

## Artificial Disc Replacement (cervical arthroplasty)

### Overview

Artificial disc surgery replaces a worn-out disc in the spine with a device that moves like a natural disc. The device is made of metal plates with a ceramic or polymer core that flexes or glides. It's an alternative to spinal fusion, which stops all motion at the disc. The benefit of an artificial disc is less stress on adjacent discs compared to fusion. But it is not for those with facet joint arthritis or weak bones. It's an option if physical therapy or medications fail to relieve neck or arm pain caused by pinched nerves.

### What is cervical disc replacement?

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. 1A).

Cervical disc replacement removes a damaged disc in the neck and replaces it with an artificial one. The surgeon removes the bad disc through an incision in the throat area. The artificial disc is then put in its place. The device's two metal plates are anchored to the bony roof and floor of the joint space. The device's center polymer surface allows tilting, gliding, and rotating motions (Fig. 1B).

Similar to knee replacement, an artificial disc preserves motion, while spinal fusion stops motion (Fig. 1C).

Advantages of artificial disc replacement (also called arthroplasty) include:

- Maintains normal neck movement
- Lowers the risk of stress to adjacent discs
- Does not require a bone graft
- Allows early neck motion after surgery

Since 2007, the U.S. Food & Drug Administration has approved seven artificial cervical disc devices. Each has different design attributes. In 2013, the FDA approved use at two-levels of the spine. Insurance coverage for these devices varies and requires prior authorization.

Arthroplasty can treat discs between vertebrae C3-C7 as a single-level or two-level surgery. It can be done as an outpatient surgery where patients go home the same day.

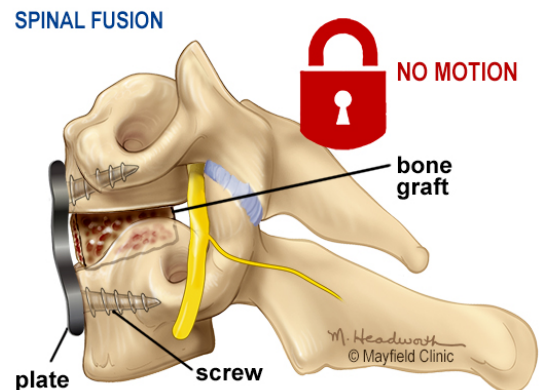
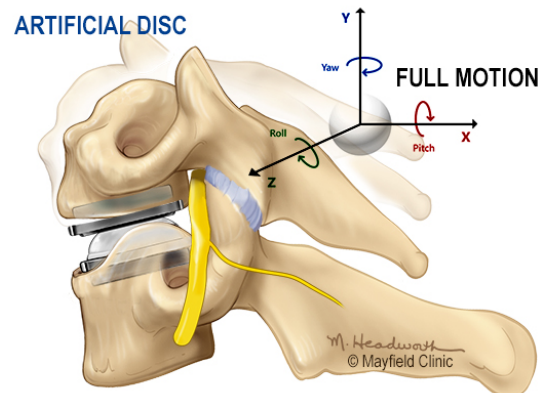
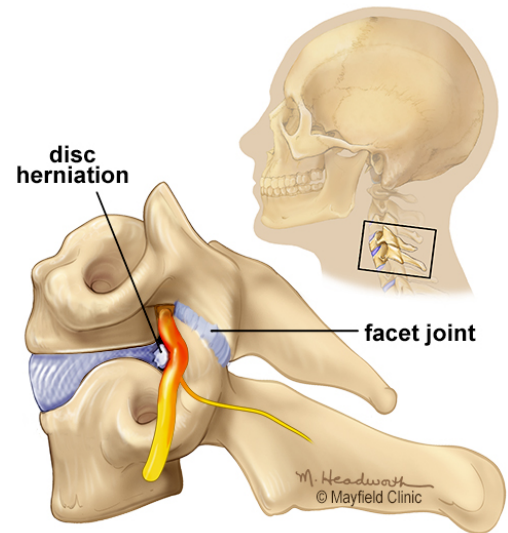


Figure 1. **A.** A herniated disc pinches nearby nerves. **B.** To relieve compression, the damaged disc is replaced with an artificial disc device that mimics motion of a healthy disc. **C.** In contrast, spinal fusion "locks" the bones together.

