

Spinal Fusion: Lateral Lumbar Interbody Fusion (LLIF)

Overview

Lateral interbody fusion is a minimally invasive surgery to treat disc problems in the low back. In spinal fusion, two or more bones of the spine are joined to stop painful motion, decompress pinched nerves, and correct scoliosis. Through a small incision at the side of the waist, the disc is removed and a bone graft is inserted to restore the height and relieve nerve pinching. During healing, the bones will fuse together. Patients typically go home the same day; recovery time takes 6 to 12 weeks.

What is lateral spine fusion?

When back and leg pain result from injury or degenerative changes in the spine (Fig. 1), a lateral lumbar interbody fusion (LLIF) may be recommended. Fusion stabilizes the spine and prevents painful motion. The surgery is sometimes called DLIF, which stands for direct lateral interbody fusion, or XLIF, for extreme lateral interbody fusion. Both refer to the same technique.

During lateral fusion, an incision is made at the side of the waist. The damaged disc is removed and the space between the bony vertebrae is filled with a spacer bone graft. The spacer restores the height between the bones and relieves pinching of the spinal nerves. The graft becomes a bridge between the two bones to promote fusion. In some cases the graft is strengthened with a plate and screws on the side or with pedicle screws from the back.

As the body begins healing, new bone cells grow around the graft. After 3 to 6 months, the bone graft should fuse the two vertebrae, forming one solid piece of bone. Like reinforced concrete, instrumentation and fusion work together.

Depending on the symptoms, a one-level or multi-level fusion may be performed. A one-level fusion joins two bones while a two-level fusion joins three bones.

Lateral spine fusion is a unique minimally invasive surgery for several reasons. First, the small incision is only 1 inch long near the waist. Second, its path to the spine is from the side (Fig. 2). The surgeon uses dilation tubes to create a tunnel between the patient's abdominal organs in front and the strong spine muscles in back. Third, a nerve-monitoring probe guides the path to safely enlarge the tubular instruments without injuring the spinal nerves.

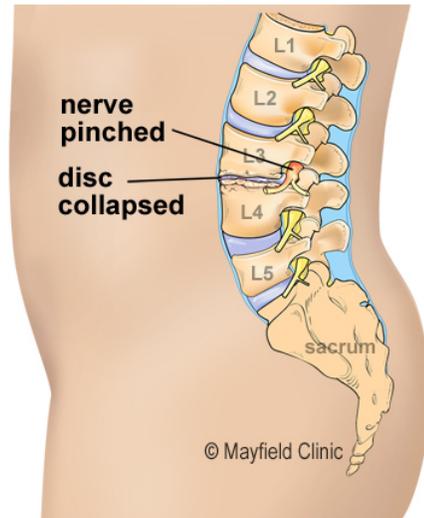


Figure 1. (side view) A collapsed degenerative disc pinches the nerve between the bones, causing back pain and instability.

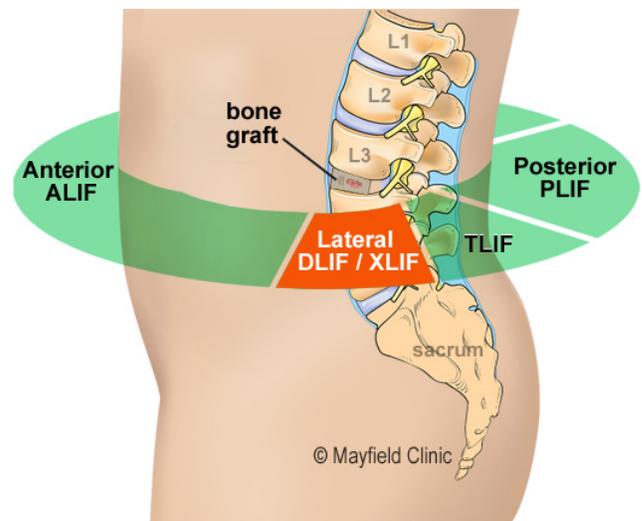


Figure 2. Through an incision made at the waist, lateral fusion (DLIF, XLIF) reaches the spine from the side. The disc is removed and replaced with a bone graft. Lateral fusion is an alternative to ALIF and TLIF surgeries.

