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- Thomas N. Bernard, Jr., MD

The Anatomy of Low Back Pain

Low back pain affects 1 in 6 individuals. During his or her lifetime, 80% of adults will have an episode of low back pain requiring some form of medical treatment.¹ Americans spend at least \$50 billion each year on low back pain, the most common cause of job-related disability and a leading contributor to missed work.²

To successfully manage low back pain, your physician must accurately locate the source of the pain. Physicians find the source of low back pain by taking a thorough medical history, by examining the patient, and by analyzing diagnostic images. Often, patients with low back pain can be treated without surgery; however, patients with severe injuries or illness can require an operation.

Anatomy of the back

The back is a complex structure of bones and tissues covering the body's trunk from the neck to the pelvis (see page 3). The spinal column supports the upper body's weight and houses and protects the spinal cord, a delicate nervous system structure that carries nerve signals for body movement and conveys sensations. Vertebral bones are stacked on top of one another creating the spinal column. In the spaces between the vertebrae, spongy pads of cartilage called intervertebral discs allow for flexibility and act like shock absorbers during body movement. In adults, the spinal cord descends from the base of the brain to just below the rib cage. Small nerves or nerve roots enter and emerge from the spinal cord through spaces between the vertebrae.

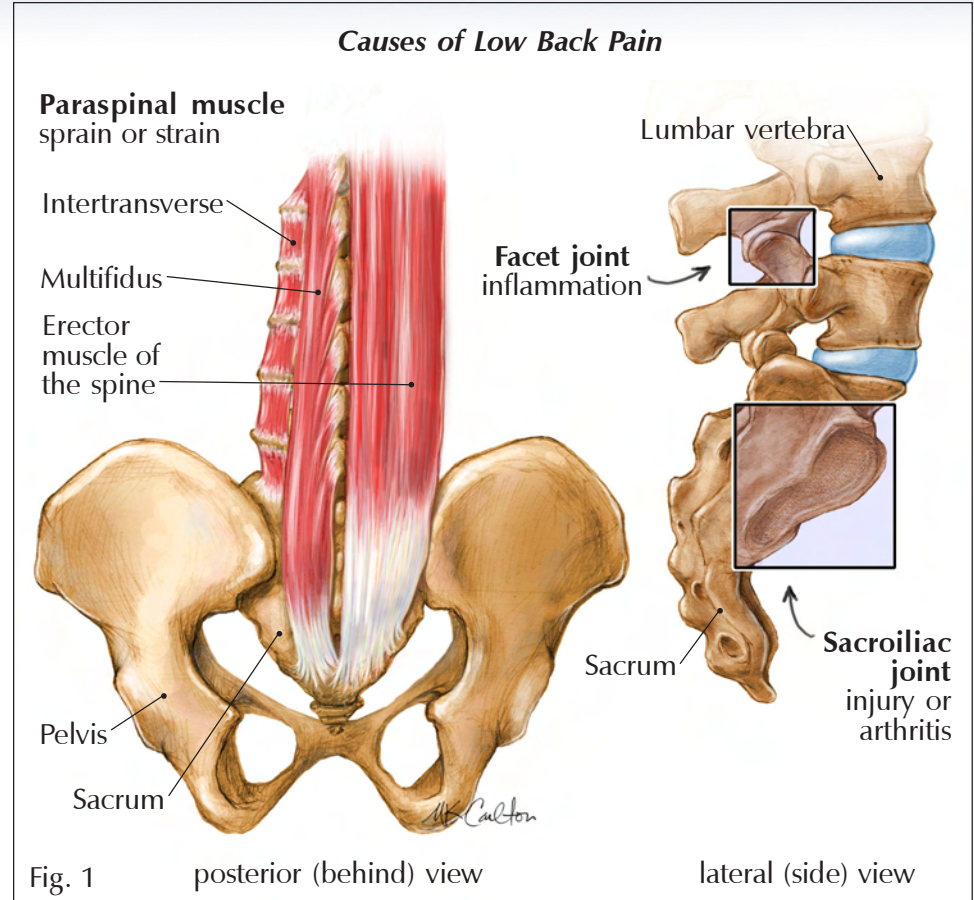


Fig. 1 posterior (behind) view

lateral (side) view

Starting from the top, the spine has 4 regions: the **cervical** spine, which consists of the 7 cervical, neck, vertebrae, C1 to C7; the **thoracic**, or upper back, consisting of 12 vertebrae, T1 to T12; the **lumbar** spine, or lower back, consists of 5 vertebrae, L1 to L5; and the **sacral** spine consists of 5 segments of the lower spine and the coccyx, which are fused together at the base of the spine.

Causes of low back pain

Low back pain can be caused by injury or disease such as arthritis. Lumbar strain (stretching or tearing a muscle or tendon) or sprain (stretching or tearing a ligament) can cause injury to the facet joints or paraspinal muscles (muscles adjacent to spinal column) (Fig. 1). This type of injury can be self-limiting; however, it can be treated with ice, heat, stretching exercises, anti-inflammatory medications, and muscle relaxants. Physical therapy or manual, or manipulative, therapy can help with recovery, as well.

