

## Spondylolysis and Spondylolisthesis

### basic level

#### Overview

Spondylolysis (spon-dee-low-lye-sis) and spondylolisthesis (spon-dee-low-lis-thee-sis) are conditions that affect the moveable joints of the spine that help keep the vertebrae aligned one on top of the other. Spondylolysis is actually a weakness or stress fracture in one of the bony bridges that connects the upper and lower facet joints. This weakness can cause the vertebrae to slip forward out of their normal position, a condition called spondylolisthesis. Treatment options include physical therapy to strengthen the muscles surrounding the area. Sometimes the patient is placed in a brace. In severe cases, surgery is also an option.

#### Anatomy of the facet joints

Your spine is made of 24 moveable bones called vertebrae that provide the main support for your body, allowing you to bend and twist. Each of the vertebrae are separated and cushioned by a gel-like disc, keeping them from rubbing together. The vertebrae are connected and held to each other by ligaments and joints, called facet joints (see Anatomy of the Spine).

The upper facet joint (superior facet) and the lower (inferior facet) are connected by a narrow bridge called the pars interarticularis, which literally means the "piece between the articulations" (Fig. 1). The inferior facet of one vertebra fits perfectly into the superior facet of the one below it—overlapping like shingles—beginning with the vertebra at the base of your skull and ending at your tailbone.

#### What are spondylolysis & spondylolisthesis?

Spondylolysis and spondylolisthesis are separate, yet related conditions. Spondylolysis usually comes first, though not always. The term comes from "spondylo," which means "spine," and "lysis," which means to divide. Spondylolysis is a breakdown or fracture of the narrow bridge between the upper and lower facets, called the pars interarticularis (Fig. 2). It can occur on one side (unilateral) or both sides (bilateral) and at any level of the spine, but most often at the fourth or fifth lumbar vertebra. If spondylolysis is present, then you have the potential to develop spondylolisthesis.

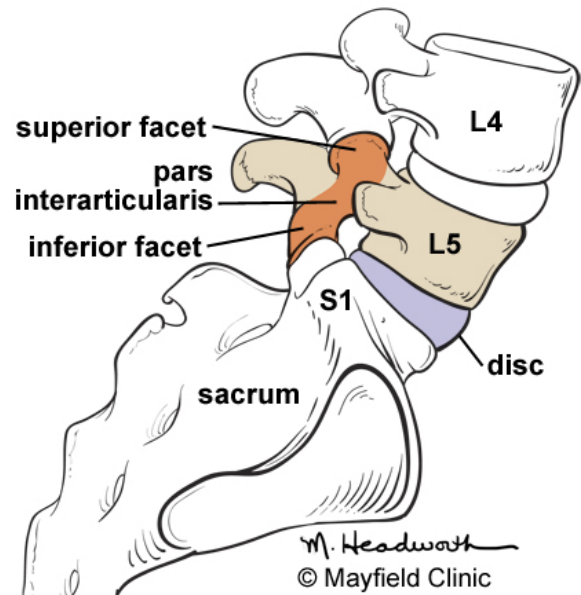


Figure 1. The superior and inferior facets articulate together forming the facet joint. Each vertebra has two facet joints, one pair that connects to the vertebra above (superior facets) and one pair that connects to the vertebra below (inferior facets). The thin bridge of bone that connects the superior and inferior facets is the pars interarticularis.

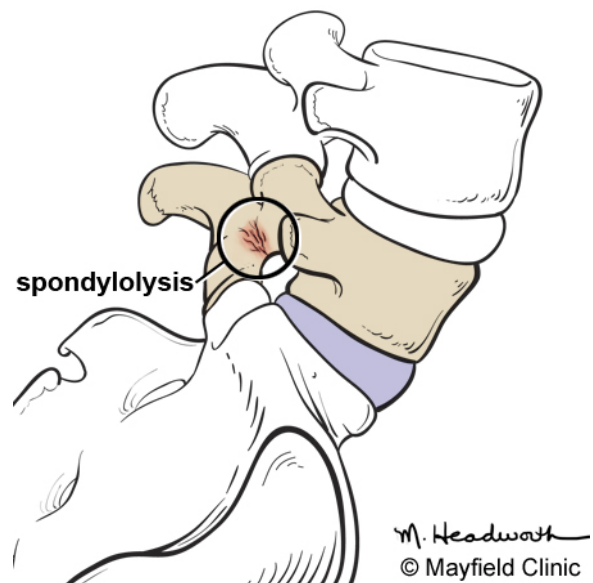


Figure 2. Spondylolysis is a breakdown or fracture of the pars articularis.

