Questions & Answers about . . .

Spinal Stenosis

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
National Institutes of Health
Public Health Service • U.S. Department of Health and Human Services

For Your Information

This publication contains information about medications used to treat the health condition discussed here. When this booklet was printed, we included the most up-to-date (accurate) information available. Occasionally, new information on medication is released.

For updates and for any questions about any medications you are taking, please contact the U.S. Food and Drug Administration at 1–888–INFO–FDA (1–888–463–6332, a toll-free call) or visit their Web site at www.fda.gov.

Additional copies of this booklet are available from

National Institute of Arthritis and Musculoskeletal and Skin Diseases
NIAMS/National Institutes of Health
1 AMS Circle
Bethesda, MD 20892–3675

You can also find this booklet on the NIAMS Web site at www.niams.nih.gov/hi/topics/spinalstenosis/spinal_sten.htm.

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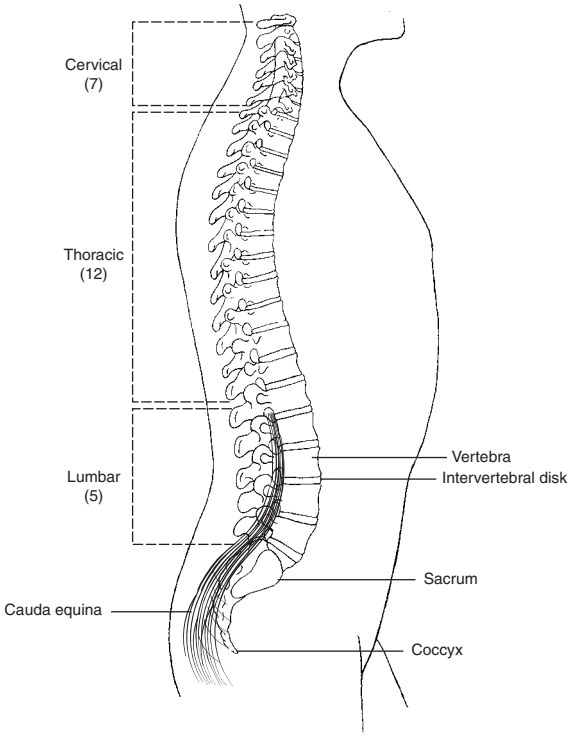
This publication contains general information about spinal stenosis. It describes the condition's causes, symptoms, diagnosis, and treatments. At the end is a list of additional resources. If you have further questions after reading this publication, you may wish to discuss them with your doctor.

What Is Spinal Stenosis?

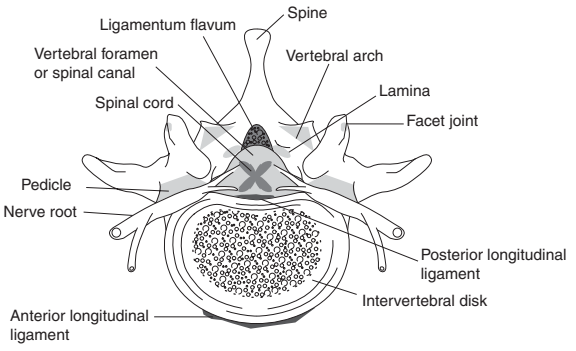
Spinal stenosis is a narrowing of spaces in the spine (backbone) that results in pressure on the spinal cord and/or nerve roots. This disorder usually involves the narrowing of one or more of three areas of the spine: (1) the canal in the center of the column of bones (vertebral or spinal column) through which the spinal cord and nerve roots run, (2) the canals at the base or roots of nerves branching out from the spinal cord, or (3) the openings between vertebrae (bones of the spine) through which nerves leave the spine and go to other parts of the body. The narrowing may involve a small or large area of the spine. Pressure on the lower part of the spinal cord or on nerve roots branching out from that area may give rise to pain or numbness in the legs. Pressure on the upper part of the spinal cord (that is, the neck area) may produce similar symptoms in the shoulders, or even the legs. (See figs. 1, 2 and 3.)

