



## Spinal Fusion: Transforaminal Lumbar Interbody Fusion (TLIF)

### Overview

Transforaminal lumbar interbody fusion is a surgery used to treat disc problems in the low back. Fusion locks together two or more bones to stop painful motion, relieve pinched nerves, and correct scoliosis. Through small, minimally invasive incisions in the back, the disc is removed. A bone graft spacer is placed in the space to restore the height and relieve nerve pinching. During healing, the bones fuse together.

### What is transforaminal spine fusion?

Your doctor may recommend spinal fusion to repair damaged discs and realign bones causing back or leg pain. There are several ways to reach the spine and perform a fusion (Fig. 1). Your surgeon will discuss the best approach for your unique problem.

During transforaminal fusion, an incision is made off the middle of the back (Fig. 2). The facet joint is removed to enlarge the foramen opening for the nerve (hence the name transforaminal). Bone spurs and ligaments are removed to decompress the nerve. The surgeon removes the damaged disc and fills the space between the bones with a spacer bone graft. The spacer restores the height between the bones and relieves pinched nerves. The graft becomes a bridge between the two bones to promote fusion. The graft is strengthened with metal screws and rods.

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

TLIF fuses both the front disc space and the back facet joints, stopping all motion at that spine level.

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. Fusion will take away some flexibility in your spine, but most patients will not notice.

TLIF can be performed in a hospital or an outpatient surgery center. Patients often go home the next day for a one-level fusion, or in a couple of days for multi-level fusion. Recovery time can take up to 12 weeks.

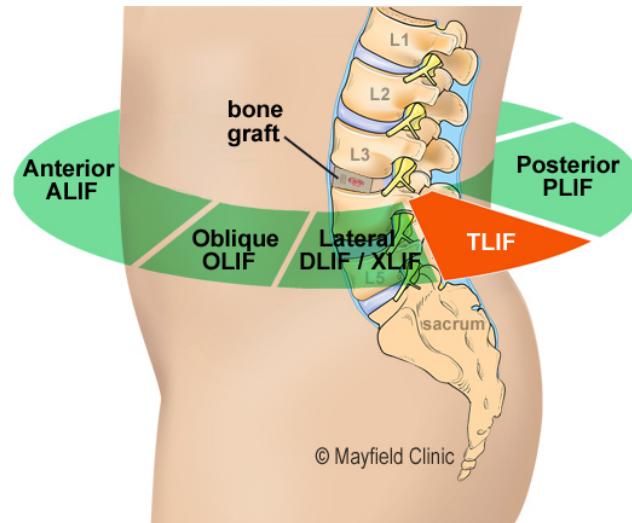


Figure 1. During a transforaminal fusion (TLIF), the surgeon approaches the spine through an incision near the center of the back. The disc is removed and replaced with a bone graft. Transforaminal fusion is an alternative to LLIF and ALIF surgeries.

### Who is a candidate?

You may be a candidate for TLIF if you have:

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

You are not a candidate for TLIF if you have:

- severe osteoporosis
- problems that would prevent bone fusion
- prior fusion at that level

Fusion may be helpful in treating:

- **Degenerative disc disease:** the drying and shrinkage of discs with age. As the disc thins or herniates, the vertebrae bones rub and pinch the nerves.
- **Spondylolisthesis:** a forward slip of a vertebra bone out of its normal position. It can kink and compress the nerves, causing pain.
- **Spinal stenosis:** the narrowing of the spinal canal and nerve root canals. Enlarged facet joints and ligaments pinch the nerves causing pain and numbness in the legs.

- **Scoliosis:** an abnormal curve of the spine caused by misalignment of the bones. In adults this occurs from aging discs, arthritis, or previous spine surgery.

### 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 the 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 half an 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.
- **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 orthopedic surgeon can perform spine surgery. Many spine surgeons have specialized training in minimally invasive surgery. 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?

In the 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. 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.

Continue taking the medications your surgeon recommends. Stop taking all non-steroidal anti-inflammatory medicines (ibuprofen, naproxen, etc.) and blood thinners (Coumadin, aspirin, Plavix, etc.) 7 days before surgery.

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 and drinking before surgery

The most important way to achieve a successful spine fusion is to eliminate tobacco use (cigarettes, vaping, 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 an increased risk of infection. Talk with your doctor about ways to help you quit smoking: nicotine replacements, medications (Chantix, Zyban), and tobacco counseling programs.