Lateral fusion can be performed in a hospital or as an outpatient same-day procedure.

Other types of spinal fusion surgery used to treat disc problems include ALIF, TLIF, PLIF, and AxialIF, each with its own advantages and disadvantages.

Who is a candidate?

You may be a candidate for LLIF if you have:

- degenerative disc disease
- low-grade spondylolisthesis
- mild to moderate scoliosis
- symptoms that have not improved with physical therapy or medication

You are not a candidate for LLIF if you have:

- damaged disc at L5-S1, because the hip bone blocks access
- severe spondylolisthesis or scoliosis
- other problems that would prevent bone fusion
- prior abdominal surgery near the kidneys

Fusion may be helpful in treating:

- **Degenerative disc:** with age the discs dry out and shrink. As the disc spaces get smaller, these changes can lead to stenosis or disc herniation that pinches nerves (Fig. 1).
- **Spondylolisthesis:** a forward slip of a vertebra out of alignment with the spinal column. It can kink and compress the nerves, causing pain.
- **Spinal stenosis:** narrowing of the spinal canal and nerve root canal, along with enlargement of the facet joints, can pinch spinal nerves and cause pain and numbness in the legs.
- **Scoliosis:** with age or previous spine surgery, the bony vertebra may move out of alignment, causing the spine to develop an abnormal side-to-side curvature.

The surgical decision

If you are a candidate for spinal fusion, 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. It will stop the motion in the painful area of your spine, allowing increased function and return to a more normal lifestyle—though one that may not be totally pain-free.

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.

- **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. The entire thickness of bone is not removed, just the top half layer.
- **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.

- **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 orthopedic surgeon can perform spine surgery. Many spine surgeons have specialized training in minimally invasive surgery. Certain minimally invasive techniques are highly technical; they require special instruments and training to avoid complications. Ask your surgeon about his or her training, especially if your case is complex or you have had previous spinal surgery.

What happens before surgery?

Presurgical tests (e.g., blood test, chest x-ray, electrocardiogram) will be done several days before surgery. In the doctor's office, you will sign consent forms and provide your medical history (allergies, medicines/vitamins, bleeding history, anesthesia reactions, previous surgeries). Inform your healthcare provider about all the medications (over-the-counter, prescription, herbal supplements) that you are taking.

Continue taking the medications your surgeon recommends. Stop taking all non-steroidal anti-inflammatory medicines (Naprosyn, Advil, Motrin, Nuprin, Aleve, etc.) and blood thinners (Coumadin, Plavix, etc.) 1 to 2 weeks before surgery as directed by your doctor. Ask your doctor if you are unsure.

Stop smoking and drinking before surgery

The most important way to achieve a successful spine fusion is to eliminate tobacco use (cigarettes, cigars, pipes, chewing tobacco, and snuff / dip) before surgery.

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 increased risk of infection. Talk with your doctor about ways to help you quit smoking: nicotine replacements, pills without nicotine (Wellbutrin, Chantix), and tobacco counseling programs.

You should not drink alcohol 1 week before and 2 weeks after surgery to avoid bleeding problems.

Morning of surgery

- No food or drink.
- 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 (outpatient surgery center 1 hour before) your scheduled operation 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. An intravenous (IV) line will be placed in your arm.

What happens during surgery?

This surgery generally takes 1 to 2 hours, depending on how many spine levels are treated.

Step 1: prepare the patient

You will lie on the operative table and be given anesthesia. Once asleep, you will be positioned on your side; the waist area is cleansed and prepped.

Step 2: make the incision

A small 1- to 2-inch incision is made at the waist (Fig. 3). The surgeon gently makes a path between the abdominal cavity and the back muscles through the retroperitoneal space. This area contains fat as well as the kidney and colon, which are gently moved aside.

