

## Anterior Cervical Discectomy & Fusion

### Overview

Anterior cervical discectomy and fusion (ACDF) is a surgery to remove a herniated or degenerative disc in the neck. An incision is made in the throat area to reach and remove the disc. A graft is inserted to fuse together the bones above and below the disc. ACDF may be an option if physical therapy or medications fail to relieve your neck or arm pain caused by pinched nerves. Patients typically go home the same day.

### What is an anterior cervical discectomy and fusion (ACDF)?

Healthy discs act as a flexible cushion between bones, allowing your neck to bend and rotate. Wear and tear on discs can cause herniation or thinning that pinch the nerves (Fig. 1).

Discectomy literally means "cutting out the disc." A discectomy can be performed anywhere along the spine from the neck (cervical) to the low back (lumbar). The surgeon reaches the damaged disc from the front (anterior) of the spine through the throat area. By moving aside the neck muscles, trachea, and esophagus, the disc and bony vertebrae are exposed. Surgery from the front of the neck is more accessible than from the back (posterior) because the disc can be reached without disturbing the spinal cord, spinal nerves, and the strong neck muscles. Depending on your particular symptoms, one disc (single-level) or more (multi-level) may be removed.

After the disc is removed, the space between the bony vertebrae is empty. To prevent the vertebrae from collapsing and rubbing together, a spacer bone graft is inserted to fill the open disc space. The graft serves as a bridge between the two vertebrae to create a spinal fusion. The bone graft and vertebrae are fixed in place with metal plates and screws. Following surgery, the body begins its natural healing process and new bone cells grow around the graft. After 3 to 6 months, the bone graft should join the two vertebrae and form one solid piece of bone. The instrumentation and fusion work together, similar to reinforced concrete.

After fusion you may notice some range of motion loss, but this varies according to neck mobility before surgery and the number of levels fused. If only one level is fused, you may have similar or

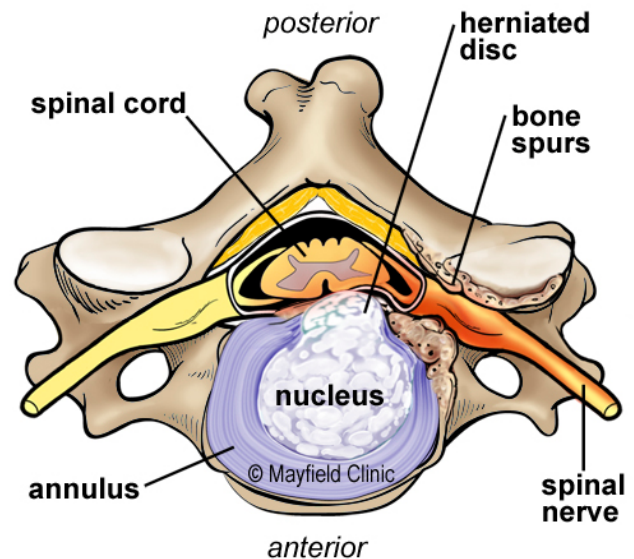


Figure 1. (top view of vertebra) Degenerative disc disease is the thinning and drying of discs. Tears in the disc annulus can allow the nucleus material to escape and compress the spinal cord causing numbness and weakness. Bone spurs may develop which can lead to a narrowing of the nerve root canal (foraminal stenosis). The pinched spinal nerve becomes swollen and painful.

even better range of motion than before surgery. If more than two levels are fused, you may notice limits in turning your head and looking up or down.

Artificial disc replacement has emerged as an alternative to fusion. Similar to knee replacement, the artificial disc is inserted into the damaged joint space and preserves motion, whereas fusion eliminates motion. Outcomes for artificial disc compared to ACDF are similar, but it is not for those with facet joint arthritis or weak bones. Talk with your surgeon about whether ACDF or artificial disc replacement is appropriate for you.

