Part 2: Chiari Decompression Surgery
Chiari surgery

A posterior fossa decompression is a surgical procedure performed to remove the bone at the back of the skull and spine. The dura overlying the tonsils is opened and a patch is sewn to expand the space, similar to letting out the waistband on a pair of pants. The goals of surgery are to stop or control the progression of symptoms caused by tonsillar herniation, to relieve compression of the brainstem and spinal cord, and to restore the normal flow of cerebrospinal fluid (CSF). The surgery takes about 2 to 3 hours and recovery in the hospital usually lasts 2 to 4 days.

You may be a candidate for decompression surgery if you have:
- An abnormal collection of CSF in the spinal cord (syrinx)
- A Chiari malformation obstructing CSF flow (confirmed by cine MRI) and is causing severe or worsening symptoms

What happens before surgery?

During the office visit, the neurosurgeon will explain the procedure, its risks and benefits, and answer any questions. Next, you will sign consent forms and complete paperwork to inform the surgeon about your medical history (i.e., allergies, medicines, vitamins, bleeding history, anesthesia reactions, prior surgeries). Discuss all medications (prescription, over-the-counter, and herbal supplements) that you are taking with your healthcare provider. Some medications will need to be continued or stopped the day of surgery. You will be scheduled for presurgical tests (e.g., a blood test, electrocardiogram, chest X-ray, and CT scan) several days before surgery.

Stop taking all non-steroidal anti-inflammatory medicines (Naprosyn, Advil, Motrin, Nuprin, Aleve) and blood thinners (coumadin, Plavix, aspirin) 1 week before surgery. Stop smoking and chewing tobacco 1 week before and 2 weeks after surgery because these activities can cause bleeding problems. Wash your hair with Hibiclens® (chlorhexidine) antiseptic soap for 3 consecutive days before surgery. No food or drink is permitted past midnight the night before surgery.  

Morning of surgery

- 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, contacts, body piercings, nail polish, etc.
- Leave all valuables and jewelry at home (including wedding bands).
- Bring a list of medications (prescriptions, over-the-counter, and herbal supplements) with dosages and the times of day usually taken.
- Bring a list of allergies to medication or foods.

Arrive at the hospital 2 hours before your scheduled surgery time to complete the necessary paperwork and work-ups. You will meet with a nurse who will ask your name, date of birth, and what procedure you are having. 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. An intravenous (IV) line will be placed in your arm before transport to the operating room.
What happens during surgery?

- **Step 1: prepare the patient**
  You will lie on the operating table and be given anesthesia. Once asleep, your head will be placed in a 3-pin skull-fixation device, which attaches to the table and holds your head in position during surgery. An inch wide strip of hair is shaved along the planned incision. The scalp is prepped with an antiseptic.

- **Step 2: make a skin incision**
  A skin incision is made down the middle through the neck muscles so that the surgeon can see the skull and top of the spine. The skin incision is about 3 inches long (Fig 14). The skin and muscles are lifted off the bone and folded back.

- **Step 3: remove bone**
  The surgeon removes a small section of skull at the back of your head (suboccipital craniectomy). In some cases the bony arch of the C1 vertebra may be removed (laminectomy). These steps expose the protective covering of the brain and spinal cord called the dura (Fig. 15). Bone removal relieves compression of the tonsils.

- **Step 4: open the dura**
  Next, the surgeon opens the dura to view the tonsils and cisterna magna (Fig. 16). Some surgeons perform a Doppler ultrasound study during surgery to determine if opening the dura is necessary. Sometimes bone removal alone may restore normal CSF flow.

- **Step 5: reduce the tonsils (optional)**
  Depending on the size of herniation, the stretched and damaged tonsils may be shrunk with electrocautery. This shrinkage ensures that there is no blockage of CSF flow out of the 4th ventricle.