## Disc replacement vs. spinal fusion

Outcomes for cervical disc replacement compare favorably to fusion. Anterior cervical discectomy and fusion (ACDF) is the gold standard for surgical treatment of a herniated disc. ACDF involves removing a damaged disc and inserting a bone graft to fuse the two vertebrae into one solid bone. ACDF and arthroplasty appear equally effective in relieving symptoms caused by disc herniation.

Surgeons theorize that arthroplasty can reduce the risk of adjacent segment disease. This can occur when a fusion imposes extra stress on the movable discs above and below the fusion. Over time, this added stress can degrade the adjacent discs, causing new problems and future surgery.

Long-term studies are needed to prove disc replacement reduces the risk of adjacent segment disease. Talk with your surgeon about whether fusion or disc replacement is appropriate for you.

## Who is a candidate?

You may be a candidate for cervical disc replacement if you have:

- a herniated disc or degenerative disc
- significant weakness in your hand or arm
- arm pain that is worse than neck pain
- symptoms that do not improve with physical therapy or medication
- healthy, non-arthritic facet joints

You may **not be a candidate** if you have:

- facet joint arthritis or ankylosing spondylitis
- osteoporosis
- a previous spinal fusion at an adjacent level
- an unstable spine, spondylolisthesis, or abnormal curvature of the neck (scoliosis/kyphosis)
- nickel allergy

Arthroplasty 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 occur when this material presses on a nerve.
- **Degenerative disc:** the drying and shrinkage of discs with age. As the disc thins, the vertebrae bones rub and pinch the nerves.

## The surgical decision

Most herniated discs heal after a few months of nonsurgical treatment. If you are a candidate for arthroplasty, the surgeon will explain your options. Consider all the risks and benefits before making your decision. In general, younger people (ages 18-60) have better outcomes and get the most benefit from artificial disc replacement.

## Who performs the procedure?

A neurosurgeon or orthopedic surgeon can perform spine surgery. Many spine surgeons have specialized training in artificial disc replacement devices. Ask your surgeon about his or her training and experience with various disc devices.

## What happens before surgery?

In the office, you will sign consent forms and provide your medical history (allergies, medicines/vitamins, bleeding history, anesthesia reactions, and previous surgeries). Inform the surgeon about all medications (prescription, over-the-counter, and herbal supplements) you are taking. Presurgical tests (blood test, EKG) 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, naproxen, 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 prepare for surgery is eliminate tobacco use. This includes cigarettes, e-cigarettes, cigars, pipes, chewing tobacco, and snuff / dip. Nicotine decreases circulation, slows wound healing, and increases risk of infection. Talk with your doctor about ways to help you quit.

## 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 or Hibiclens.
- Dress in freshly washed, loose-fitting clothing.
- Wear flat-heeled shoes with closed backs.
- Remove makeup, hairpins, contacts, body piercings, jewelry, and nail polish.
- Bring a list of medications with dosages and the times of day taken.
- Bring a list of allergies to medication or foods.

Arrive at the hospital before your scheduled surgery time to complete paperwork and health checks. An anesthesiologist will talk with you and explain the effects and risks of anesthesia.

## What happens during surgery?

The operation generally takes 1 to 3 hours.

### Step 1: prepare the patient

You will lie on the operating table and be given anesthesia. Once you are asleep, your neck area is cleaned and prepped.

### Step 2: make the incision

A 2-inch skin incision is made on the side of your neck (Fig. 2). The surgeon gently retracts the trachea, esophagus, and arteries. The muscles on the front of the spine are lifted to access the disc.

### Step 3: locate the damaged disc

An x-ray fluoroscope is used to guide a needle into the disc to confirm the level. Distractor pins are inserted into the vertebrae above and below the damaged disc to spread the bones apart.

### Step 4: remove the disc

The disc wall is cut open (Fig. 3). The surgeon removes the disc using small grasping tools. The posterior ligament behind the vertebrae may be released to reach the spinal canal.

### Step 5: decompress the nerves

Any bone spurs are removed. The foramen through which the spinal nerves pass are enlarged (Fig. 4). This step, called a foraminotomy, gives your nerves more room to exit the canal.