### Who is a candidate?

You may be a candidate for discectomy if you have:

- a herniated or degenerative disc
- significant weakness in your hand or arm
- arm pain that is worse than neck pain
- symptoms that have not improved with physical therapy or medication

ACDF may be helpful in treating:

- **Herniated disc:** the rubbery center of the disc can bulge or rupture through a weak area in the wall (annulus). Pain and swelling occurs when this material presses on a nerve.
- **Degenerative disc disease:** the drying and shrinkage of discs with age. As the disc thins, the vertebrae bones rub and pinch the nerves. These changes can lead to canal stenosis, bone spurs, or disc herniation (Fig. 1).
- **Cervical stenosis / myelopathy:** narrowing of the canal through which the spinal cord passes. CSM is caused by bulging discs, enlarged facet joints and thickened ligaments. Pain, weakness of the arms / legs, and walking problems arise from spinal cord compression.

### The surgical decision

Most herniated discs heal after a few months of nonsurgical treatment. If you are a candidate for ACDF, the surgeon will explain your options. Consider all the risks and benefits as you make your decision. Fusion is performed only after other treatments have been explored.

Your surgeon will also explain the various types of bone graft. These materials are placed within the remaining disc space and act as a kind of mortar between the bones as your body heals. Each type has advantages and disadvantages, especially if you smoke or have poor bone health (osteoporosis).

- **Autograft** is your living bone. The marrow contains bone-growing proteins. It can be collected from drillings during the surgery or taken from the hip as an iliac crest bone graft. The harvested bone is about a half inch thick. This graft has a higher rate of fusion. The disadvantage is the pain in your hipbone.
- **BMA** (bone marrow aspirate) is your living bone marrow, collected with a syringe from the hip (iliac bone) or vertebra. It is relatively painless compared to an iliac crest graft.
- **Allograft** is bone from an organ donor, collected and stored by a bone-bank. The donor graft has no bone-growing cells or proteins. Allograft is packed with shavings of living bone tissue taken from your spine during surgery.
- **Cellular bone matrix** is allograft from an organ donor that contains bone-growing stem cells. The putty is shaped and added to grafts.
- **BMP** (bone morphogenetic protein) is sometimes added to bone-graft material to stimulate bone growth naturally in the body.

### Who performs the procedure?

A neurosurgeon or an orthopedic surgeon can perform spine surgery. Many spine surgeons have specialized training in complex spine surgery. Ask your surgeon about their training, especially if your case is complex or you've had more than one spinal surgery.

### What happens before surgery?

In the office, you will sign consent and other forms so that the surgeon knows your medical history (allergies, medicines/vitamins, bleeding history, anesthesia reactions, previous surgeries). Discuss all medications (prescription, over-the-counter, and herbal supplements) you are taking with your health care provider. 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.

You may be asked to wash your skin 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.)

### Stop smoking

The most important thing you can do to ensure a successful spine surgery is quit using tobacco. This includes cigarettes, vaping, cigars, pipes, chew, and snuff/dip. Nicotine prevents bone growth and decreases successful fusion. Smoking risk is serious: fusion fails in 40% of smokers compared with 8% of non-smokers [1]. Smoking also decreases blood circulation, resulting in slower wound healing and an increased risk of infection. Talk with your doctor about ways to help you quit: nicotine replacements, medications (Chantix or Zyban), and counseling programs.

### Morning of surgery

- Don't eat or drink after midnight before surgery (unless the hospital tells you otherwise). You may take permitted medicines with a small sip of water.
- Shower using antibacterial soap. Dress in freshly washed, loose-fitting clothing.
- Wear flat-heeled shoes with closed backs.
- Remove make-up, hairpins, contacts, body piercings, nail polish, etc.
- 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.

Arrive at the hospital 2 hours before (surgery center 1 hour before) your scheduled surgery time to complete the necessary paperwork and pre-procedure work-ups. An anesthesiologist will talk with you and explain the effects of anesthesia and its risks.

## What happens during surgery?

There are seven steps to the procedure. The operation generally takes 1 to 3 hours.

### Step 1: prepare the patient

You will lie on your back on the operative table and be given anesthesia. Once asleep, your neck area is cleansed and prepped. If a fusion is planned and your own bone will be used, the hip area is also prepped to obtain a bone graft. If a donor bone will be used, the hip incision is unnecessary.

### Step 2: make an incision

A 2-inch skin incision is made on the right or left side of your neck (Fig. 2). The surgeon makes a tunnel to the spine by moving aside muscles in your neck and retracting the trachea, esophagus, and arteries. Finally, the muscles that support the front of the spine are lifted and held aside so the surgeon can clearly see the bony vertebrae and discs.