- **Step 6: attach dura patch**
  A patch of synthetic material or the patient’s pericranium (a piece of deep scalp tissue just outside the skull) is sutured into place (Fig. 17). This patch enlarges the dura opening and the space around the tonsils. The dural patch is sutured in a watertight fashion. The suture line is covered with a dural sealant to prevent CSF leak (Fig. 18).

- **Step 7: close the incision**
  The strong neck muscles and skin are sutured together. A dressing is placed over the incision.
What happens after surgery?

You will wake up in the recovery area called the post-anesthesia care unit (PACU). Your throat may feel sore from the tube inserted to assist your breathing during surgery. Once awake, you’ll be moved to your room. Blood pressure, heart rate, and respiration will be monitored. If you feel nausea or headache after surgery, medication can be given. When your condition stabilizes, you will be discharged in the care of family or a caregiver, usually 1 or 2 days after surgery.

The length of the hospital stay varies but is usually 2 to 3 days. When released from the hospital, you will be given discharge instructions:

Discomfort

1. After surgery, pain is managed with narcotic medication. Because narcotic pain pills are addictive, they are used for a limited period (2 to 4 weeks). Thereafter, pain is managed with acetaminophen (e.g., Tylenol) and nonsteroidal anti-inflammatory drugs (NSAIDs) (e.g., aspirin; ibuprofen, Advil, Motrin, Nuprin; naproxen sodium, Aleve).

2. Regular use of narcotics can cause constipation, so drink lots of water and eat high fiber foods. Stool softeners (e.g., Colace, Docusate) and laxatives (e.g., Dulcolax, Senokot, Milk of Magnesia) may be bought over-the-counter.

3. Ice packs for 20 minutes can help relieve neck and shoulder pain and muscle spasms. Muscle relaxants may be prescribed.

Restrictions

4. Avoid activities that increase pressure in the head:
   • Bending over, with head low
   • Straining and constipation
   • Prolonged coughing (use a cough suppressant)

5. Do not drive after surgery until discussed with your surgeon and avoid sitting for long periods.

6. Do not lift anything heavier than 5 pounds (e.g., gallon of milk), including children.

7. Housework and yard-work are not permitted until the first follow-up office visit. Avoid gardening, mowing, vacuuming and loading / unloading the dishwasher, washer, or dryer.

8. Do not drink alcoholic beverages while on pain medicine.

Activity

9. Gradually return to your normal activities. Fatigue is common.

10. Begin the isometric neck exercises and stretches as instructed.

11. Walking is encouraged: start with short walks and gradually increase the distance. Wait to participate in other exercise until discussed with your surgeon. Avoid getting over heated.

Bathing/Incision Care

12. Shower and wash hair with mild shampoo after surgery unless otherwise directed by your surgeon. No tub baths, hot tubs, or swimming pools.

13. Sutures or staples, if used, will need to be removed 7 to 14 days after surgery. Ask your surgeon or call the office to find out when.

When to Call Your Doctor

14. Fluid may accumulate under the skin around the incision. A visible swelling that is soft and squishy may be a sign of cerebrospinal fluid (CSF) leakage. A clear sticky fluid may leak from the incision. Call the surgeon should any drainage occur.

15. If you experience any of the following:
   • A temperature that exceeds 101°F
   • An incision that shows signs of infection, such as redness, swelling, pain, or drainage.
   • Decreased alertness, increased drowsiness, weakness of arms or legs, increased headaches, vomiting, or severe neck pain that prevents lowering your chin toward the chest.
Recovery

Before you leave the hospital, appointments with the neurosurgeon will be scheduled 10 to 14 days after surgery to remove your sutures and check your recovery. Recovery from the actual surgery varies from 4 to 6 weeks, depending on your general health.

After surgery, you can expect some headache and neck pain from the incision that may last several weeks. You will be given isometric neck exercises to do at home. These will help with neck mobility and healing. The exercises can be done while sitting, standing, or lying on your back. Repeat this series at least 4 times a day.