Back pain that radiates into the lower extremities can be referred pain from the facet joints or sacroiliac joint or from an irritated or compressed nerve caused by a disc herniation or spinal stenosis (narrowing of the spinal canal that houses the spinal cord and nerve roots). Often, patients with moderate symptoms from nerve compression improve with medications, physical therapy, or spinal injections. However, surgery can be necessary if a patient's level of pain cannot be managed by nonoperative treatment or if the nerve damage continues.

Diagnostic tools

Magnetic resonance imaging (MRI, a scan that shows the bones, muscles, tendons, and ligaments) and computed tomography (CT, a scan using special x-ray equipment to show bones, organs, and soft tissue) have revolutionized the ability to show the anatomy of the spine. Congenital (at birth) abnormalities, fractures, tumors, infection, disc herniations (a bulging or protruding disc), degenerative (wear and tear) changes, and nerve compression can be displayed with these advanced imaging techniques.

Preventing low back pain

Several proactive measures can reduce the risk of low back pain. Although, some back problems are hereditary, these preventive measures can be helpful in preventing common causes of low back pain.

- Quit smoking. Smokers have a higher incidence of low back pain due to chronic coughing and the harmful and toxic agents in smoke that increase disc degeneration.
- Diet sensibly. Obesity hastens disc degeneration and makes rehabilitation more difficult. Weight reduction programs should be initiated by a professional. Avoid crash dieting.
- Exercise regularly. A 30-minute walk each day is as good as an "apple a day," to keep the doctor away.

Advanced exercise programs should be supervised by a professional and structured to the individual's particular needs. Some moderate-level low back exercises are shown below (Fig. 2).

- Reduce osteoporosis. Menopausal women should have periodic bone density evaluations to identify those who are at risk for osteoporosis. It is much easier to treat this problem early rather than later after it develops. Osteoporotic spine or pelvic fractures are more common in the aging population.
- Avoid habit-forming drugs. Many doctors with good intentions prescribe narcotic medications for back pain that can be treated by other methods. These medications can become habit forming if taken on a regular basis.
- Avoid work-related back pain. Learn proper body mechanics for physically demanding jobs. Even with sedentary jobs, ergonomic workstations, chairs with a lumbar support, and a safety conscious employer are essential to reduce work-related low back pain.
- Have an annual check up. All adults should have an annual wellness physical examination by their primary care physician. Detecting and treating abnormal conditions and disease can prevent chronic back pain.

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References:

1. Haldeman, SD, Kirkaldy-Willis WH, Bernard, Jr. TN. *An Atlas of Back Pain: The Encyclopedia of Visual Medicine Series*. Parthenon Publishing. 2002:9.
2. National Institute of Neurological Disorders and Stroke. Low Back Pain. www.ninds.nih.gov/disorders/backpain/detail_backpain_pr.htm. Accessed 12/7/05.

Exercise 1: Standing Extension with Lateral Bending

- ① Starting position- place hands in small of back and lean backwards.



- ② While leaning backwards, lean to the right, hold briefly, then return to starting position.



- ③ While leaning backwards, lean to the left, hold briefly, then return to starting position.



Exercise 2: Single Knee to Chest

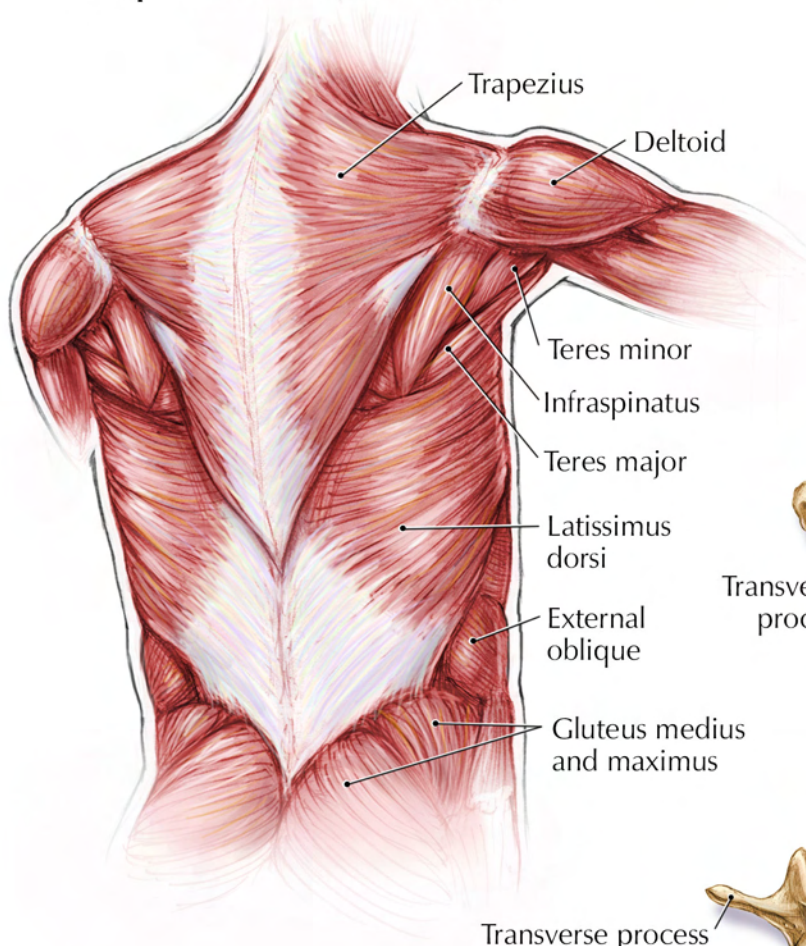
Starting position- Lie on back with one leg straight, clasp both hands over the other knee with hip flexed 90 degrees. Gently pull knee toward chest to feel stretch in lower back. Return knee to ground and repeat with the other leg.



