ROYAL AUSTRALASIAN COLLEGE OF SURGEONS

Neurosurgical Society of Australasia

Craniotomy

A guide for patients

Talk to your Neurosurgeon

The aim of this pamphlet is to provide you with general information about craniotomy. It is not a substitute for advice from your neurosurgeon and does not contain all the known facts about craniotomy. Read this entire pamphlet carefully and save it for future reference. Some technical terms may require further explanation by your neurosurgeon. Write down questions you want to ask. Your neurosurgeon will be pleased to answer them.

While the risk of a major complication is low, complications are possible (see page four). Although patients should be as informed as possible about the surgical treatment, every aspect cannot be covered in this pamphlet. Every case is different, and for this reason, patients are advised to seek a full explanation from their neurosurgeon.

Discuss all aspects of your surgery, including:

- the diagnosis
- whether all non-surgical treatment options have been considered
- risks, complications and limitations of surgery, and
- the chances of success and failure.

Your neurosurgeon cannot guarantee that surgery will meet all your expectations or that surgery has no risk. If you are uncertain, you are encouraged to seek the opinion of another specialist. This pamphlet should only be used 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 any questions, ask your neurosurgeon.

Your Surgeon

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.

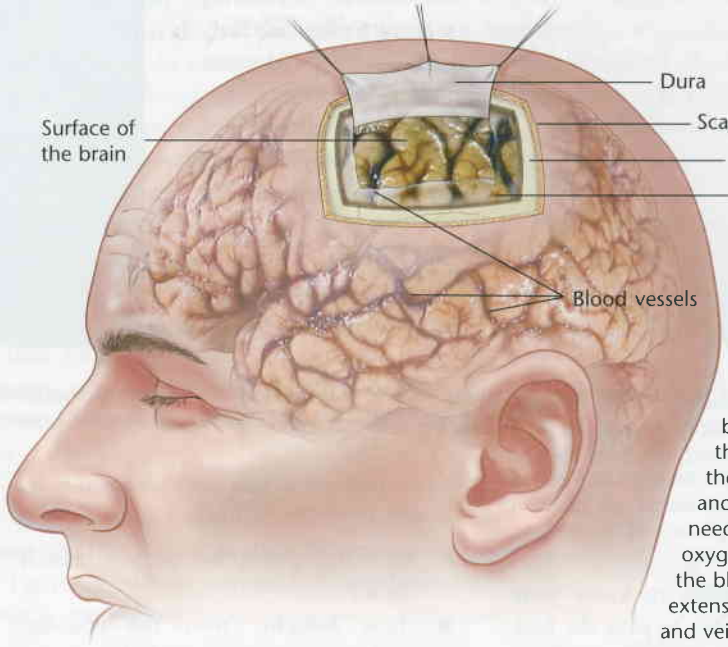
Treatment Information Pamphlet

PROCEDURE:.....

PATIENT'S NAME:.....

DOCTOR'S NAME:.....

EDITION NUMBER:.....DATE: (day).....(month).....(year).....



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.

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

The thought of brain surgery can be very upsetting, but advances over the past 20 years have made surgery safer, simpler and increasingly successful.

Neurosurgeons are now able to operate in areas of the brain that were once thought impossible to reach. Also, the need to reoperate in some patients has been greatly reduced.

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

- a growth within the brain or from the membranes that surround the brain. The brain fits so snugly inside the skull that an abnormal growth that takes up space can raise intracranial pressure. 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 a weak spot bulges like a bubble. Over time, the aneurysm gets bigger. It may press on crucial areas of the brain. More often, it is first discovered when it ruptures, causing major bleeding into and around the brain. Neurosurgeons place a permanent titanium clip across the neck of the aneurysm to seal it from the normal artery. An untreated aneurysm may eventually burst and cause life-threatening bleeding into the brain.
- an infection or abscess that needs to be drained.
- a fractured skull caused by injury.

