, some patients may be advised differently, depending on the procedure and health issues. Discuss this carefully with your surgeon.

Smoking: Patients who smoke must stop for at least three weeks before surgery, and three weeks after surgery. Smokers have increased risks of infections, heart and lung complications, deep venous thrombosis (DVT), and delayed or incomplete healing. It is best to quit.

ANAESTHESIA

While modern anaesthesia is safe and complication rates are low, it does have risks.

Craniotomy is usually performed under general anaesthesia. In some patients, a local anaesthetic and sedation may be used. With "awake craniotomy", the patient needs to be fully conscious, cooperative and capable of answering questions asked by the surgeon.

Inform your anaesthetist about any heart disease, respiratory disease, diabetes or other medical condition. Routine blood

tests may be taken to detect problems that could complicate surgery or anaesthesia. Chest X-ray examinations and electrocardiogram (ECG) tests may be ordered to assess your suitability for general anaesthesia. Your anaesthetist can provide more information.

RECOVERY AFTER SURGERY

You will wake up in the recovery area where nursing staff monitor your progress and regularly check your blood pressure, pulse, temperature and well-being. Some patients may be in the intensive care unit.

You will have a soft dressing on the wound and possibly a tube from the scalp incision to drain any excess blood or fluid from the incision area. The drain tube is removed after one or two days.

Some discomfort and pain around the incision is normal, and you may have a headache. Your neurosurgeon will prescribe pain-relieving medication. Depending on the surgery, other medications may be prescribed. These may include medications to control swelling of the brain and to prevent seizures.

You may have some swelling and bruising around the face and eyes. This usually starts to settle in a week or so.

Intracranial pressure and heart rate may be measured with special monitors. In some

cases, a ventilator to assist breathing may be needed. A urinary catheter may be placed to help empty the bladder.

The dressing is checked regularly and usually removed in one or two days. The incision line may be left uncovered or covered with a small dressing.

When you are ready, nursing staff will help you to sit up, stand and walk, which is usually fairly soon after surgery. Gradually, you will stay up for longer periods and be able to move around more. Walking helps to improve recovery and reduce the risk of a blood clot (DVT) in a deep vein of a thigh or leg.

While most patients stay in hospital for one to two weeks, many go home in a few days. With some complex cases, patients may be in hospital for several weeks.

RECOVERY AND CARE AT HOME

Depending on the procedure, you may need to rest at home for several weeks, you should discuss this with your neurosurgeon. It is common to feel tired for up to six weeks after surgery. Rest when tired. Do not do too much. It may help to have naps during the day. Minimise all lifting, and lift nothing heavy. Consider asking family or friends to help with childcare and everyday chores for one or two weeks.

The incision must be kept clean and dry. Wear a shower cap when showering or having a bath. The sutures or staples in the scalp are usually removed in about five to 10 days. After the sutures are removed, you can gently wash your hair with a mild shampoo. Do not put any lotions or creams on this area, unless instructed to do so by your surgeon.

If the incision is covered with a dressing, change it regularly. Once the dressing is removed, a clean hat, scarf or head covering can be worn until hair grows back.

The bone is usually fixed solidly at the time of surgery and will take six months to one year to fuse. The scar on the scalp should fade to a pale thin line, usually within six months.

If your doctor has prescribed medica-

tions, take these strictly as directed. Do not take any "over the counter" medications without checking with your doctor.

You will be given specific instructions concerning your return to work and normal activities. You may be able to return to light duties after about six weeks. Avoid contact sports for at least one year. You may be able to resume some gentle non-contact sport after about three months.

Walking is a good form of exercise and hastens recovery by increasing your strength. Start by walking short distances, and gradually increase the distance you walk each day.

Eat a well-balanced, nutritious diet. Consult your doctor about drinking alcohol as it may interfere with a medication.

In some patients, physiotherapy, occupational therapy or speech therapy may be needed to aid recovery. Your surgeon will follow your recovery closely and will advise you about follow-up visits. You may have a further CT or MRI scan to check healing.