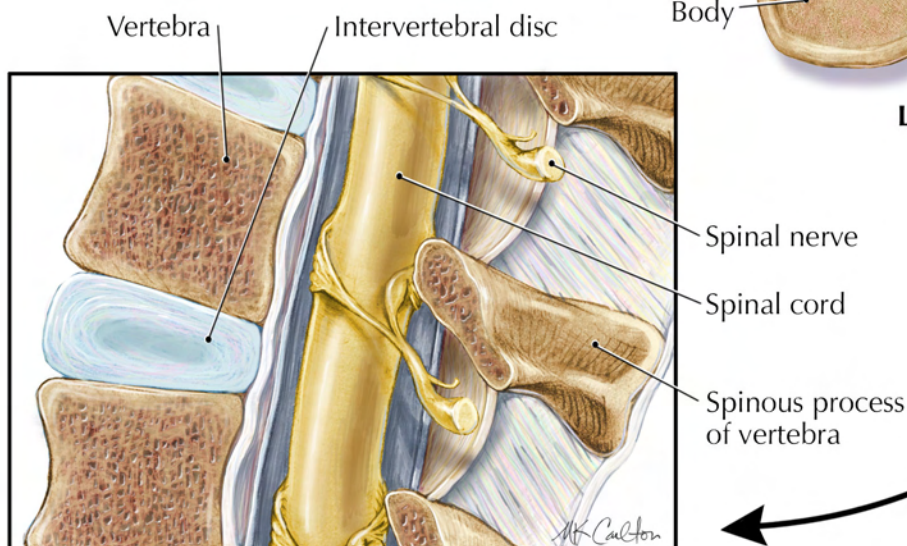
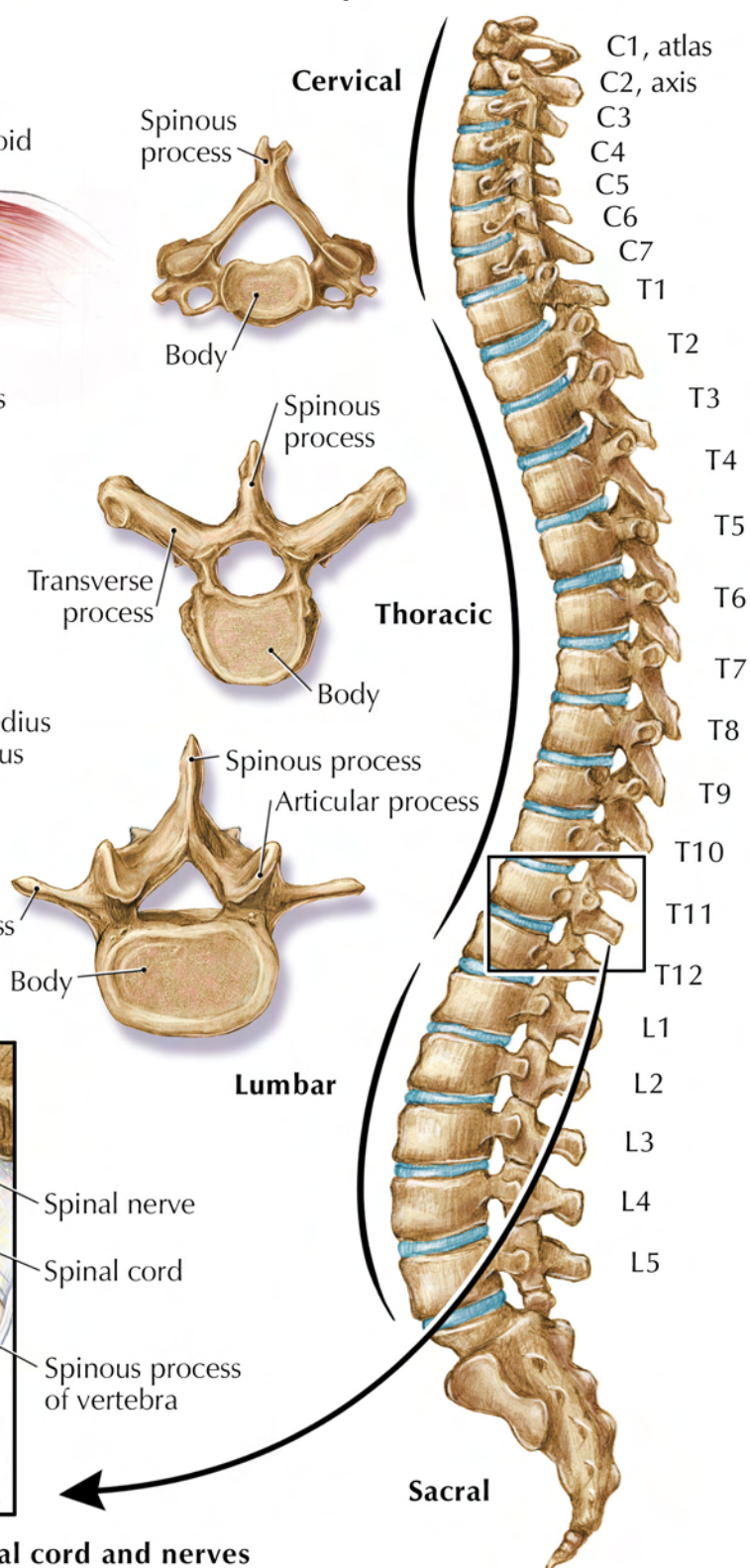
Fig. 2