Figure 1



Side View of Spine

Figure 2



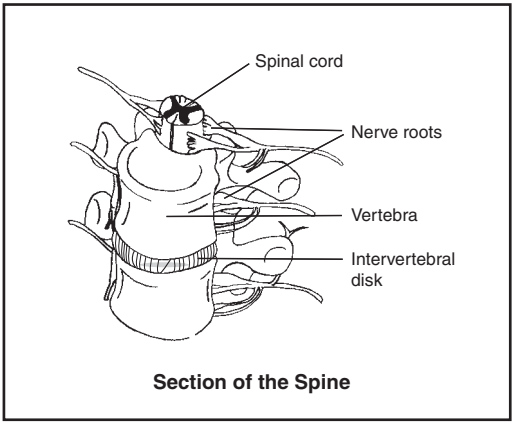
Structures of the Spine

Who Gets Spinal Stenosis?

This disorder is most common in men and women over 50 years of age. However, it may occur in younger people who are born with a narrowing of the spinal canal or who suffer an injury to the spine.

What Structures of the Spine Are Involved?

Figure 3



Section of the Spine

The spine is a column of 26 bones that extend in a line from the base of the skull to the pelvis (see fig. 1). Twenty-four of the bones are called vertebrae. The bones of the spine include 7 cervical vertebrae in the neck; 12 thoracic vertebrae at the back wall of the chest; 5 lumbar vertebrae at the inward curve (small) of the lower back; the sacrum, composed of 5 fused vertebrae between the hip bones; and the coccyx, composed of 3 to 5 fused bones at the lower tip of the vertebral column. The vertebrae link to each other and are cushioned by shock-absorbing disks that lie between them.

The vertebral column provides the main support for the upper body, allowing humans to stand upright or bend and twist, and it protects the spinal cord from injury. Following are structures of the spine most involved in spinal stenosis. (See figs. 1, 2 and 3, and fig. 7 on p. 11.)

- **Intervertebral disks**—pads of cartilage filled with a gel-like substance which lie between vertebrae and act as shock absorbers.

- **Facet joints**—joints located on the back of the main part of the vertebra. They are formed by a portion of one vertebra and the vertebra above it. They connect the vertebrae to each other and permit back motion.

- **Intervertebral foramen (also called neural foramen)**—an opening between vertebrae through which nerves leave the spine and extend to other parts of the body.

- **Lamina**—part of the vertebra at the back portion of the vertebral arch that forms the roof of the canal through which the spinal cord and nerve roots pass.

- **Ligaments**—elastic bands of tissue that support the spine by preventing the vertebrae from slipping out of line as the spine moves. A large ligament often involved in spinal stenosis is the ligamentum flavum, which runs as a continuous band from lamina to lamina in the spine.

- **Pedicles**—narrow stem-like structures on the vertebrae that form the walls of the front part of the vertebral arch.

- **Spinal cord/nerve roots**—a major part of the central nervous system that extends from the base of the brain down to the lower back and that is encased by the vertebral column. It consists of nerve cells and bundles of nerves. The cord connects the brain to all parts of the body via 31 pairs of nerves that branch out from the cord and leave the spine between vertebrae.

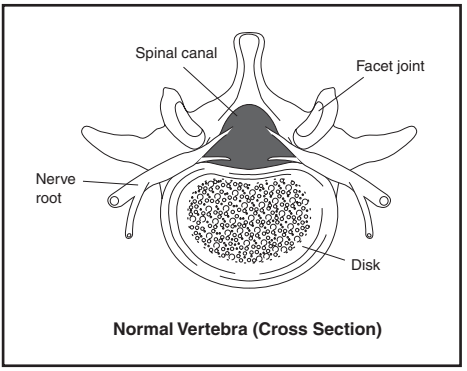
- **Synovium**—a thin membrane that produces fluid to lubricate the facet joints, allowing them to move easily.

- **Vertebral arch**—a circle of bone around the canal through which the spinal cord passes. It is composed of a floor at the back of the vertebra, walls (the pedicles), and a ceiling where two laminae join.

- **Cauda equina**—a sack of nerve roots that continues from the lumbar region, where the spinal cord ends, and continues down to provide neurologic function to the lower part of the body. It resembles a "horse's tail" (*cauda equina* in Latin).