Step 3: locate the damaged disc

A monitoring probe is inserted to detect the nerves that form the sciatic nerve. Looking at the fluoroscope (a special x-ray), the surgeon carefully passes a long tube along the path through the psoas muscle to the disc (Fig. 4).

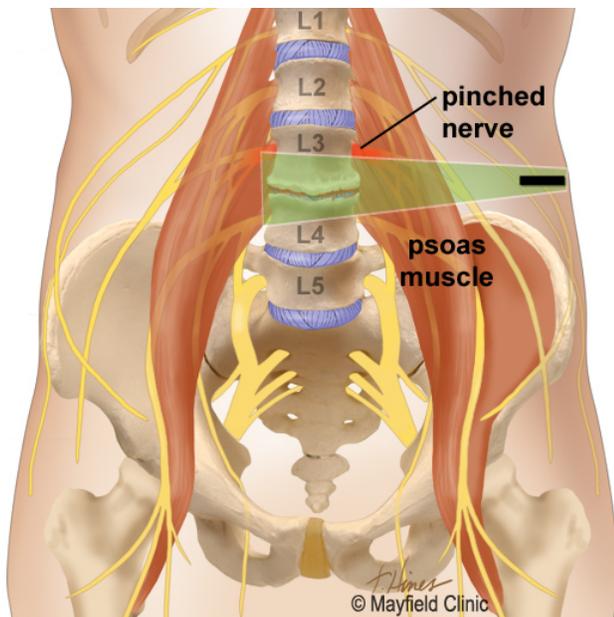


Figure 3. (front view) A 1-inch skin incision is made at the waist, and a corridor (green area) is opened through the psoas muscle to the disc.

Step 4: remove the disc

Next, a series of dilator tubes are passed, one around the other, to separate the muscles and create a tunnel to the spine. Working through the tube, the surgeon removes the damaged disc (Fig. 5).

Step 5: prepare the disc space

The open disc space is measured and an appropriate sized spacer or bioplastic cage is selected. Progressively larger spacer trials are slid into the space to reopen the height and decompress the nerves. When height has been restored, the permanent spacer is prepared with bone graft.

Bone marrow is taken from the iliac crest with a syringe (or by incision) and then mixed with other graft material. The mortar-like paste contains bone-growing proteins that are packed into the spacer cage.

Step 6. insert the bone graft

Guided by x-ray fluoroscopy, the spacer graft is inserted into the empty disc space, pushing the two bones apart to restore normal disc height (Fig. 6 and 7).

Step 7. insert plate and screws (optional)

The spacer graft may be held in place with a metal plate screwed into the side of the vertebrae, or with screws and rods from the back. The hardware provides stability during fusion.

Step 8. close the incision

The tubes and instruments are removed. The skin incision is closed with Steri-Strips or biologic glue.

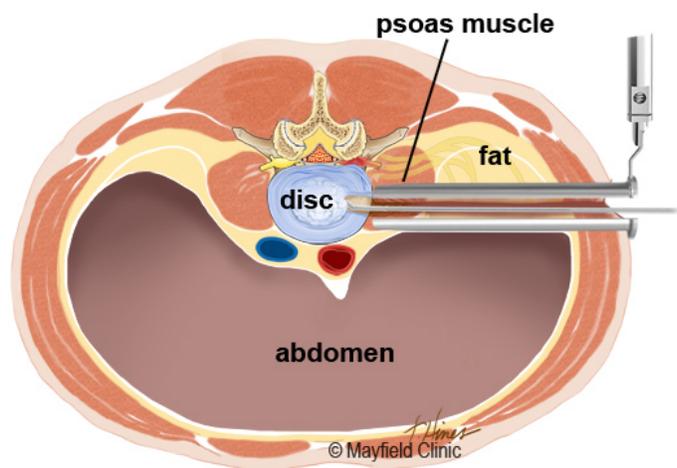


Figure 4. (cross section view) Using a tubular retractor, the surgeon makes a corridor behind the abdominal wall through a fat-filled retroperitoneal space to the psoas muscle. A monitoring probe detects the position of nerves along the side of the spine and helps guide a safe path through the muscle to the disc.