BACK to the basics: ANATOMY OF THE BACK

Superficial muscles of the back



The spine and the vertebrae



Cross section of T11 vertebra showing the spinal cord and nerves

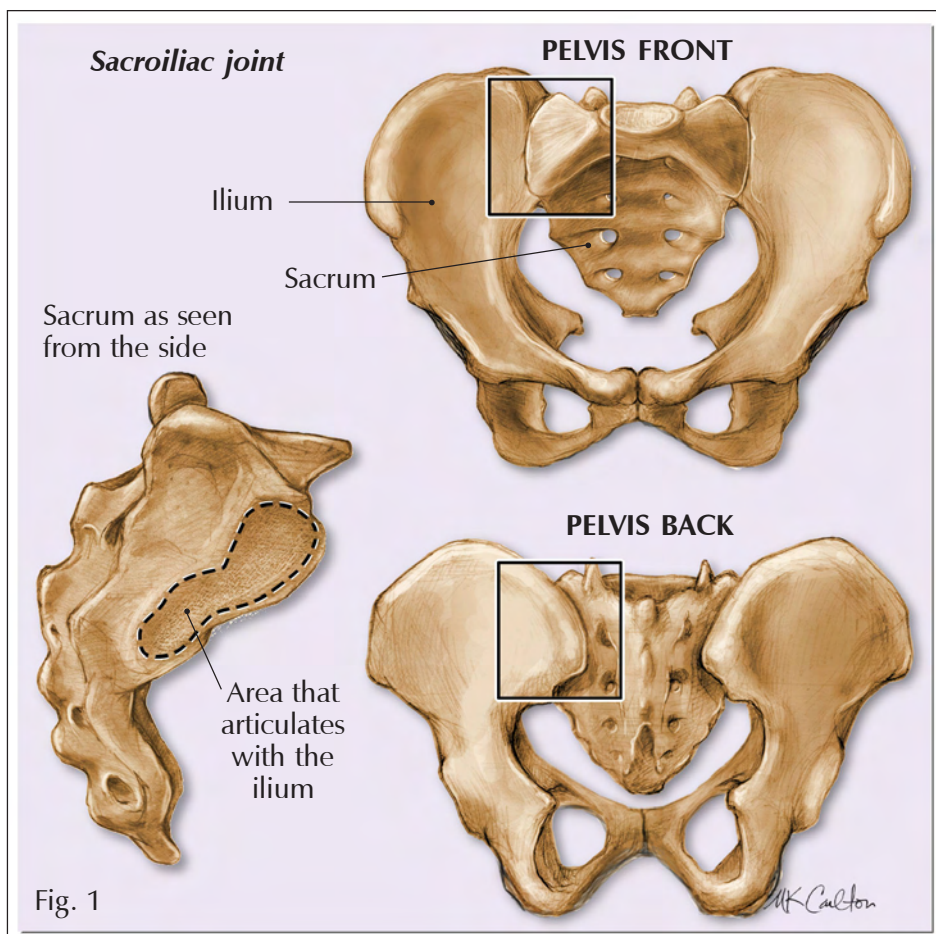
Sacroiliac Joint Dysfunction

A common cause of back pain

The sacroiliac (SI) joint, one of the most stable joints of the body, is an unevenly shaped joint formed where the hipbone meets the sacrum (Fig. 1). It has very little motion, but the motion it does have is important for the proper functioning of the lumbar spine (lower back), and hips. The SI joints act like shock absorbers for the pelvis and the lower back during motion, reacting continually while the body is moving.

How did I do it?

SI joint dysfunction is one of the most common problems found in people who have back pain. Some people notice a problem right away, while others can live with occasional pain and discomfort for months or years. The SI joint can become injured from trauma (slips or falls), from inflammatory conditions, or from overuse.



Orthopaedic Tests for Sacroiliac Joint Dysfunction

A physical examination can include several orthopaedic tests to determine if the sacroiliac joint is causing low back pain. Two tests that health-care professionals commonly use are Patrick's test and Gaenslen's test.

Patrick's test stresses the hip and sacroiliac joints. With the patient supine (on the back), the right leg is lifted to where the ankle rests on the left knee. Then, the right knee is pressed downward to test for hip mobility. A positive test produces back, buttocks, or groin pain. The test is completed for both legs to test both sacroiliac joints.