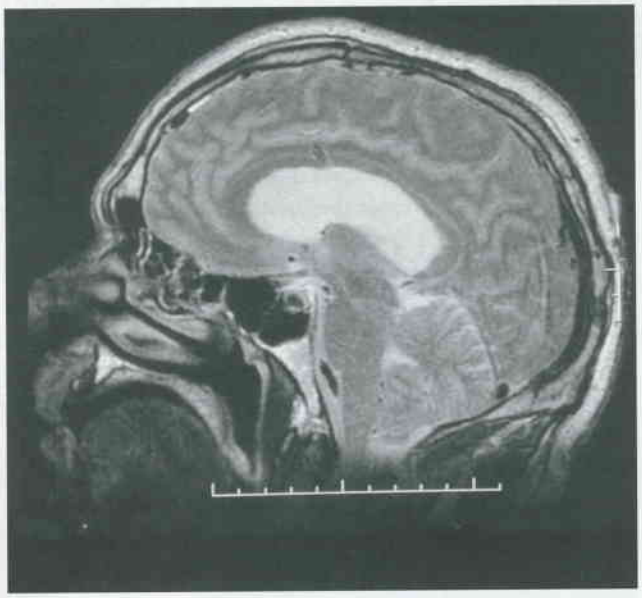
Diagnostic imaging

Advanced imaging techniques and improved computer technology have led to more accurate diagnosis, exact localisation 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 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.

Rarely, ultrasound studies may be used. Ultrasound is often useful in diagnosing the spasm of cerebral arteries that can be associated with some conditions.

Your neurosurgeon or radiologist can explain which diagnostic tests are needed in your case.



A cross-sectional image of the brain and head produced by magnetic resonance imaging (MRI).

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 (keloid) or poor healing of scars after previous surgery.

Give the neurosurgeon a list of ALL 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 can increase the risk of excessive bleeding during and after surgery. Your neurosurgeon will advise you.

Smoking: Patients who smoke must stop for at least three weeks before surgery, and three weeks after surgery. It is best to quit completely, because smoking interferes with healing, recovery and good health.

Anaesthesia

Craniotomy is usually performed under general anaesthesia. In some patients, a local anaesthetic and sedation may be used. Modern anaesthesia is safe, and complication rates are low, but it does have some risks.

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 electrocardiograph (ECG) tests may be ordered to assess your suitability for general anaesthesia. Your anaesthetist can provide more information.

Image guidance

Prior to surgery, it can be very 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 aid the surgeon.

Interpreter

If you have trouble reading English, telephone the translating and interpreting service. ***Australia:*** Translating and Interpreting Service (T.I.S.) 13 14 50 (national number). ***New Zealand:*** Interpreting and Translation Services 09 276 0014 (Auckland).

ITALIAN
Se avete difficoltà nel leggere in inglese, telefonate al servizio interpreti e traduttori. Australia:13 14 50 Nuova Zelanda: 09 276 0014

GREEK
Αν δυσκολεύεστε να διαβάσετε αγγλικά, τηλεφωνήστε στην υπηρεσία διερμηνέων μεταφραστών. Αυστραλία: 13 14 50 Νέα Ζηλανδία: 09 276 0014

MAORI
Mehe rarurarau ana koe ki te riiti i nga korero-pukapuka i roto i te reo Paakeha, me waea atu koe ki te tari kai whakamaori i nga kupu korero pukapuka me te reo, Te naama hei waea - tangaatu mou i Ahitreiria (Australia) ko: 13 14 50. Te naama waea i Aotearoa (New Zealand) ko: 09 276 0014.