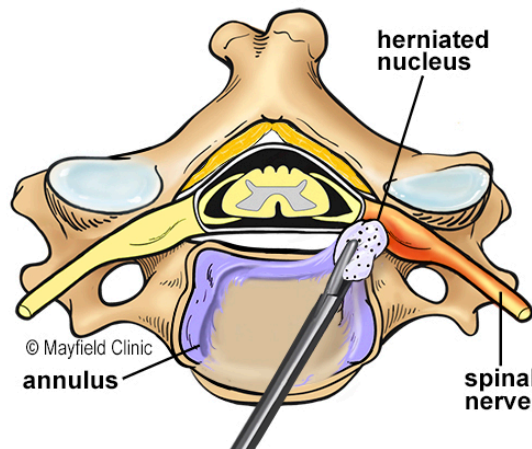


Figure 4. (top view) Disc fragments and bone spurs are removed to enlarge the foramen and free the nerves.

### Step 6: prepare disc implant

The width and depth of the disc space is measured and a trial size is selected. The trial implant is tapped into the empty disc space. An x-ray is taken to ensure the size is optimal. Multiple trials may be placed until a good fit is found.

The permanent implant is loaded into the inserter cartridge. The surgeon taps the inserter (containing the artificial disc device) into position. The distractor pins are released and the cartridge removed. Pressure is applied to the distractor pins to compress and set the implant "teeth" into the bony endplates (Fig. 5).



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

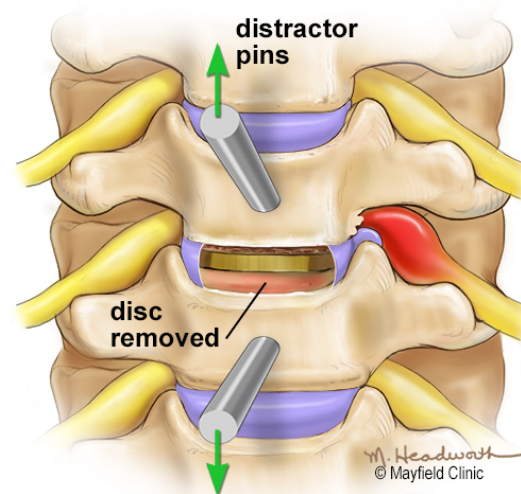


Figure 3. Distractor pins open the disc space. The disc annulus is cut open and the disc nucleus is removed.

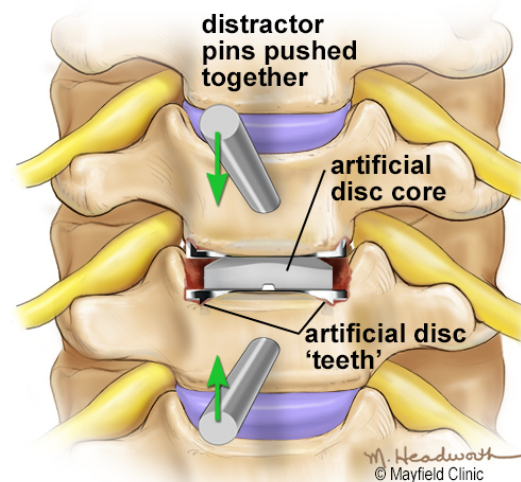


Figure 5. The artificial disc device is inserted into the disc space and pressure is applied to the pins, setting the teeth of the implant into the bone.

### Step 7. close the incision

The distractor pins are removed. The muscle and skin incisions are sutured together. Biologic skin glue is placed across the incision.

### What happens after surgery?

You will awaken in the recovery area. Your blood pressure, heart rate, and respiration will be monitored. Any pain will be addressed. Once awake, you can begin gentle movement (sitting in a chair, walking). Most patients go home the same day. However, if you have difficulty breathing or unstable blood pressure, you may need to stay overnight.

Hoarseness, sore throat, or difficulty swallowing may occur in some patients. These symptoms usually resolve in 1 to 4 weeks.

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

### Restrictions

- Avoid bending or twisting your back.
- Don't lift anything heavier than 5 pounds.
- No strenuous activity including housework, yard work, or sex.
- Don't drive the first 2-3 days or while taking pain medicines or muscle relaxers.
- 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 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 or 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.
- Steri-strips and stitches are removed at your follow-up appointment.