Gaenslen's test is performed by maximally flexing the hip joint on one side while the opposite hip joint is extended. With the patient supine, both legs are brought up to the chest, and then one leg is allowed to drop slowly over the edge of the examination table without support. This maneuver stresses both the sacroiliac joints simultaneously and will cause pain.

The pain from SI joint dysfunction can come from doing something as simple as bending over to pick up a pencil or tie a shoe or from slipping on a rug and falling in your kitchen. It is also common during pregnancy. An overuse injury can occur when an athlete trains without enough recovery time; when someone who has a "sitting job" works in the yard all weekend; or when the elementary school teacher chases, bends, and gets on eye level with his or her students.

Signs and symptoms

Pain from SI joint dysfunction can be sharp or a dull ache, and muscle spasms are common. Often, the pain can be felt in the groin, in the buttocks, below the knee, or in the front or back of the thigh. Numbness, tingling, and leg "heaviness" are common. The pain and symptoms can often be mistaken for a disc or nerve problem. SI joint dysfunction often occurs along with facet joint dysfunction in the lumbar spine. It can also exist along with other injuries or diseases, such as herniated (protruding or bulging) discs, spinal stenosis (narrowing of the spinal canal that houses the spinal cord and nerve roots), degenerative (wearing) disc and joint disease, sciatica (herniated lumbar disc causing nerve root irritation), and arthritis. The symptoms can become worse with prolonged standing or sitting, bending, lifting, standing up from a seated position, and stair climbing. Often,

athletes with persistent hamstring strains have underlying SI joint dysfunction.

Treatment

After a visit to the doctor and the possibility of a condition that requires surgery has been eliminated, nonoperative treatment can begin.

You need 4 things for a healthy back: 1) normal mobility, 2) back muscle endurance, 3) strength, and 4) flexibility. A referral from the doctor to a skilled manual physical therapist is needed to restore mobility of the spine. Once normal mobility has been reached by appropriate and specific manual therapy techniques, exercises can be started to maintain the mobility of the joint. Soon afterwards, endurance exercise (usually a gradual walking program), and specific strengthening and flexibility exercises can be added.

SI joint dysfunction is a rather common ailment; however, it can be misdiagnosed and mistreated. The majority of low back problems related to joint dysfunction or weak muscles can be treated by a skilled manual physical therapist without the need for surgery.

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Suggested reading:

Boers T. *The Manual Therapist Approach to Low Back Pain in Managing Low Back Pain*, 4th Ed. Kirkaldy-Willis WH and Bernard TN, editors. Philadelphia: Churchill Livingstone. 1999.

Back Pain

Back pain is one of the most common ailments treated in the United States. However, the good news is that most back pain resolves with exercise and mild medication. Also, there are simple exercises you can do to prevent back pain.

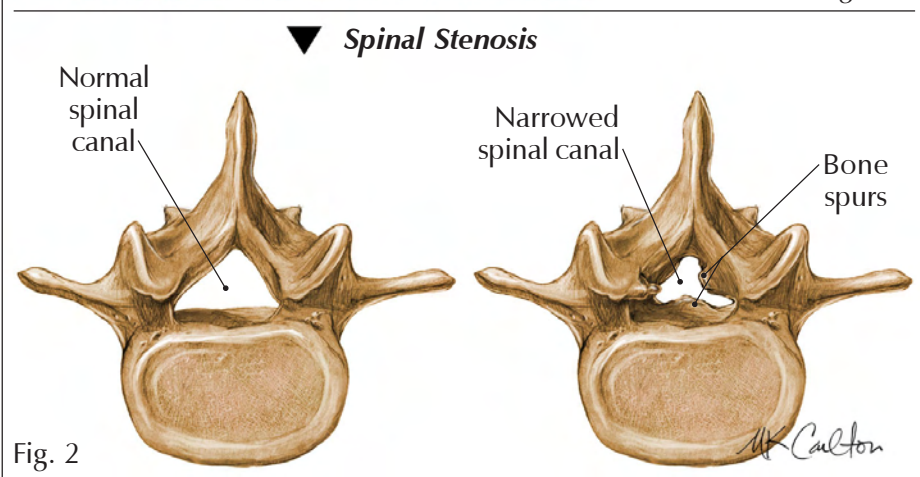
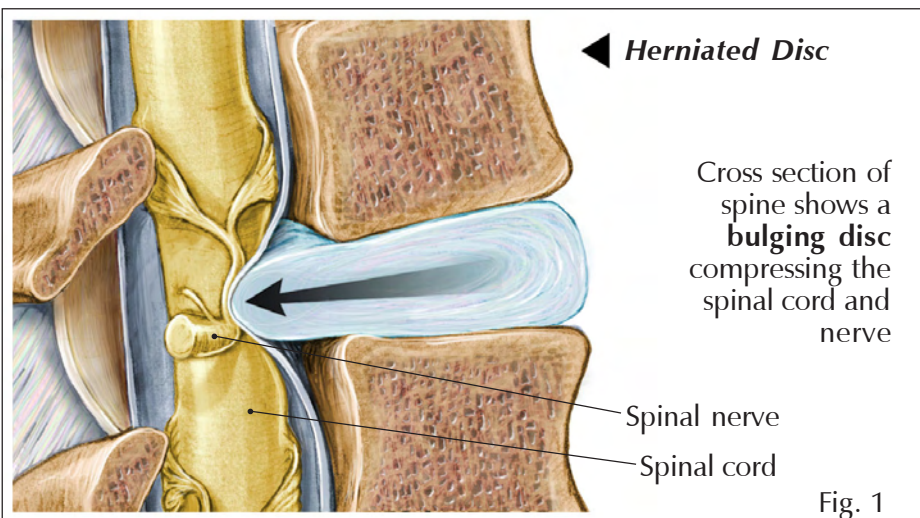
Causes of back pain