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

### 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.
- 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.
- 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 (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.

### What happens during surgery?

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

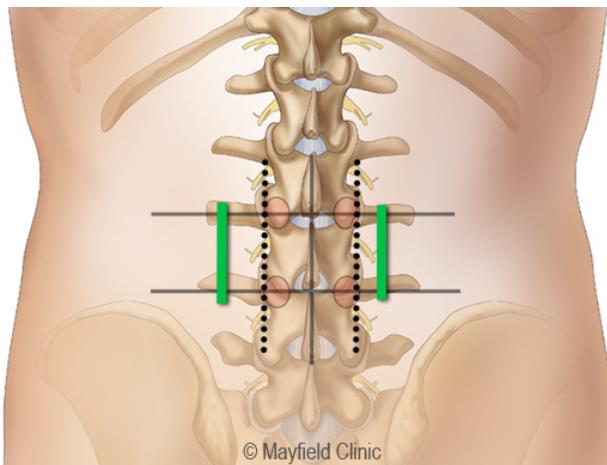


Figure 2. One-inch skin incisions (green lines) are made about 4.5 cm off the middle of your back.

### **Step 1: prepare the patient**

You will lie on the operating table and be given anesthesia. Once asleep, you will be positioned on your stomach with your chest and sides supported by pillows. The incision area is cleansed and prepped.

### **Step 2: make the incision**

An x-ray fluoroscope or image guidance is used to plan the approach. The surgeon makes small 1- to 2-inch incisions off the midline over the specific disc level (Fig. 2). A series of dilating tubes split the back muscles and create a path toward the spine.

### **Step 3: remove the facet joint**

The surgeon removes a portion of the bony lamina and facet joint (Fig. 3). This opens the spinal canal and exposes the dura sac protecting the nerves. Bone spurs and ligament are removed to free the nerve.

### **Step 4: remove the disc**

The nerve is gently retracted so the surgeon can remove the disc nucleus (Fig. 4). The disc annulus remains in place to hold the bone graft cage.

### **Step 5: prepare the disc space**

Bone shavers are used to prepare the fusion bed. The open disc space is measured and a spacer size is selected. The trial spacer is slid into the empty disc space. An x-ray is taken to ensure that the depth, placement, and wedge angle create sufficient height and decompress the nerves.

When a good fit is made, the bone graft material is prepared for the fusion. The mortar-like paste contains bone-growing proteins that are packed into the permanent bioplastic spacer cage.

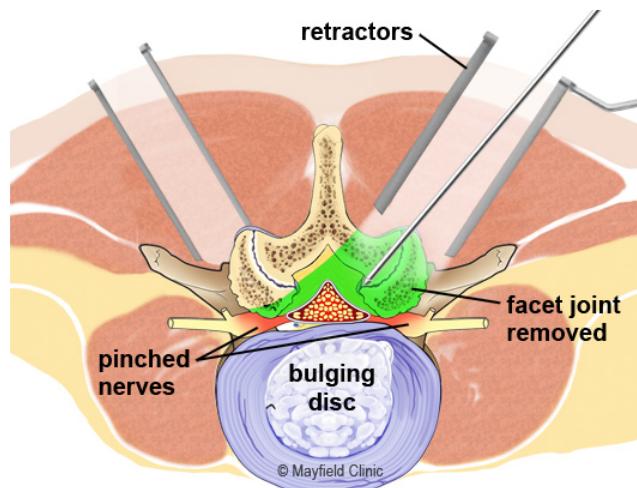


Figure 3. (Top view) Using tubular dilators, the surgeon splits the back muscles to reach the spine. The bony lamina and facet joint (green areas) are removed to decompress the nerves.