The term spondylolysis is misleading. There may be no crack in the bone because that bone could just be cartilage that never formed into bone. This shows up as a hole or gap on an X-ray. Or it could be that the back part of the vertebra broke off and tried to heal itself with scar tissue sometime in childhood.

Spondylolisthesis is the actual slipping forward of the vertebral body (the term "listhesis" means "to slip forward") (Fig. 3). It occurs when the pars interarticularis separates and allows the vertebral body to move forward out of position causing pinched nerves and pain. Spondylolisthesis usually occurs between the fourth and fifth lumbar vertebra or at the last lumbar vertebra and the sacrum. This is where your spine curves into its most pronounced "S" shape and where the stress is heaviest.

Slippage is measured on a scale from grade 1 slippage (25%) to grade 4 (100%). The more the lower back curves in (swayback or lordosis), the steeper the grade.

### What are the symptoms?

Mild cases of spondylolysis and spondylolisthesis usually cause minimal pain. In fact, the conditions are often found by accident when a person has a pre-employment examination or X-rays of the back for an unrelated reason.

When spondylolysis and spondylolisthesis do cause pain, you may experience low back pain, stiffness, and muscle spasms. You may also have sciatica (pain radiating down one or both legs), or numbness, though this is not common. Leg pain will usually be worse when you stand or walk.

The amount of pain you have depends on how fast your vertebrae are slipping. If you have very subtle symptoms, you may only feel tightness in your hamstrings or find that you can no longer touch your toes, but not feel any nerve pain.

### What are the causes?

Spondylolisthesis is most often caused by spondylolysis. The cause of spondylolysis is not as clearly defined. Most believe it is due to a genetic weakness of the pars interarticularis. Both spondylolysis and spondylolisthesis can be present at birth or occur through injury. Repeated stress fractures caused by hyperextension of the back (as in gymnastics and football) and traumatic fractures are also causes. The most common cause in adults is degenerative arthritis.

### Who is affected?

Those who play sports, especially gymnasts and football players, are more likely to have spondylolisthesis. The condition most often affects people over 40 years of age. About 5% of

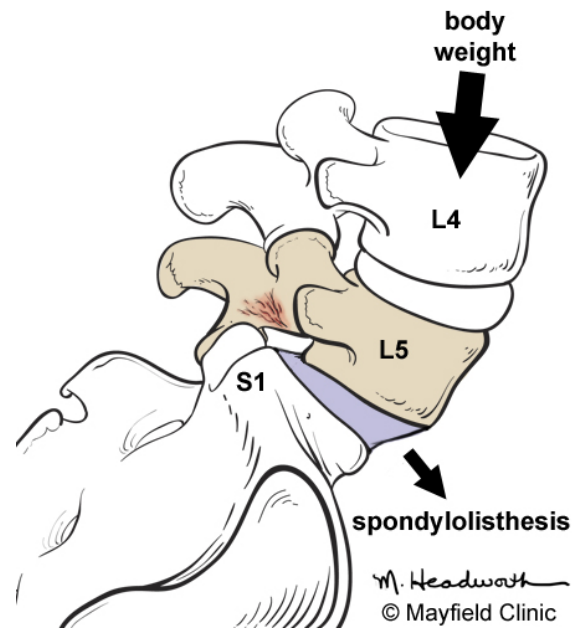


Figure 3. Spondylolisthesis is the forward slippage of a vertebra out of its normal position caused by spondylolysis. The facet joint is no longer able to hold the vertebra in place against the ever-present downward force of body weight.