SAMOAN
Afai e faaletonu lau faitau i le Gagana Peretania, telefoni le tautua faaliliu ma faamatala upu. Ausetalia 13 14 50 Niu Sila 09 276 0014

TONGAN
Kapau 'oku 'ikai ke mahino ho'o lau he lea fakapapalangi, telefoni ki he kautaha liliulea mo fakatonulea. 'Aositelelia: 13 14 50 Nu'usila: 09 276 0014

CHINESE
如果您閱讀英語有困難，請致電口筆譯服務處。澳大利亞： 13 14 50 新西蘭： 09 276 0014

TURKISH
İngilizce okumakta zorluk çekiyorsanız, tercümanlık servisini arayınız. Avustralya: 13 14 50 Yeni Zelanda: 09 276 0014

ARABIC
إذا وجدتم صعوبة في قراءة الإنجليزية اتصلوا بخدمة الترجمة الخطية والشفوية على الرقم 13 14 50 في أستراليا و 09 276 0014 في نيوزيلاندا

VIETNAMESE
Nếu quý vị gặp khó khăn khi đọc tiếng Anh, điện thoại cho dịch vụ thông ngôn và phiên dịch. Tại Úc: 13 14 50 tại Tân tây lan: 09 276 0014.

The Surgical Procedure

Usually, a section of the scalp is shaved. A special "stereotactic" metal frame is often used to hold the head steady during the operation. The surgeon makes an incision through the scalp, over the affected area of the brain, to the skull bone. 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 incision is shown in these illustrations. As shown in the bottom-left illustration, the skin is folded back. Leaving one side attached maintains the blood flow, to aid healing when the skin incision is closed.

The surgeon uses a surgical drill to make a series of small burr holes in the skull. A safety system stops the drill automatically when the bone is drilled through. A special bone-cutting instrument is used to cut from one burr hole to the next, creating a bone flap. The bone flap is removed and kept in a sterile environment during the operation.

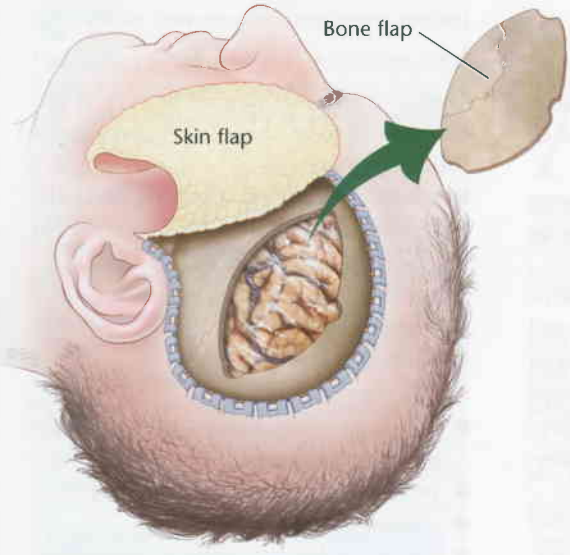
The membranes covering the brain (the outer, thick dura mater and the inner, thin arachnoid and pia mater) are opened, and the area of the brain to be operated on is exposed. Specialised surgical instruments are used to operate on the particular condition, disease or trauma.

An operating microscope is used to better enable the surgeon to see the fine structures. Often a "neuro-navigation" device is used to allow for more accurate localisation of the structures and abnormalities of the brain. For many conditions (for example, aneurysms), the surgery is on the surface of the brain rather than within the brain.

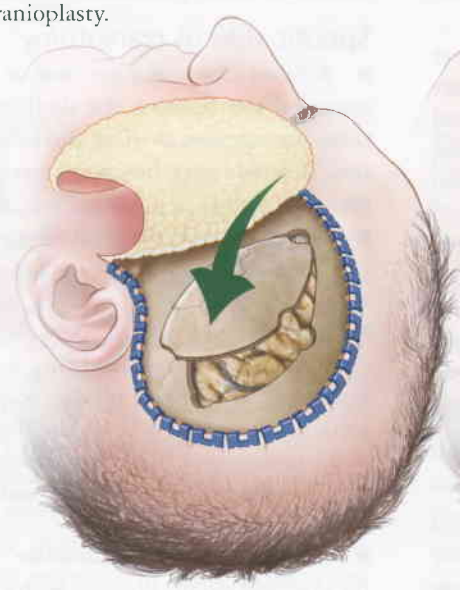
At the end of the procedure, the dura mater is sutured closed. The bone flap is (usually) replaced and secured with small metal plates and screws. Finally, the scalp incision is closed with sutures or surgical staples.