The causes of back pain vary, but they can be separated into 2 major categories: acute (sudden, traumatic) and chronic (long-term). Acute back pain lasts for less than 6 weeks and can often be associated with a specific incident. Acute episodes of back pain may be related to overuse, such as repeated twisting and bending and improper lifting techniques. Often, these muscular pains

resolve with rest, moist heat, and mild pain relievers such as aspirin or acetaminophen.

Acute pain can also be caused by an injury that results in a fracture or a herniated (protruding or bulging) disc (Fig. 1). A compression fracture can result from minor injuries in patients with osteoporosis. Compression fractures can be treated with pain medication, bracing, and, occasionally, with vertebroplasty or kyphoplasty (injection of bone cement into the vertebrae to stabilize the bone). Disc herniations can occur suddenly and lead to back pain, muscle spasm, and, frequently, leg pain. These herniations may resolve with exercise and medication, or they can persist and require surgical removal of the disc.

Chronic back pain is much more common and often more difficult to treat than acute back pain. It can be caused by degenerative (wearing) changes in the spine. The discs, which are cushions between the bones, often narrow and stiffen with age, leading to degenerative disc disease. The spinal canal can narrow because bone spurs can form on the small facet joints, or bone spurs can develop on the vertebrae themselves leading to spinal stenosis (Fig. 2). Instability between the vertebrae can also lead to chronic back and leg pain.



Protecting the back

Risk factors for developing back pain include obesity, a sedentary life style, frequent heavy lifting with improper mechanics, improper sitting mechanics, and frequent twisting and bending. To avoid injury to the back, always lift objects keeping them balanced and centered and lift with knees flexed, using the legs to do most of the work. Sit with proper lumbar support, feet on the ground, and have work centered in front of you, not off to the side. A regular exercise program that emphasizes core strengthening and aerobic activity will help to protect the back. These exercises include partial sit-ups, hamstring stretching and strengthening, and lumbar strengthening.

Back pain can begin as aching, stiffness, or spasms in the lower back. These symptoms can be treated with rest—avoid heavy lifting and frequent twisting or bending—and use moist heat and mild pain medication. Exercises to stretch the back and legs and strengthen the abdomen and lumbar spine should be started within a few days of the onset of pain. Aerobic exercise, such as walking or swimming, should also be started after 2 or 3 days rest. These simple measures will maintain strength and flexibility and allow for a more rapid recovery.

Pain, numbness, or tingling in the legs may be associated with back pain injury and is due to involvement of the nerve as it exits the spine. The pain is caused by pressure on the nerve or inflammatory changes around the nerve. This type of pain can require a medication called a nonsteroidal anti-inflammatory drug with or without a muscle relaxant. Early treatment also includes a strengthening, stretching, and aerobic exercise program. If pain persists beyond several weeks, diagnostic images of the back may be needed. The doctor may order an MRI (magnetic resonance image, a scan that shows bones, muscles, tendons, and ligaments), an EMG/NCV test (nerve study test), a myelogram (injection of dye into the spinal canal), or other studies.