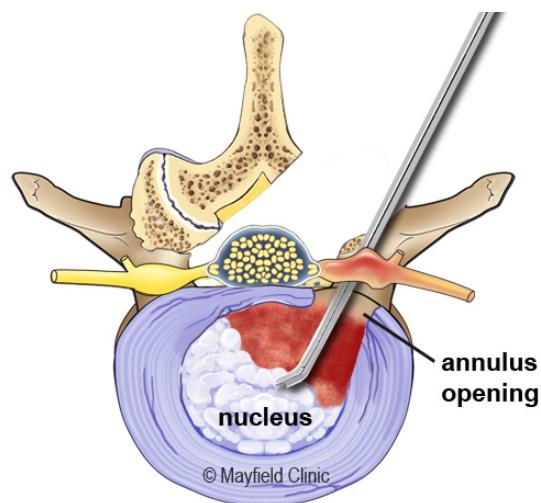


Figure 4. The disc nucleus is removed. Bone shavers are used to prepare a fusion bed..

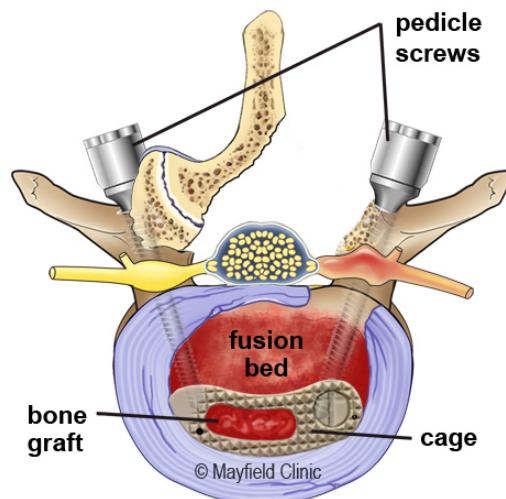


Figure 5. The cage is packed with bone graft material and inserted into the empty disc space. Screws are then placed through the pedicles into the vertebral body.

## **Step 6. insert the bone graft**

Guided by x-ray fluoroscopy, the permanent spacer cage is inserted into the empty disc space, pushing the two bones to restore normal disc height (Fig. 5).

## **Step 7. insert pedicle screws**

Two sets of pedicle screws are placed in the bone above and below the operated disc space and on both the right and left sides of the spine (Fig. 6). A rod is passed to connect two screws together.

In cases of spondylolisthesis, the surgeon pulls on the screws to realign the bones before securing them to the rod (Fig. 7). The hardware provides stability during fusion.

## **Step 8. close the incision**

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

## **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).

Patients typically go home the next day. Be sure to have someone at home with you the first 24 to 48 hours to help.

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 / twisting your back.
- 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**

- Wash your hands before and after cleaning your incision to prevent infection.
- 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

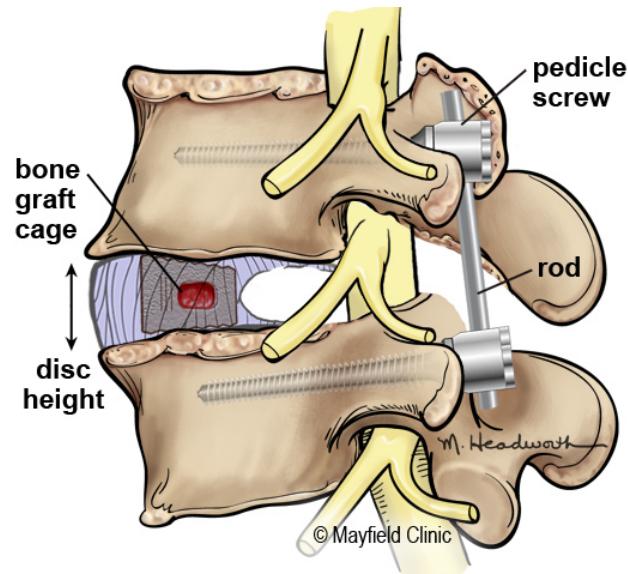


Figure 6. (Side view) A spacer cage restores the collapsed disc height, realigns the bones, and relieves pinching of nerves.