What happens after surgery?

You will awaken in the postoperative 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 having a 1- or 2-level LLIF go home the same day. However, if any difficulty in breathing or unstable blood pressure occurs, the patient can be transferred to a hospital.

Discharge instructions

Discomfort

- Take pain medication as directed by your surgeon. Narcotics can be addictive and are used for a limited period of time.
- Narcotics can also cause constipation. Drink lots of water and eat high-fiber foods. Laxatives and stool softeners such as Dulcolax, Senokot, Colace, and Milk of Magnesia are available without a prescription.
- Do **not** 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).
- Ice your incision 3-4 times per day for 15-20 minutes to reduce pain and swelling.

Restrictions

- Avoid bending, lifting or twisting your back for the next 6 weeks.
- Do not lift anything heavier than 5 pounds for 2 weeks after surgery.
- No strenuous activity for the next 2 weeks, including yard work, housework and sex.
- DO **NOT** SMOKE, vape, dip, chew or use nicotine products. It prevents new bone growth and may cause your fusion to fail.
- Do not drive until after your follow-up appointment. You may ride in the car for short distances of 45 minutes or less if necessary.
- Do not drink alcohol for 2 weeks after surgery or while you are taking narcotic medication.

Activity

- You may need help with daily activities (e.g., dressing, bathing), for the first couple days.
- Get up and walk 5-10 minutes every 3-4 hours. Gradually increase your walking time, as you are able.

Bathing/Incision Care

- Wash your hands thoroughly before and after cleaning your incision to prevent infection.
- If you have Dermabond (skin glue) covering your incision, you may shower the day after surgery. Gently wash the area daily with soap and water. Pat dry.

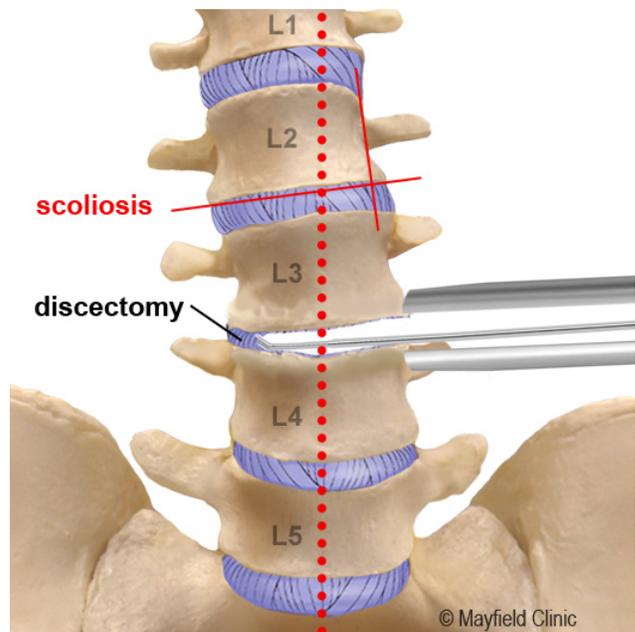


Figure 5. The disc is removed with tiny instruments through the tube retractor.