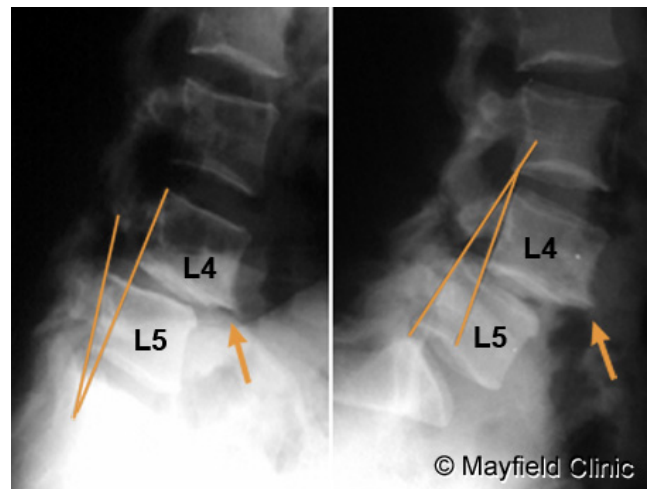


Figure 4. X-rays show spondylolisthesis at the L4-L5 vertebral level. The spine is flexed (left), then extended (right).

Americans have this structural deficiency and don't know it. Just because it shows up on an X-ray doesn't mean you will have pain.

### How is a diagnosis made?

When you first experience pain, consult your family doctor. Your doctor will take a complete medical history to understand your symptoms, any prior injuries or conditions, and determine if any lifestyle habits are causing the pain. Next a physical exam is performed to determine the source of the pain and test for any muscle weakness or numbness.

- **X-ray** test uses X-rays to view the bony vertebrae in your spine and can tell your doctor if any of them are too close together or whether you have arthritic changes, bone spurs, fractures, or any slippage of the vertebrae (Fig. 4).
- **Magnetic Resonance Imaging (MRI) scan** is a noninvasive test that uses a magnetic field and radiofrequency waves to give a detailed view of the soft tissues of your spine. Unlike an X-ray, nerves and discs are clearly visible. It allows your doctor to view your spine 3-dimensionally in slices, as if it were sliced layer-by-layer like a loaf of bread with a picture taken of each slice. The pictures can be taken from the side or from the top as a cross-section. It may or may not be performed with a dye (contrast agent) injected into your bloodstream. An MRI can tell your doctor where your spine is damaged and if there is any nerve compression. It can also detect bony overgrowth, spinal cord tumors, or abscesses.
- **Computed Tomography (CT) scan** is a safe, noninvasive test that uses an X-ray beam and a computer to make 2 dimensional images of your spine. Similar to an MRI, it allows your doctor to view your spine in slices, as if it were sliced layer-by-layer with a picture taken of each slice. It may or may not be performed with a dye (contrast agent) injected into your bloodstream. This test is especially useful for confirming if a disc is damaged.
- **Single Photon Emission Computed Tomography (SPECT) scan** is a sensitive diagnostic tool used to analyze blood flow to an organ which may help determine how that organ is functioning. It involves the injection of a small amount of radioactive substance into a vein. As the substance is circulated in the blood, it is absorbed by the tissues and then gives off energy. This energy is captured by a special camera that transfers the information to a computer. There the information is converted into a 3-dimensional picture. This picture can detect stress fractures, spondylolysis, infection, and tumors by the differences in how the radioactive substance is absorbed by normal healthy tissue vs. diseased tissue.

### What treatments are available?

First, athletic activity should be stopped to allow the fracture to heal. Conservative nonsurgical treatment is the first step and may include medication, rest, physical therapy, home exercises, hydrotherapy, a brace, chiropractic manipulation, and pain management. Periodic x-rays will allow the doctor to watch the degree of slippage. Surgery may be needed if slippage continues or if your pain doesn't respond to conservative treatment.

## Nonsurgical treatments

**Self care and braces:** Using correct posture (see Posture for a Healthy Back) and keeping your spine in alignment are the most important things you can do for your back. The lower back (lumbar curve) bears most of your weight, so proper alignment of this section can prevent further slippage and injury to your spinal nerves and discs. You may need to make adjustments to your daily standing, sitting, and sleeping habits and learn proper ways to lift and bend (see Self Care for Neck & Back Pain). You may need to wear a back brace for a short period of time while you strengthen the abdominal and lower back muscles. The brace may decrease muscle spasm and pain as well as help immobilize your spine and help the healing process. Your doctor may refer you to an orthotist who specializes in custom-made braces.