Isometric neck exercises. The key to isometric exercise is to prevent your head from moving. Resist the pressure of your hands and maintain constant tension in your neck muscles. Be sure to breathe. Holding your breath may cause an increase in your blood pressure that may result in becoming dizzy or lightheaded.

- **Side neck muscles.** Place your palm against the right side of your head (temple area). Take a breath. Have your head match the resistance on the right side without bringing your ear towards the shoulder. Breathe out to 10 seconds. Repeat 10 times. Switch sides to work your left side.

- **Front neck muscles.** Place the palms of your hands on the top of your forehead. Take a deep breath in through the nose. Have your forehead match the resistance of your palm. Breathe out slowly through your mouth to the count of 10. Repeat 10 times.

- **Back neck muscles.** Clasp your hands behind the top of your head. Take a breath in. Press the back of your head against your hands and breathe out. Hold this position for 10 seconds and repeat 10 times.

Patients typically return to work in 4 to 6 weeks, but be sure to check with your surgeon. A follow-up cine MRI is planned for 6 months to 1 year.

Recovery from the Chiari syndrome and its symptoms may take months or longer. Returning to "normal" is gradual – time is your best ally. Slowly increase activity, avoid strenuous lifting, adhere to instructions and maintain a positive attitude. Focus on the symptoms that have improved, and have patience with those symptoms that remain. Keep a symptom diary to track your progress over time.
What are the results?

The results of your decompression surgery depend on the severity of the Chiari malformation and the extent of any previous brain and nerve injury before treatment. Eighty five to 95% of patients experience major relief of symptoms [2]. However, patients may continue to have residual symptoms from syringomyelia. If injury in the spinal cord has already become permanent, surgery won’t reverse the damage.

Exertional headache and neck pain respond well to decompressive surgery as do most of the brainstem signs (e.g., swallowing problems, facial pain/numbness, voice changes, tinnitus, eye problems, dizziness). Recovery of sleep problems, memory, and spinal cord signs (e.g., numbness or tingling in hands and feet, muscle weakness) take longer and may not completely return to normal.

![MRI comparison](image)

*Figure 19. MRIs before and 1 year after surgery showing restored CSF flow (blue line) around the tonsils and disappearance of the syrinx (yellow arrow) in the spinal cord.*

Decompression surgery may allow the syrinx to drain on its own. Follow up is needed to monitor CSF flow and the syrinx site. This progress is evaluated at 1 year with cine MRI (Fig. 19). For any residual symptoms, you and your doctor will discuss possible options to determine the best care.

Recurrence of compression or obstruction of CSF flow is rare.
What are the risks?

No surgery is without risks. General complications of any surgery include bleeding, infection, blood clots, stroke, reactions to anesthesia, and death (rare). Specific complications related to a Chiari decompression craniectomy and duraplasty may include:

- Risk of head and neck pain is variable.
- Cerebrospinal fluid (CSF) leakage is the escape of CSF that flows around the brain. This usually takes the form of a squishy pocket of fluid or drainage from the incision. If leakage is suspected, apply a pressure dressing over the incision and contact your surgeon immediately. If the leak continues, surgical repair may be necessary. New closure techniques and use of biologic glue reduces the risk of CSF leak.
- There is a risk of pseudomeningocele, an abnormal collection of cerebrospinal fluid (CSF) under the tissues of the neck. The collection may resolve on its own; however notify your surgeon if this occurs.
- Nerve or brain damage may cause permanent disability.

Q&A: chiari surgery

Q: What about minimally invasive endoscopic Chiari surgery? I've heard that it's better than a standard "open" surgery?

A: Many patients have read online or heard about minimally invasive or endoscopic Chiari surgery. Minimally invasive can mean many different things: smaller skin incision, less neck muscle splitting, no dura opening, no shrinkage of the tonsils, or use of ultrasound and endoscopes. Despite what the words "minimally invasive" suggest, the amount of bone removal necessary to effectively restore normal CSF flow should be the same in any procedure, endoscopic or open. Each patient’s anatomy and size of Chiari is different and only a surgeon with direct knowledge of your case can determine if a minimally invasive technique is appropriate. As with all new techniques, studies comparing the long-term results and risks of minimally invasive surgery with conventional surgery are needed.