What Causes Spinal Stenosis?

Figure 4



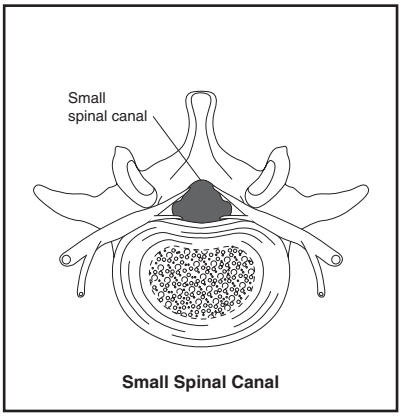
The normal vertebral canal (see fig. 4) provides adequate room for the spinal cord and cauda equina. Narrowing of the canal, which occurs in spinal stenosis, may be inherited or acquired. Some people inherit a small spinal canal (see fig. 5) or have a curvature of the spine (scoliosis) that produces pressure on nerves and soft tissue and compresses or stretches ligaments. In an inherited condition called achondroplasia, defective bone formation results in abnormally short and thickened pedicles that reduce the diameter (distance across) of the spinal canal.

Acquired conditions that can cause spinal stenosis are explained in more detail in the sections that follow.

Degenerative Conditions

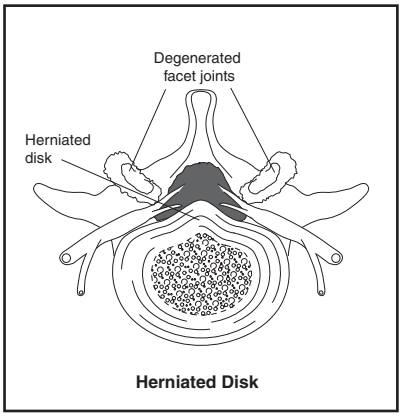
Spinal stenosis most often results from a gradual, degenerative aging process. Either structural changes or inflammation can begin the process. As people age, the ligaments of the spine may thicken and calcify (harden from

Figure 5



Small Spinal Canal

Figure 6



Herniated Disk

deposits of calcium salts). Bones and joints may also enlarge: when surfaces of the bone begin to project out from the body, these projections are called osteophytes (bone spurs).

When the health of one part of the spine fails, it usually places increased stress on other parts of the spine. For example, a herniated (bulging) disk may place pressure on the spinal cord or nerve root (see fig. 6). When a segment of the spine becomes too mobile, the capsules (enclosing membranes) of the facet joints thicken in an effort to stabilize the segment, and bone spurs may occur. This decreases the space (neural foramen) available for nerve roots leaving the spinal cord.

Spondylolisthesis, a condition in which one vertebra slips forward on another, may result from a degenerative condition or an accident, or, very rarely, may be acquired at

birth. Poor alignment of the spinal column when a vertebra slips forward onto the one below it can place pressure on the spinal cord or nerve roots at that place.

Aging with secondary changes is the most common cause of spinal stenosis. Two forms of arthritis that may affect the spine are osteoarthritis and rheumatoid arthritis.[1]

Osteoarthritis—Osteoarthritis is the most common form of arthritis and is more likely to occur in middle-aged and older people. It is a chronic, degenerative process that may involve multiple joints of the body. It wears away the surface cartilage layer of joints, and is often accompanied by overgrowth of bone, formation of bone spurs, and impaired function. If the degenerative process of osteoarthritis affects the facet joint(s) and the disk, the condition is sometimes referred to as spondylosis. This condition may be accompanied by disk degeneration, and an enlargement or overgrowth of bone that narrows the central and nerve root canals.

Rheumatoid Arthritis—Rheumatoid arthritis usually affects people at an earlier age than osteoarthritis does and is associated with inflammation and enlargement of the soft tissues (the synovium) of the joints. Although not a common cause of spinal stenosis, damage to ligaments, bones, and joints that begins as synovitis (inflammation of the synovial

[1] The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse has separate publications on osteoarthritis and rheumatoid arthritis. Single copies are free.

membrane which lines the inside of the joint) has a severe and disrupting effect on joint function. The portions of the vertebral column with the greatest mobility (for example, the neck area) are often the ones most affected in people with rheumatoid arthritis.