### Step 3: locate the damaged disc

With the aid of a fluoroscope (a special X-ray), the surgeon passes a thin needle into the disc to locate the affected vertebra and disc. The vertebrae bones above and below the damaged disc are spread apart with a special retractor.

### Step 4: remove the disc

The outer wall of the disc is cut (Fig. 3). The surgeon removes about 2/3 of your disc using small grasping tools, and then looks through a surgical microscope to remove the rest of the disc. The ligament that runs behind the vertebrae is removed to reach the spinal canal. Any disc material pressing on the spinal nerves is removed.

### Step 5: decompress the nerve

Bone spurs that press on your nerve root are removed. The foramen, through which the spinal nerve exits, is enlarged with a drill (Fig. 4). This procedure, called a foraminotomy, gives your nerves more room to exit the spinal canal.

### Step 6. prepare a bone graft fusion

Using a drill, the open disc space is prepared on the top and bottom by removing the outer cortical layer of bone to expose the blood-rich cancellous bone inside. This "bed" will hold the bone graft material that you and your surgeon selected:

- **Bone graft from your hip.** A skin and muscle incision is made over the crest of your hipbone. Next, a chisel is used to cut through the hard outer layer (cortical bone) to the inner layer (cancellous bone). The inner layer contains the bone-growing cells and proteins. The bone graft is then shaped and placed into the "bed" between the vertebrae (Fig. 5).



Figure 2. A 2-inch skin incision is made on the side of your neck.

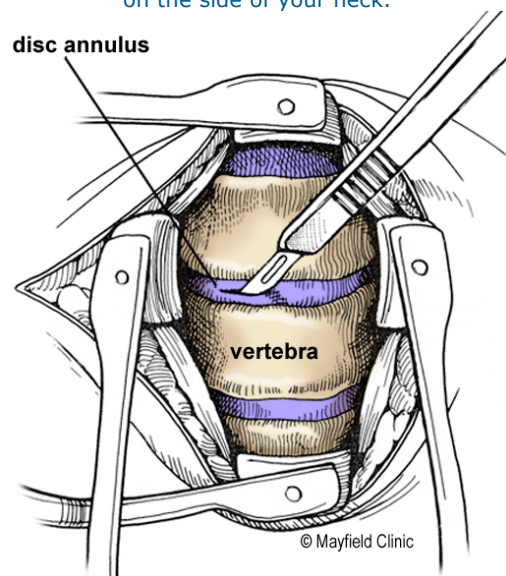


Figure 3. The muscles are retracted to expose the bony vertebra. The disc annulus is cut open and the disc material is removed with grasping tools.

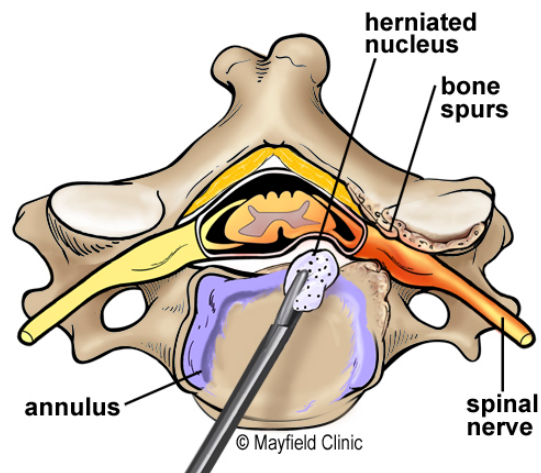


Figure 4. (top view) The disc annulus and nucleus are removed to decompress the spinal nerve. Bone spurs are removed to enlarge the foramen and free the nerve.