Driving: Your surgeon can provide guidance regarding restrictions on driving after surgery. This is for medical and legal reasons. Generally, you will not be able to drive for a minimum of three to six months, and in some cases longer.

It is your responsibility to notify the road traffic authorities of medical restrictions on your driving. Prior to a return to driving, your surgeon may recommend an assessment by an occupational therapist to ensure your driving ability is satisfactory.

Possible Complications of Craniotomy Surgery

All surgical procedures are associated with some risk. Despite the highest standards of surgical practice, complications are possible.

It is not usual for a doctor to dwell at length on every possible side effect or rare but serious complication of any surgical procedure. However, it is important that you have enough information to weigh up the benefits and risks of craniotomy.

Most patients will not have complications, but if you have concerns about possible side effects, discuss them with your surgeon.

This list of possible complications is intended to inform you, not to alarm you. There may be others that are not listed.

General risks of surgery

- A blood clot that develops in a deep vein of a leg (deep vein thrombosis, DVT) may travel to the heart and cause a pulmonary embolism. This is infrequent but can be life threatening and requires immediate treatment.
- Pain and discomfort around incisions.
- Complications related to anaesthesia and the anaesthetic; nausea for one or two days is common.
- Allergic reaction to anaesthetic agents, antiseptic solutions, suture material or dressings.
- Excessive bleeding from the operated site.
- Slow or incomplete healing (most likely to occur in smokers and people with diabetes).
- A keloid scar or hypertrophic scar. Most scars fade and flatten, but some become keloid or hypertrophic, and remain raised, itchy, thick and red. A keloid or hypertrophic scar can be annoying but is not a threat to health. Additional surgery or

chemical treatment may be needed to try to improve the scar.

- Although unlikely, a serious complication or death is possible, even with fairly minor procedures.

Specific risks of craniotomy

- A blood clot may form near or at the operation site between the skull and the skin, causing pain, swelling and inflammation. A second operation may be needed to remove the clot.
- Bleeding inside the skull after surgery. A second craniotomy may be required.
- Infection involving the bone flap. This may lead to the bone flap being removed and replaced with a plastic or special metallic material at a later date. Infection of the meninges or brain may develop, requiring long-term antibiotic treatment and possibly a second operation.
- Excess fluid may accumulate within the skull and require drainage with a shunt.
- Uncommonly, the temporalis muscle (at the side of the head) may become weak, sometimes permanently. This could affect your bite and may result in some asymmetry of the face.
- Brain damage may occur during the procedure or later, as a result of swelling. This may cause temporary worsening of neurological symptoms or permanent impairment.
- The risk of developing epileptic seizures is small. Medication is sometimes prescribed to prevent this.
- There may be a slight hollow in the skull where the bone flap was removed. This does not pose a risk to health.
- Headache may persist for about two weeks, sometimes longer.
- The skin around the scalp incision may feel numb for some months.

- Infrequently, serious complications such as muscle weakness, paralysis or visual impairment may occur.
- A serious complication can prevent the patient from returning to work or driving.

REPORT TO YOUR NEUROSURGEON

Contact your neurosurgeon at once if you have any of these signs or symptoms after surgery:

- temperature higher than 38°C or chills
- redness, increasing pain, tenderness or discharge of fluid at the incision
- severe headache
- increased sleepiness
- fainting spells or seizures
- vision problems
- persistent or increasing pain or numbness in your arms or legs
- problems with walking or balance
- ongoing nausea or vomiting
- any questions or concerns about your surgery or your condition.

Go immediately to the nearest hospital emergency department if you have sudden shortness of breath, which may or may not be accompanied by chest pain, and call your surgeon.

COSTS OF TREATMENT

Ask your surgeon about coverage by public health insurance, private health insurance and out-of-pocket costs. You may want to ask for an estimate that lists the likely costs. This includes costs for tests, examinations, surgical, anaesthetic and hospital fees, medications and other matters relating to diagnosis and treatments. If further treatment is needed, extra costs are likely to apply.

Ask which costs can be claimed on health insurance. As the cost of actual treatment may differ from the proposed treatment, the final account may vary from the estimate. It is better to discuss costs before treatment rather than afterwards.