Other Acquired Conditions

The following conditions that are not related to degenerative disease are causes of acquired spinal stenosis:

- *Tumors of the spine* are abnormal growths of soft tissue that may affect the spinal canal directly by inflammation or by growth of tissue into the canal. Tissue growth may lead to bone resorption (bone loss due to overactivity of certain bone cells) or displacement of bone.

- *Trauma* (accidents) may either dislocate the spine and the spinal canal or cause burst fractures that produce fragments of bone that penetrate the canal.

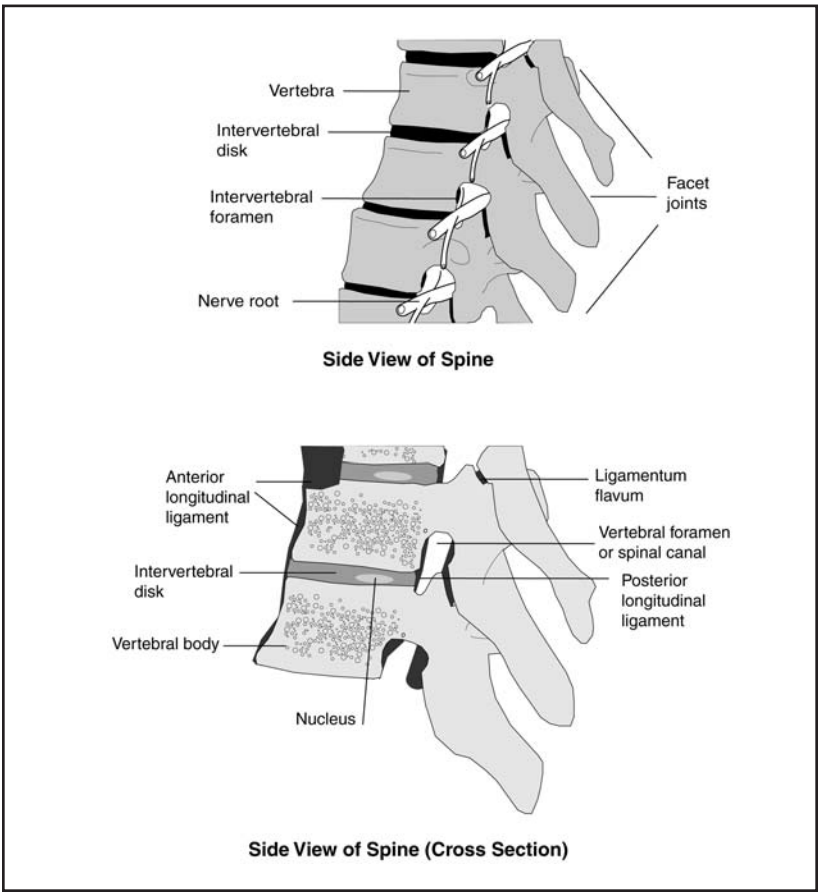
- *Paget's disease of bone* is a chronic (long-term) disorder that typically results in enlarged and abnormal bones. Excessive bone breakdown and formation cause thick and fragile bone. As a result, bone pain, arthritis, noticeable bone structure changes, and fractures can occur. The disease can affect any bone of the body, but is often found in

the spine. The blood supply that feeds healthy nerve tissue may be diverted to the area of involved bone. Also, structural problems of the involved vertebrae can cause narrowing of the spinal canal, producing a variety of neurological symptoms. Other developmental conditions may also result in spinal stenosis.

- *Fluorosis* is an excessive level of fluoride in the body. It may result from chronic inhalation of industrial dusts or gases contaminated with fluorides, prolonged ingestion of water containing large amounts of fluorides, or accidental ingestion of fluoride-containing insecticides. The condition may lead to calcified spinal ligaments or softened bones and to degenerative conditions like spinal stenosis.

- *Ossification of the posterior longitudinal ligament* occurs when calcium deposits form on the ligament that runs up and down behind the spine and inside the spinal canal (see fig. 7). These deposits turn the fibrous tissue of the ligament into bone. (Ossification means "forming bone.") These deposits may press on the nerves in the spinal canal.