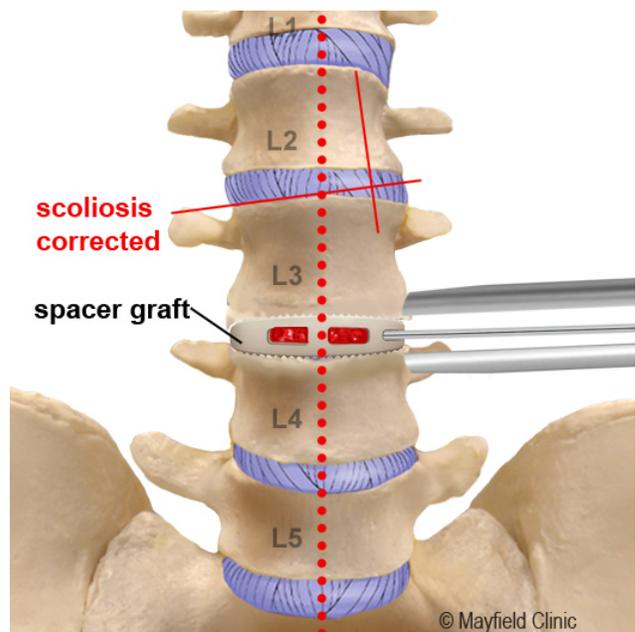


Figure 6. A spacer bone graft is inserted to restore the collapsed disc height, realign the bones, and relieve pinching of nerves.

- If you have staples, steri-strips, or stitches, you may shower 2 days after surgery. Remove the gauze dressing and gently wash the area with soap and water. Replace the dressing or completely remove it if no drainage. Inspect and wash the incision daily.
- Do not submerge or soak the incision in water (bath, pool or tub).
- Some drainage from the incision is normal. A large amount of drainage, foul smelling drainage, or drainage that is yellow or green should be reported to your surgeon's office immediately.
- Staples, steri-strips, and stitches will be removed at your follow-up appointment.

Bracing

- If you were given a brace, wear it at all times unless you are sleeping or showering.

When to Call Your Doctor

- Call if your temperature exceeds 101.5° F. Call if the incision begins to separate or show signs of infection, such as redness, swelling, pain, or drainage.
- Swelling and tenderness in the calf of one leg.
- New onset of tingling or numbness in the legs or numbness in the groin area.

Recovery and prevention

Schedule a follow-up appointment with your surgeon for 2 weeks after surgery. Recovery time to daily activities is usually 6 to 12 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.

Fusion takes time. Follow the "BLT" of spine surgery recovery by limiting your bending, lifting and twisting for 2 to 3 months. Work modifications may be necessary.

Recurrences of 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 (e.g., stress management)
- Healthy diet of real foods
- No smoking

What are the results?

As a minimally invasive procedure, lateral lumbar fusion uses a small incision, has short operating time, minimizes blood loss, and poses few serious complications. With its minimal trauma to the spine and nearby tissues, patients often return to daily activities within 6 weeks. Each patient's result and recovery differs based on his or her health and

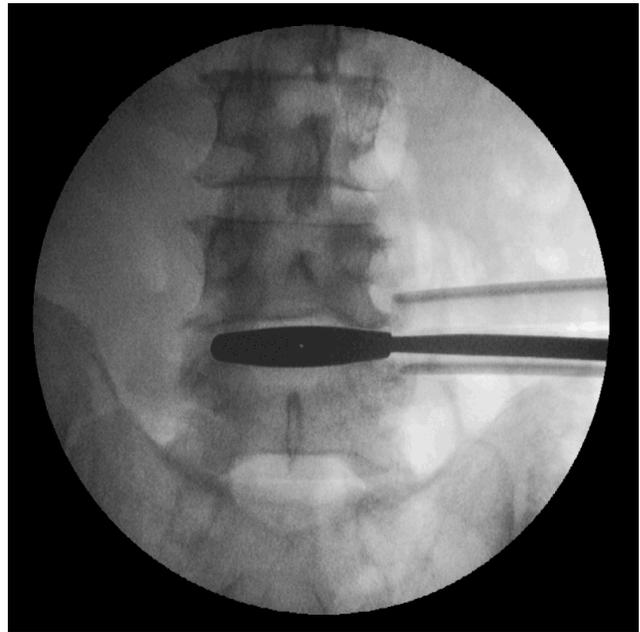


Figure 7. (front view) X-ray sequence shows opening of the disc space and increase in height as the bone graft is inserted.