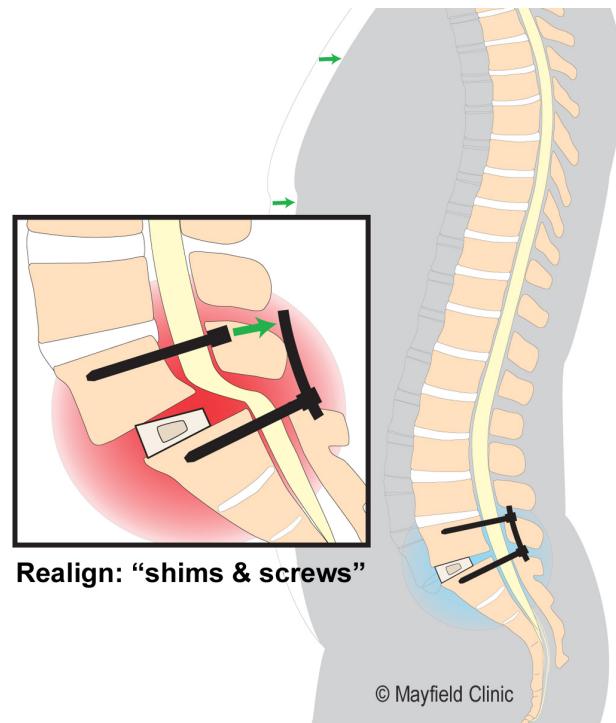


Figure 7. In spondylolisthesis, TLIF uses a wedged bone graft to shim the top vertebra while screws are used to pull the bones back into alignment on top of each other.

- two or more dressings in a day, call the office.
- Don't soak the incision in a bath, pool or tub.
- 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 will be 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 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 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 your surgeon's approval. They prevent new bone growth and may cause your fusion to fail.
- You may take acetaminophen (Tylenol).

### **Activity**

- 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.
- Get up and walk 5-10 minutes every 3-4 hours. Gradually increase walking, as you are able.
- If you were given a brace, wear it at all times except when sleeping, showering, or icing.

### **When to Call Your Doctor**

- Fever over 101.5° (unrelieved by Tylenol)
- Unrelieved nausea or pain
- Signs of incision infection, such as redness, swelling, or drainage.
- Rash or itching at the incision (allergy to Dermabond skin glue)
- Swelling and tenderness in the calf of one leg
- New onset of tingling or numbness 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 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.

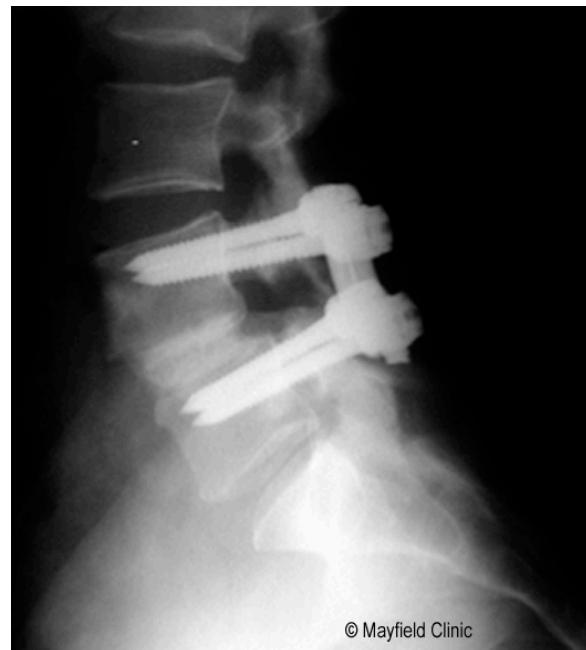
Recurrences of pain are common. The key to avoiding recurrence is prevention:

- Proper lifting techniques
- Good body mechanics and 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, transforaminal 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 lifestyle. Keep a positive attitude and perform your physical therapy as instructed.

Achieving a spinal fusion varies depending on the technique used, your general health, and whether you smoke (Fig. 8).



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Figure 8. X-ray at 3 months shows the bone graft has fused the two vertebrae into one solid piece of bone.

## 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 TLIF may include [1]:

**Vertebrae fail to fuse.** Common reasons why bones do not fuse include smoking and alcohol use, osteoporosis, obesity, diabetes, 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 the problem.

**Adjacent segment disease.** Fusion causes the transfer of added stress and load to the discs and bones above or below the fusion segment. The added wear and tear can eventually degenerate the adjacent discs 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 questions, please contact Semmes Murphey at 901-522-7700.

### Sources

1. Khan NR, Foley KT. Surgical Outcomes for Minimally Invasive vs Open Transforaminal Lumbar Interbody Fusion: An Updated Systematic Review and Meta-analysis. *Neurosurgery* 77:847–874, 2015

### Links

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

### 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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