It’s also important to understand that some minimally invasive techniques used for children (whose skulls are still growing) may or may not be appropriate for adults.

We perform the least invasive procedure that is effective for the patient’s unique anatomy. We constantly seek to improve the results and lessen the side effects of surgery.

Q: Why do some surgeons remove bone from the vertebra in the neck?

A: The amount of tonsillar herniation is a determining factor to remove the arch of the C1 vertebra (e.g., someone with 4mm herniation versus someone with 20mm herniation). If a person is young or athletic, we always try to avoid disturbing the C1 vertebra. There have been cases where a person can develop craniospinal instability years after their surgery, either by a neck injury or the natural aging process. Some surgeons prefer to shrink the tonsils rather than remove the bone of C1.
Q: Will more of my brain sag out of my head if you remove bone from the skull?
A: No. The bone removal is in the very middle of the skull to allow the tonsils more space. The cerebellar hemispheres are supported by bone along the undersides of the skull. Cases of cerebellar slumping (or cerebellar ptosis) that you may have heard about are rare complications caused by too much bone removal. It’s important to have surgery performed by a Chiari expert to avoid reconstructive surgery.

Q: Does my syrinx cavity need to be drained with a shunt?
A: No. Years ago placing a shunt into the syrinx cavity was common, but long-term results and problems with shunt clogging have made this technique uncommon and used only for special cases. Adequate decompression of the brainstem and fourth ventricle will allow CSF flow and pressure to normalize and should eventually lead to disappearance of the syrinx on its own.

Q: Why do some surgeons open the dura and some do not?
A: Sometimes bone removal alone is enough to relieve the compression and restore CSF flow (especially in children). Surgeons may use ultrasound to test the movement of CSF and determine if opening the dura and sewing a patch (duraplasty) is necessary. However, in adults the dura is less pliable, so a graft is sewn to enlarge the space. The technique is similar to a tailor letting out the waistband on a pair of pants. While avoiding dura opening may decrease the risk of CSF leak, inadequate decompression may increase the risk of a poor result and lead to reoperation.

Q: Is there a difference in dura patch material?
A: Many patch materials are available, ranging from autologous (patient’s own) tissue to a variety of cadaveric and synthetic materials. We prefer to use patch material obtained from the pericranium (tissue overlying the skull) or a synthetic collagen material.

Q: Does Chiari recur after surgery?
A: True anatomical recurrence of Chiari I is rare. There are many reasons why some patients consider their surgery unsuccessful or “failed.” Technical failure of the surgery means obstructed CSF flow at the foramen magnum. Failure of some symptoms to resolve does not always mean failure of the surgical repair. A cine MRI study is used to evaluate CSF flow.

Scarring of tissue, inadequate removal of bone, new neck or head trauma, increased brain pressure, and tethered cord can be causes of recurrence. Surgical complications such as cerebellar slumping or spinal instability can also cause recurrence.

Q: Why do some people have multiple surgeries?
A: At our center, we see many patients with previous surgery (done by other surgeons) who have had an inadequate decompression to restore normal CSF flow. Either the bone removal was too small or the dura was not opened to adequately expand the space. Delayed post-operative scarring may also lead to repeat surgery. Cine flow and MRI studies play a major role in determining the need for reoperation.
Resources

If you have more questions, please contact the Mayfield Chiari Center at 800-325-7787 or 513-221-1100.

Links
American Syringomyelia Alliance Project, www.asap.org
Conquer Chiari, www.conquerchiari.org
Chiari & Syringomyelia Foundation, www.csfinfo.org
Spina Bifida Association, www.spinabifidaassociation.org

Sources