**Physical therapy:** The goal of physical therapy is to help you return to full activity as soon as possible. Exercise is very helpful for pain and it can help you heal faster (see Exercise for a Healthy Back). Physical therapists can instruct you on proper lifting and walking techniques, and they'll work with you to strengthen your abdominal muscles and lower back. They'll also encourage you to increase the flexibility of your spine and legs.

**Medication:** Your doctor may prescribe pain relievers, nonsteroidal anti-inflammatory medications (NSAIDs), and steroids. Sometimes muscle relaxers are prescribed for muscle spasms.

- **Nonsteroidal anti-inflammatory drugs** (NSAIDs), such as aspirin, naproxen (Aleve, Naprosyn), and ibuprofen (Motrin, Nuprin, Advil) are used to reduce inflammation and relieve pain.
- **Analgesics**, such as acetaminophen (Tylenol), can relieve pain but don't have the anti-inflammatory effects of NSAIDs. Long-term use of analgesics and NSAIDs may cause stomach ulcers as well as kidney and liver problems.
- **Steroids** can be used to reduce the swelling and inflammation of the nerves. They are taken orally (as a Medrol dose pack) in a tapering dosage over a 5-day period. They have the advantage of providing pain relief within a 24-hour period.
- **Epidural steroid injections:** This minimally invasive procedure involves an injection of corticosteroid and an analgesic-numbing agent into the epidural space of the spine to reduce the swelling and inflammation of the nerves. About 50% of patients will notice relief after an epidural injection, although the results tend to be temporary. If the injections are helpful, they can be done up to 3 times a year.

- **Facet injections:** This minimally invasive procedure involves an injection of corticosteroid and an analgesic-numbing agent to the painful facet joint, either inside the joint capsule or in the tissue surrounding the joint capsule.

**Holistic therapy:** Some patients want to try holistic therapies such as acupuncture, acupressure, nutritional supplements, and biofeedback. The effectiveness of these treatments for spondylolysis may help you learn coping mechanisms for managing pain as well as improving your overall health.

### Surgical treatments

If slippage continues or if your pain doesn't respond to conservative treatment, surgery may be necessary. Surgery can address both the instability of the spine and compression of the nerve roots. The surgeon may first perform a lumbar laminectomy to relieve pressure on the nerve root. Then a bone graft will be used to fuse the loose vertebrae and keep them from sliding out of place. In some cases metal plates, hooks, rods and screws may be used to support the fusion. It may take a while for the two pieces of bone to grow together, so you should avoid extremes of motion while healing. Fusion is successful in over 90% of cases because it stops the instable motion and keeps your spinal canal from narrowing further.

### Clinical trials

Clinical trials are research studies in which new treatments - drugs, diagnostics, procedures, vaccines, and other therapies - are tested in people to see if they are safe and effective. You can find information about current clinical investigations, including their eligibility, protocol, and participating locations, on the web at: the National Institutes of Health (NIH) at [clinicaltrials.gov](http://clinicaltrials.gov) and [www.centerwatch.com](http://www.centerwatch.com).

### Sources & links

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

### Links

[www.spine-health.com](http://www.spine-health.com)  
[www.spineuniverse.com](http://www.spineuniverse.com)  
[orthoinfo.aaos.org](http://orthoinfo.aaos.org)



Figure 5. X-ray shows the screws, rods, and bone graft that have been placed to realign the vertebrae on top of each other and create a spinal fusion.

### Glossary

- degenerative arthritis:** the wearing away of cartilage that cushions joints in the hands, feet and spine. Bone spurs can develop where the joints rub together resulting in limited motion.
- foramen** (intervertebral foramen): the opening or window between the vertebrae through which the nerve roots leave the spinal canal.
- hyperextension:** extending a joint or limb beyond its normal limit.
- lamina:** flat plates of bone originating from the pedicles of the vertebral body that form the posterior outer wall of the spinal canal and protect the spinal cord. Sometimes referred to as vertebral arch.
- lordosis:** increased curvature of the normally curved lumbar spine that tends to make the buttocks more prominent.
- pars interarticularis:** the narrow strip of bone between the superior and inferior facets of the vertebra.
- spondylolisthesis:** when one vertebra slips forward on another.
- spondylolysis:** a spinal instability in which there is a weakness between the body of a vertebra and the pedicle.

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 reviewed by > Theresa Greenwald, RN



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