### Medications

- 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.

- If painful constipation does not get better, call the doctor to discuss other medicine.
- Your surgeon may prescribe nonsteroidal anti-inflammatory medicine for 6 weeks to block bone growth around the disc device.

### Managing pain

- Ice your incision 3-4 times per day for 15-20 minutes to reduce pain and swelling.
- Don't sit or lie in one position longer than an hour unless you are sleeping. Stiffness leads to more pain.

### Activity

- Get up and walk 5-10 minutes every 3-4 hours. Gradually increase walking as you are able.
- You are encouraged to gently move your neck as tolerated.
- You may have a sore throat or difficulty swallowing for a few days. Eat a light diet of soft food in small bites. Resume your normal diet as tolerated.

### When to Call Your Doctor

- Fever over 101.5 (not relieved by Tylenol)
- Unrelieved nausea or vomiting
- Severe, unrelieved pain
- Unable to urinate 6-8 hours after surgery despite having a full bladder
- Signs of incision infection
- Rash or itching at the incision. It may be an allergy to Dermabond skin glue.
- Swelling and tenderness in the calf of one leg (sign of a blood clot)
- New onset of tingling, numbness, or weakness in the arms or legs
- Dizziness, confusion, nausea, or excessive sleepiness

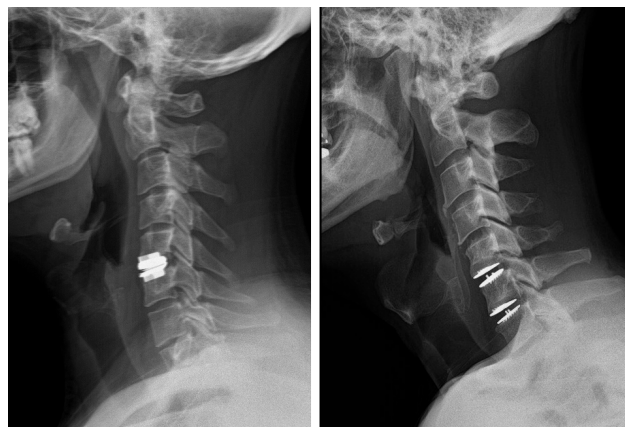


Figure 6. Left x-ray shows a single-level C5-C6 ProDisc device. Right x-ray shows two-level C5-C6-C7 Mobi-C arthroplasty.

## Recovery and prevention

Schedule a follow-up appointment with your surgeon for 2 weeks after surgery. Recovery time generally lasts 4 to 6 weeks. The surgeon will decide at your follow-up visit when to release you back to work.

A soft cervical collar may be worn briefly to provide support and comfort. However, you are encouraged to move your neck. A post-op X-ray is usually taken after 6 weeks to check on bone healing (Fig. 6). Your surgeon may prescribe neck stretches, exercises, or physical therapy once your incision has healed.

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

- Proper lifting techniques
- Good posture while sitting, standing, moving, and sleeping
- Appropriate exercise program
- Ergonomic work area
- Healthy weight and lean body mass
- Positive attitude and relaxation techniques (stress management)
- Tobacco avoidance

## What are the results?

Be sure to discuss the most current outcomes of the specific disc device your surgeon recommends.

Studies show cervical artificial disc replacement (ADR) is successful in relieving arm pain in more than 70% of patients. Cervical ADR has shown at least equivalent results to ACDF in relieving neck pain, arm pain, patient function, and satisfaction, and with no increase in surgical complications. These results reflect 5 to 10 years of follow-up in FDA-approved studies.[1]

The overall rate of adjacent segment disease with cervical ADR was 14% (7-23%) years after surgery but varies by device – compared to ACDF, which is 22-40% at 10 years.

The incidence of bone overgrowth (heterotopic ossification) varies significantly between artificial disc devices. See risks below.