Depending on the type of procedure, the operation may take from two to five hours, and sometimes longer. In some cases, for example if there is brain swelling, the bone flap is removed and not replaced during the initial operation. This is done to allow decompression of the brain and lower the intracranial pressure. The removed bone is stored in a deep freeze. The bone is replaced in a second operation known as cranioplasty.

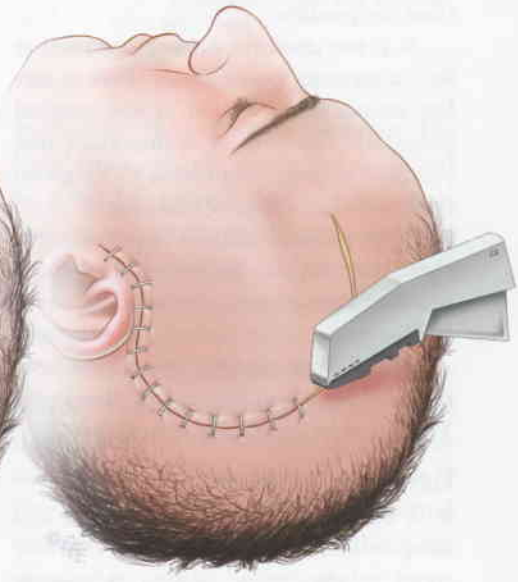
The size, shape and location of the scalp incision depend on the diagnosis and location of the intracranial problem. The surgeon will attempt to keep the scalp incision above the hair line, but an incision may sometimes extend into the facial area and may be visible.



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



The bone flap is usually replaced after the surgery.



The scalp incision is closed with stitches or surgical staples.

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 moved to intensive care.

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 your 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 in the urethra to help empty the bladder.

While most patients stay in hospital for one to two weeks, many go home in a few days. 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 blood clots in the deep veins of the thighs and legs. 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.

Recovery and Care at Home

Depending on the procedure, you may need to rest at home for six to 12 weeks. It is common to feel tired for up to six weeks after surgery. Rest when tired, and do not try to do too much. It may help to have naps during the day. Minimise all lifting, and avoid heavy lifting. Consider asking family or friends to help with childcare and everyday chores for one or two weeks.

The sutures or staples in the scalp are usually removed in about five to 10 days. Until then, the incision must be kept clean and dry. Wear a shower cap when showering or having a bath. 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 doctor. If the incision is covered with a dressing, change this regularly. Once the dressing is removed, a clean hat, scarf or head covering can be worn until the hair grows back.

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

If your doctor has prescribed medications, 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. Contact sports should be avoided 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 your 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 alcohol may interfere with your medication. In some cases, physiotherapy, occupational therapy or speech therapy may be needed to aid your recovery. Your doctor 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 progress.

Driving: Your surgeon can provide guidance regarding restrictions on driving after surgery. This is for both medical and legal reasons. Generally, you will not be able to drive for a minimum of six weeks, and in some cases the period may be 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 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 the legs (deep vein thrombosis, DVT) and that may travel to the lungs, causing pulmonary embolism. This complication is infrequent but can be life threatening.
- Pain and discomfort around the incisions.
- Anaesthetic complications; nausea for one or two days is common.
- Excessive bleeding from the operated site.
- Slow healing (most likely to occur in smokers).
- Allergic reaction to anaesthetic agents, antiseptic solutions, suture material or dressings.
- A keloid scar or hypertrophic scar. Most scars fade and flatten, but some may 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 very 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 is serious, and 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 also develop, requiring long-term antibiotics 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.
- 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.
- There is a small risk of developing epileptic seizures. Medication is sometimes prescribed to prevent this.
- There may be a slight hollow in the skull where the bone flap was removed; however, this does not pose any 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
- 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 doctor 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 with your doctor before treatment rather than afterwards.

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