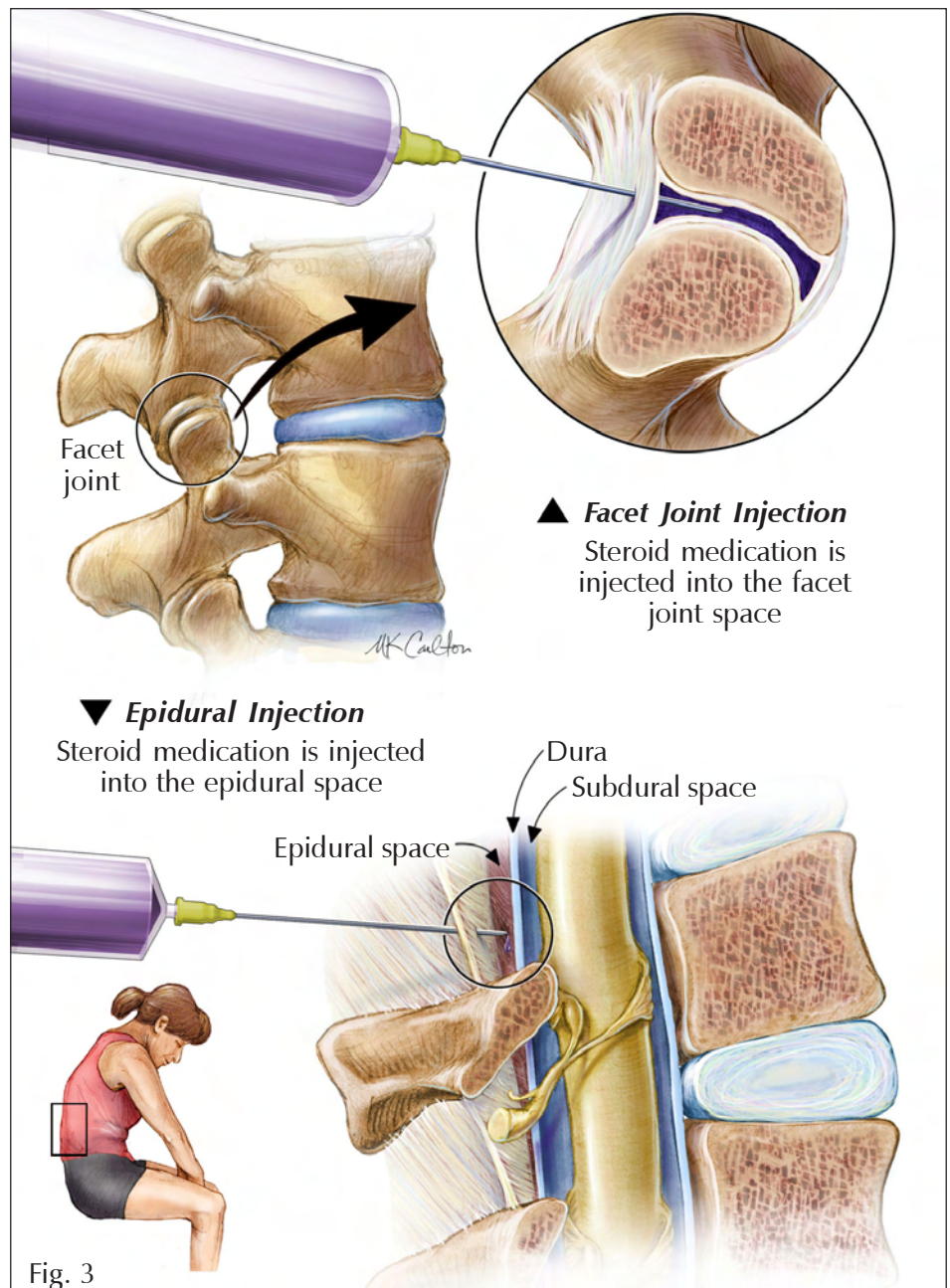
Treatments

Once the cause of the pain is determined, the treatment may include injections into the epidural space or the facet joints with a steroid medication (Fig. 3). These injections help to decrease inflammation around the nerves and decrease the pain. Persistent pain may indicate a need for surgery to

remove or replace the disc, to remove the bone spurs, or to fuse the unstable spinal segments.

To learn more about correct lifting techniques, sitting posture, and exercises, visit the American Academy of Orthopaedic Surgeons Web site at www.aaos.org.

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Core Stability

Have a 'ball' building a strong core

Severe back pain is second only to the common cold as a reason employees miss work, making it a major health concern. What can you do to diminish the possibility of experiencing low back pain? A focus gaining popularity is exercise that promotes a strong **core** or trunk to provide stability for the lower back.

Providing support like a corset, the core muscles of your trunk, or torso, surround the trunk, pelvis, abdomen, and spine. A recent trend is to use an exercise ball to strengthen the core muscles. An exercise ball is a large vinyl ball, inflated at different degrees and used during stretching and exercise routines. Doing exercises on an exercise ball takes away the firm foundation your body uses to support itself. Decreasing the stability provided by this foundation makes your body use muscles that you seldom use to maintain balance. Exercises using the ball target a specific muscle group and require the involvement of additional muscle groups. In turn, the core muscles work together to respond to your body's movements, improving stability, balance, and posture.