## What are the risks?

No surgery is without risks. General risks of any surgery include bleeding, infection, blood clots (deep vein thrombosis), and reactions to anesthesia. Specific risks related to artificial disc replacement may include:

**Hoarseness and swallowing difficulties.** In some cases, temporary hoarseness can occur. The recurrent laryngeal nerve, which controls the vocal cords, may be irritated during surgery. It may take

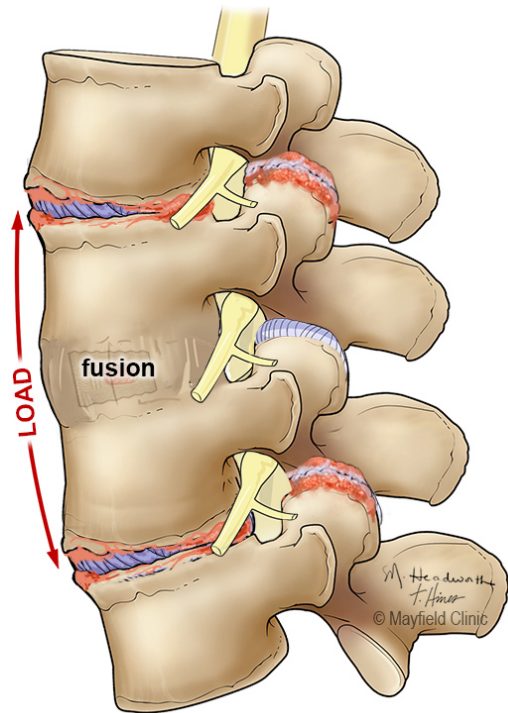


Figure 7. Adjacent segment disease has two causes: the natural aging process and fusion surgery. Fusing bones together may accelerate degeneration by transferring the stress load to discs above and below the fusion level. The risk in the cervical spine is 3% per year. Artificial disc replacement in younger people reduces the risk over their lifetime.

several months for this nerve to recover. In rare cases (less than 1/250) hoarseness and swallowing problems may persist and need further treatment with an ear, nose, and throat specialist.

**Bone overgrowth** (heterotopic ossification). Bone may start to grow around the artificial disc device. This may appear on follow-up x-rays months to years after surgery. Bony growth is graded on a 5-point scale. This may reduce range of motion or bridge across the device and cause unintended fusion. Taking non-steroidal anti-inflammatory drugs (NSAIDs) for 6 weeks after surgery has shown to lessen the risk of ossification.

**Device migration.** In rare instances, the endplates and central core of the artificial disc may move from the correct position. If this occurs, a second surgery may be needed to fix or replace the device.

**Adverse reaction to metal.** There are reports of artificial discs with metal-on-metal bearings giving off metal ions that may react with nearby tissues to cause pain or eventual implant failure. Also, some people may have an allergic reaction to the nickel, chromium, or cobalt in the metal device.

**Vertebra fracture.** In rare instances, a vertebra can fracture during surgery or afterward. Immobilizing the neck with a brace may enable the fracture to heal. If a second surgery is required, the artificial disc is removed and a fusion performed.

**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 carpet under furniture, 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. Wahwood W. et al. Artificial Discs in Cervical Disc Replacement: A Meta-Analysis for Comparison of Long-Term Outcomes. *World Neurosurg* 134:598-613, 2020.
2. Health Quality Ontario: Cervical Artificial Disc Replacement Versus Fusion for Cervical Degenerative Disc Disease: A Health Technology Assessment 19(3):1-223, 2019.
3. Yu Gao et al: A Meta-Analysis comparing the Results of Cervical Disc Arthroplasty with Anterior Cervical Discectomy and Fusion (ACDF) for the Treatment of Symptomatic Cervical Disc Disease. *J Bone Joint Surg Am* 95(6): 555-561, 2013.

### Links

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

### Glossary

**adjacent segment disease:** a condition that may occur after a spinal fusion surgery to join or "lock" two or more bones together, stopping the natural motion at that level. Degenerative changes develop on the discs and facet joints above or below the level where a previous surgery was performed.

**ankylosing spondylitis:** a chronic inflammatory disease that affects the joints between the vertebrae of the spine, and the joints between the spine and the pelvis. It eventually causes the affected vertebrae to fuse or grow together.

**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.

**heterotopic ossification:** abnormal bone formation within muscle and soft tissues. It is a problem that typically occurs weeks after an injury or surgery.



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