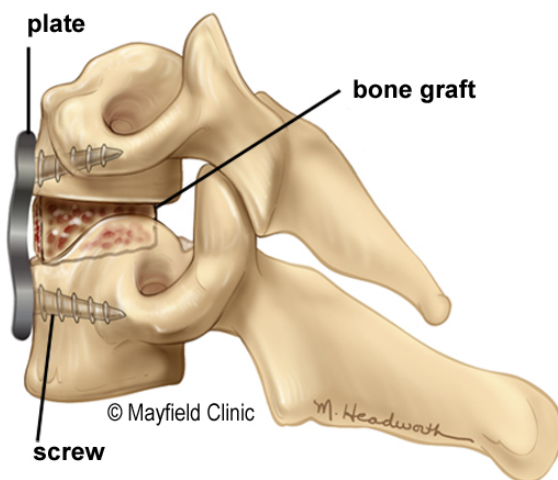
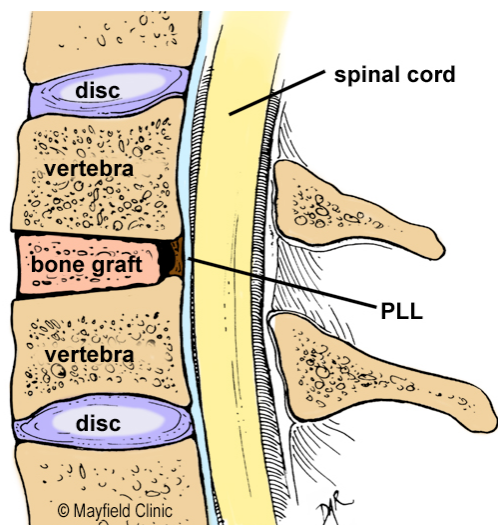


Figure 5. (side view) A bone graft is shaped and inserted into the shelf space between the vertebrae.

- **Bone bank or fusion cage.** A cadaver bone graft or bioplastic cage is filled with the leftover bone shavings containing bone-growing cells and proteins (Fig. 6A). The graft is then tapped into the shelf space.

The bone graft is often reinforced with a metal plate screwed into the vertebrae to provide stability during fusion. An x-ray is taken to verify the position of the graft, plate, and screws (Fig. 6B).

**Alternative option: artificial disc replacement.** Instead of a bone graft or fusion cage, an artificial disc device is inserted into the empty disc space (Fig. 7). In select patients, it may be beneficial to preserve motion.

### Step 7. close the incision

The spreader retractors are removed. The muscle and skin incisions are sutured together. Steri-Strips or biologic glue is placed across the incision.

### What happens after surgery?

You will awaken in the postoperative recovery area. Blood pressure, heart rate, and respiration will be monitored. Any pain will be addressed. Once awake, you can increase your activity level (sitting in a chair, walking). Patients who have had bone graft taken from their hip may feel more discomfort in their hip than neck incision. Most patients having a 1 or 2 level ACDF are sent home the same day. However, if you have difficulty breathing or unstable blood pressure, you may need to stay overnight.

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

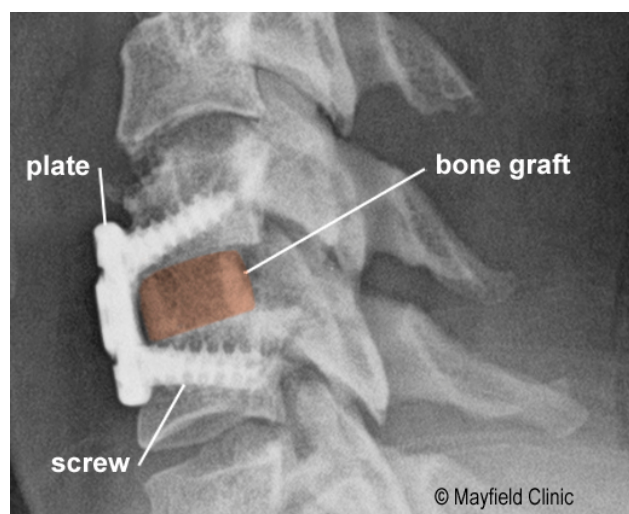


Figure 6. Illustration (A) and x-ray (B) shows a metal plate and four screws used to hold the bone graft between the vertebrae while fusion occurs.