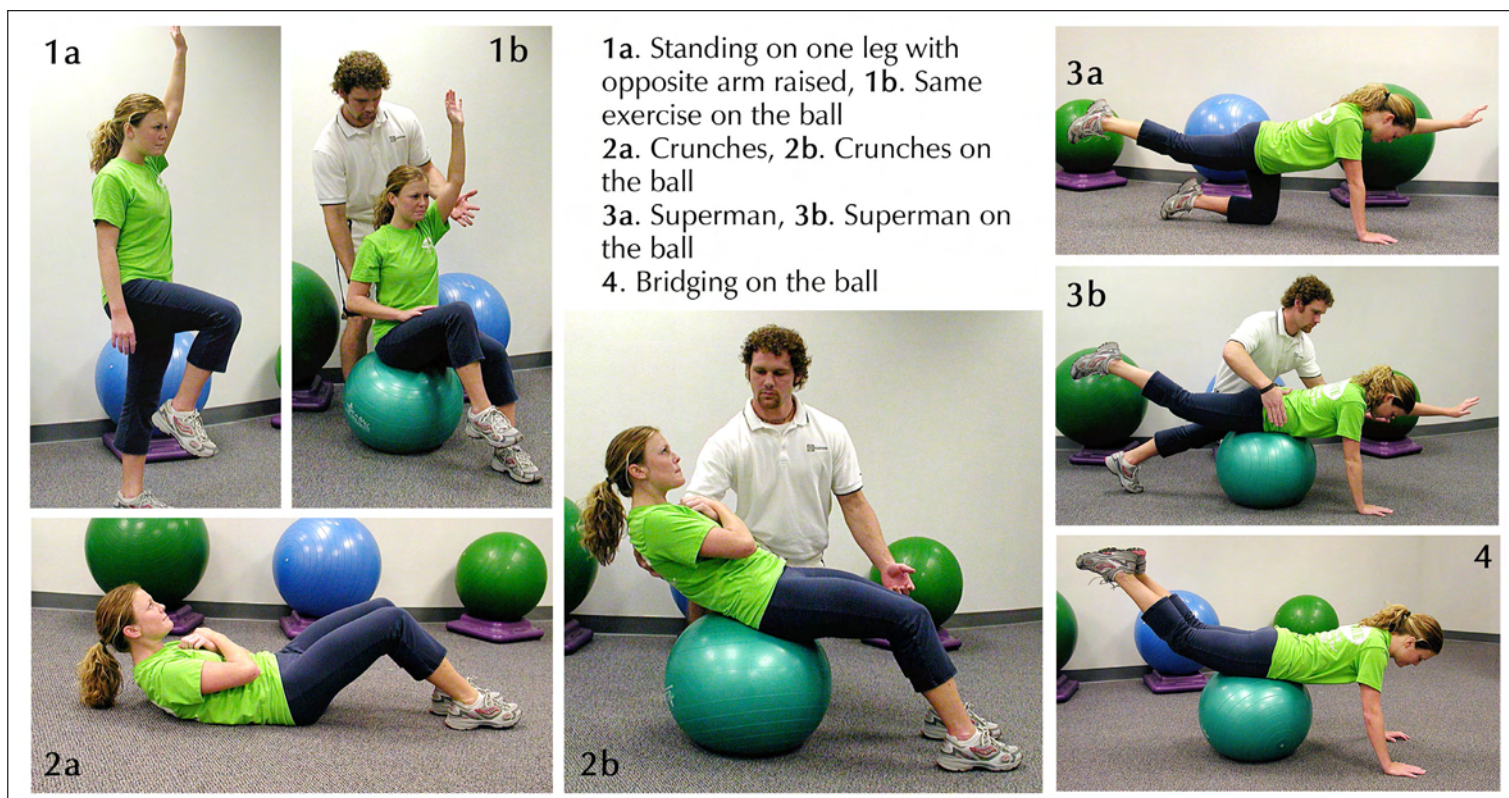
Everyone needs a strong, stable core. When the lower back becomes stronger, the muscles have the endurance needed to support the upper body throughout the day. Unfortunately, the average person spends little time exercising, especially with the allure of the Internet, advances in home entertainment, movie theatres, and

increases in travel. As people become more sedentary, our core muscles are used less often causing them to weaken and provide less spine support. This weakness opens the door for a possible injury leading to low back pain.

Before getting started with core exercises using an exercise ball, you should make an honest assessment of your physical ability and receive a physician's approval. Warm-up prior to starting the core exercises by walking or riding a stationary bike. Select 3 to 4 low-level exercises that challenge your core and balance. Sitting on a ball isn't easy; therefore, when possible have a physical therapist instruct and assist you with the exercises to ensure proper technique and repetitions. Most exercises done on a gym floor can be advanced to lower-level ball exercises (Figs. 1-4), such as the single leg sit and stand, crunches, superman, and bridging. As you progress with core strength, the level of difficulty of the exercises can be increased to improve core stability.

There are plenty of exercises that can challenge your core strength and stability and resources abound to assist you in getting started. There are physical therapists, athletic trainers, personal trainers, fitness classes, and videotapes from which you can learn. You can also join Pilates, yoga, or aerobics classes that use the ball in their workout programs. The best advice is to find a program that you enjoy and are most likely to continue.

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Thomas N. Bernard, Jr., MD, is a native of New Orleans, Louisiana, where he attended Tulane University and received his undergraduate degree in biology. After graduation in 1971, he was commissioned in the United States Navy and served as gunnery officer aboard the U.S.S. Hawkins (DD-873) until 1974. After a year of graduate studies in biology at Tulane Graduate School, he entered Tulane Medical School, graduating in 1979.

Dr. Bernard interned at the United States Public Health Hospital in New Orleans from 1979-1980. Shortly after, he started his orthopaedic residency with the Tulane University Department of Orthopaedic Surgery. In his final year of training, he served as Chief Resident. Upon completion of his residency, Dr. Bernard underwent postgraduate training as a spine fellow with Dr. Henry LaRocca in New Orleans and with Dr. W.H. Kirkaldy-Willis at the University of Saskatchewan, Canada.

Dr. Bernard is board certified in orthopaedic surgery. In 1994, he was recertified in this field. He is affiliated with the Tulane University Department of Orthopaedic Surgery as an Assistant Clinical Professor of Orthopaedic Surgery. He holds membership with the North American Spine Society and the American Back Society. Dr. Bernard has published more than thirty scientific articles and currently serves on the editorial board of the medical journal *Spine*.

Dr. Bernard and his wife, Denise, have four children.



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