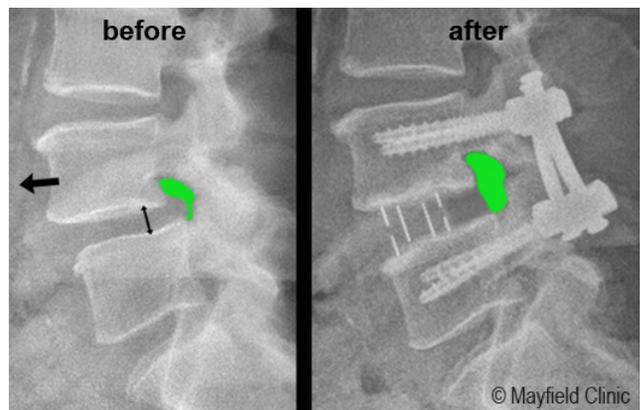


Figure 8. (side view) In this before and after x-ray of surgery, the bone graft restores the disc height. The LLIF relieves pinched nerves by enlarging the foramen where they exit the spine (green area). This is called indirect decompression. Screws may be inserted to keep the bones aligned during fusion.

lifestyle. Keep a positive attitude and perform your physical therapy as instructed.

The LLIF surgery commonly relieves painful pinched nerves by indirect decompression. By increasing the height of the disc space, more room is created for the nerves to move freely in the canals (Fig. 8). The surgeon does not see or touch the spinal nerves with instruments. By comparison, in a TLIF or PLIF surgery, the nerves are decompressed under direct vision.

Achieving a spinal fusion varies depending on the technique used, your general health, and whether you smoke.

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.

Specific complications related to LLIF spinal fusion may include [1]:

Thigh weakness and/or pain. Because the surgical path crosses through the psoas muscle, you may have temporary thigh pain, groin numbness, and tingling that usually resolves in a couple of weeks. The thigh muscle may be weak and more difficult to flex at the hip. The weakness usually resolves in 3 to 6 months.

Injury to abdominal organs. Because the surgical path lies behind the abdominal cavity, there is a slight risk of injury to the bowel, kidney, ureter, and the major blood vessels lying on top of the spine.

Nerve injury. Muscle retraction can cause injury to the femoral or genitofemoral nerves in the psoas muscle.

Vertebrae fail to fuse. Common reasons why bones do not fuse include smoking and alcohol use, osteoporosis, obesity, and malnutrition. Nicotine is a toxin that inhibits bone-growing cells. If the fusion does not heal (pseudoarthrosis), another surgery may be needed for repair.

Hardware fracture. Metal screws that stabilize the spine may move or break before the bones are completely fused. Another surgery may be needed to fix or replace them.

Bone graft migration and settling. In rare cases, the bone graft moves from its correct position

between the vertebrae soon after surgery. This more often occurs if hardware (plates and screws) is not used or if fusion was for several vertebral levels. Over time, the bone graft spacer may potentially sink into the bone (subsidence) and reduce the indirect decompression. If migration or subsidence occurs, another surgery may be needed to correct this.

Transitional syndrome. Fusion causes extra stress and load transferred to the discs and bones above or below the fusion segment. 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 injury to the nerves or spinal cord. Damage can cause numbness or even paralysis. The most common cause of persistent pain is nerve damage from the disc herniation itself. If the damage was permanent, the nerve cannot respond to surgical decompression. Unlike memory foam, for example, the compressed nerve does not spring back. In such cases, spinal cord stimulation or other treatments may provide relief.

Sources & links

If you have more questions, please contact the Rock Creek Neurosurgery at 801-609-9310.

Sources

1. Uribe JS, Deukmedjian AR. Visceral, vascular, and wound complications following over 13,000 lateral interbody fusions: a survey study and literature review. *Eur Spine J* 24 Suppl 3:420-6, 2015

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) to help fuse two tissues together.

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

bone graft: bone harvested from one's self (autograft) or from another (allograft) for the purpose of fusing or repairing a defect.

discectomy: a surgery to remove herniated disc material so that it no longer irritates and compresses the nerve root.

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



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