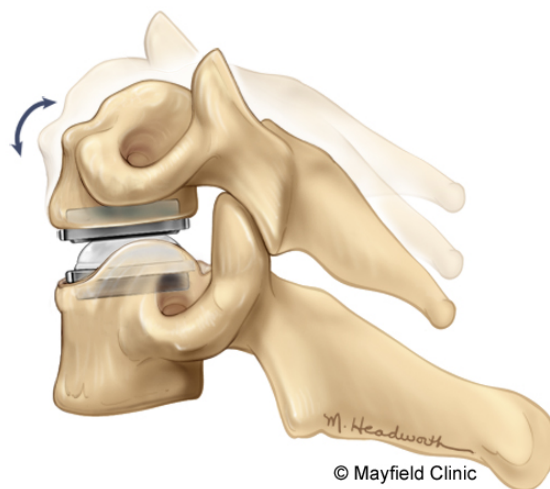


Figure 7. Motion-preserving artificial disc replacement.

## Restrictions

- Avoid bending or twisting your neck.
- Don't lift anything heavier than 5 pounds.
- No strenuous activity including yard work, housework, and sex.
- DON'T SMOKE or use nicotine products: vape, dip, chew. It prevents new bone growth and may cause your fusion to fail.
- Don't drive until after your follow-up visit.
- Don't drink alcohol. It thins the blood and increases the risk of bleeding. Also, don't mix alcohol with pain medicines.

## Incision Care

- If Dermabond skin glue covers your incision, you may shower the day after surgery. Gently wash the area with soap and water every day. Don't rub or pick at the glue. Pat dry.
- If you have staples, steri-strips or stitches, you may shower 2 days after surgery. Gently wash the area with soap and water every day. Pat dry.
- If there is drainage, cover the incision with a dry gauze dressing. If drainage soaks through two or more dressings in a day, call the office.
- Don't soak the incision in a bath or pool.
- Don't apply lotion/ointment on the incision.
- Dress in clean clothes after each shower. Sleep with clean bed linens. No pets in the bed until your incision heals.
- Some clear, pinkish drainage from the incision is normal. Watch for spreading redness, colored drainage, and separation.
- Staples, steri-strips, and stitches are removed at your follow-up appointment.

## Medications

- Take pain medicines as directed. 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.
- If painful constipation does not get better, call the doctor to discuss other medicine.
- Don't take anti-inflammatory pain relievers (Advil, Aleve) without surgeon's approval. They prevent new bone growth and may cause your fusion to fail.
- You may take acetaminophen (Tylenol).

## Activity

- If you were given a brace, wear it at all times except when sleeping, showering, or icing.
- Ice your incision 3-4 times per day for 15-20 minutes to reduce pain and swelling.
- Get up and walk 5-10 minutes every 3-4 hours. Gradually increase walking, as you are able.

## When to Call Your Doctor

- Fever over 101.5° (unrelieved by Tylenol).
- Unrelieved nausea or vomiting.
- Severe unrelieved pain.
- Signs of incision infection.
- Rash or itching at the incision (allergy to Dermabond skin glue).
- Swelling and tenderness in the calf of one leg.
- New onset of tingling, numbness, or weakness in the arms or legs.
- Dizziness, confusion, nausea or excessive sleepiness.

## Recovery and prevention

Schedule a follow-up appointment with your surgeon for 2 weeks after surgery. Recovery time generally lasts 4 to 6 weeks. X-rays may be taken after several weeks to verify that fusion is occurring. The surgeon will decide when to release you back to work at your follow-up visit.

A cervical collar or brace is sometimes worn during recovery to provide support and limit motion while your neck heals or fuses (see Braces & Orthotics). Your doctor may prescribe neck stretches and exercises or physical therapy once your neck has healed.

If you had a bone graft taken from your hip, you may experience pain, soreness, and stiffness at the incision. Get up frequently (every 20 minutes) and move around or walk. Don't sit or lie down for long periods of time.

Recurrences of neck pain are common. The key to avoiding recurrence is prevention:

- Proper lifting techniques
- Good posture during sitting, standing, moving, and sleeping
- Appropriate exercise program
- An ergonomic work area
- Healthy weight and lean body mass
- A positive attitude and relaxation techniques
- No smoking

## What are the results?

Anterior cervical discectomy is successful in relieving arm pain in 92 to 100% of patients [3]. However, arm weakness and numbness may persist for weeks to months. Neck pain is relieved in 73 to 83% of patients [3]. In general, people with arm pain benefit more from ACDF than those with neck pain. Aim to keep a positive attitude and diligently perform your physical therapy exercises.

Achieving a spinal fusion varies depending on the technique used and your general health (smoker). In a study that compared three techniques: ACD, ACDF, and ACDF with plates and screws, the outcomes were [3]:

- 67% of people who underwent ACD (no bone graft) achieved fusion naturally. However, ACD

alone results in an abnormal forward curving of the spine (kyphosis) compared with the other techniques.

- 93% of people who underwent ACDF with bone graft placement achieved fusion.
- 100% of people who underwent ACDF with bone graft placement and plates and screws achieved fusion.

### What are the risks?

No surgery is without risks. General complications of any surgery include bleeding, infection, blood clots (deep vein thrombosis), and reactions to anesthesia. If spinal fusion is done at the same time as a discectomy, there is a greater risk of complications. Specific complications related to ACDF may include:

**Hoarseness and swallowing difficulties.** In some cases, temporary hoarseness can occur. The recurrent laryngeal nerve, which controls the vocal cords, is affected during surgery. It may take several months for this nerve to recover. In rare case (less than 1/250) hoarseness and swallowing problems may persist and need further treatment with an ear, nose and throat specialist.

**Vertebrae failing to fuse.** There are many reasons why bones do not fuse together. Common ones include smoking, osteoporosis, obesity, and malnutrition. Smoking is by far the greatest factor that can prevent fusion. Nicotine is a toxin that inhibits bone-growing cells. If you continue to smoke after your spinal surgery, you could undermine the fusion process.

**Hardware fracture.** Metal screws and plates used to stabilize the spine are called "hardware." The hardware may move or break before the bones are completely fused. If this occurs, a second surgery may be needed to fix or replace the hardware.

**Bone graft migration.** In rare cases (1 to 2%), the bone graft can move from the correct position between the vertebrae soon after surgery. This is more likely to occur if hardware (plates and screws) is not used or if multiple vertebral levels are fused. If this occurs, a second surgery may be necessary.

**Adjacent segment disease.** Fusion of a spine segment causes extra stress and load to be transferred to the discs and bones above or below the fusion. The added wear and tear can eventually degenerate the adjacent level and cause pain.

**Nerve damage or persistent pain.** Any spine surgery comes with the risk of damaging the nerves or spinal cord. Damage can cause numbness or even paralysis. However, the most common cause of persistent pain is nerve damage from the disc herniation itself. Some disc herniations may permanently damage a nerve making it unresponsive to surgery. Like furniture on the carpet, the compressed nerve doesn't spring back. In these cases, spinal cord stimulation or other treatments may provide relief.

### Sources & links

If you have more questions, please contact Mayfield Brain & Spine at 800-325-7787 or 513-221-1100.

### Sources

1. Bose B: Anterior cervical instrumentation enhances fusion rates in multilevel reconstruction in smokers. *J Spinal Disord* 14:3-9, 2001.
2. Hilibrand AS, et al.: Impact of smoking on the outcome of anterior cervical arthrodesis with interbody or strut-grafting. *J Bone Joint Surg Am* 83-A:668-73, 2001.
3. Xie JC, Hurlbert RJ. Discectomy versus discectomy with fusion versus discectomy with fusion and instrumentation: a prospective randomized study. *Neurosurgery* 61:107-16, 2007.

### Links

- <http://www.spine-health.com>
- <http://www.spineuniverse.com>
- <http://www.knowyourback.org>

### Glossary

**allograft:** a portion of living tissue taken from one person (the donor) and implanted in another (the recipient) for the purpose of fusing two tissues together.

**autograft (autologous):** a portion of living tissue taken from a part of one's own body and transferred to another for the purpose of fusing two tissues together.

**bone graft:** bone harvested from oneself (autograft) or from another (allograft) for the purpose of fusing or repairing a defect.

**discectomy:** a type of surgery in which herniated disc material is removed so that it no longer irritates and compresses the nerve root.

**foraminotomy:** surgical enlargement of the intervertebral foramen through which the spinal nerves pass from the spinal cord to the body.

**fusion:** to join together two separate bones into one to provide stability.

**interbody cage:** a device made of titanium, carbon-fiber, or polyetheretherketone (PEEK) that is placed in the disc space between two vertebrae.



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