Figure 7



What Are the Symptoms of Spinal Stenosis?

The space within the spinal canal may narrow without producing any symptoms. However, if narrowing places pressure on the spinal cord, cauda equina, or nerve roots, there may be a slow onset and progression of symptoms. The neck or back may or may not hurt. More often, people

experience numbness, weakness, cramping, or general pain in the arms or legs. If the narrowed space within the spine is pushing on a nerve root, people may feel pain radiating down the leg (sciatica). Sitting or flexing the lower back should relieve symptoms. (The flexed position "opens up" the spinal column, enlarging the spaces between vertebrae at the back of the spine.) Flexing exercises are often advised, along with stretching and strengthening exercises.

People with more severe stenosis may have problems with bowel and bladder function and foot disorders. For example, cauda equina syndrome is a severe, and very rare, form of spinal stenosis. It occurs due to compression of the cauda equina, and symptoms may include loss of control of the bowel, bladder, or sexual function and/or pain, weakness, or loss of feeling in one or both legs. Cauda equina syndrome is a serious condition requiring urgent medical attention.

How Is Spinal Stenosis Diagnosed?

The doctor may use a variety of approaches to diagnose spinal stenosis and rule out other conditions.

- **Medical history**—the patient tells the doctor details about symptoms and about any injury, condition, or general health problem that might be causing the symptoms.

- **Physical examination**—the doctor (1) examines the patient to determine the extent of limitation of

movement, (2) checks for pain or symptoms when the patient hyperextends the spine (bends backwards), and (3) checks for normal neurologic function (for instance, sensation, muscle strength, and reflexes) in the arms and legs.

- **X ray**—an x-ray beam is passed through the back to produce a two-dimensional picture. An x ray may be done before other tests to look for signs of an injury, tumor, or inherited problem. This test can show the structure of the vertebrae and the outlines of joints, and can detect calcification.

- **MRI** (magnetic resonance imaging)—energy from a powerful magnet (rather than x rays) produces signals that are detected by a scanner and analyzed by computer. This produces a series of cross-sectional images ("slices") and/or a three-dimensional view of parts of the back. An MRI is particularly sensitive for detecting damage or disease of soft tissues, such as the disks between vertebrae or ligaments. It shows the spinal cord, nerve roots, and surrounding spaces, as well as enlargement, degeneration, or tumors.

- **Computerized axial tomography** (CAT)—x rays are passed through the back at different angles, detected by a scanner, and analyzed by a computer. This produces a series of cross-sectional images and/or three-dimensional views of the parts of the back. The

scan shows the shape and size of the spinal canal, its contents, and structures surrounding it.

- **Myelogram**—a liquid dye that x rays cannot penetrate is injected into the spinal column. The dye circulates around the spinal cord and spinal nerves, which appear as white objects against bone on an x-ray film. A myelogram can show pressure on the spinal cord or nerves from herniated disks, bone spurs, or tumors.

- **Bone scan**—an injected radioactive material attaches itself to bone, especially in areas where bone is actively breaking down or being formed. The test can detect fractures, tumors, infections, and arthritis, but may not tell one disorder from another. Therefore, a bone scan is usually performed along with other tests.

Who Treats Spinal Stenosis?

Nonsurgical treatment of spinal stenosis may be provided by internists or general practitioners. The disorder is also treated by specialists such as rheumatologists, who treat arthritis and related disorders; and neurologists, who treat nerve diseases. Orthopaedic surgeons and neurosurgeons also provide nonsurgical treatment and perform spinal surgery if it is required. Allied health professionals such as physical therapists may also help treat patients.

What Are Some Nonsurgical Treatments for Spinal Stenosis?

In the absence of severe or progressive nerve involvement, a doctor may prescribe one or more of the following conservative treatments:

- Nonsteroidal anti-inflammatory drugs, such as aspirin, naproxen (Naprosyn)[2], ibuprofen (Motrin, Nuprin, Advil), or indomethacin (Indocin), to reduce inflammation and relieve pain.
- Analgesics, such as acetaminophen (Tylenol), to relieve pain.
- Corticosteroid injections into the outermost of the membranes covering the spinal cord and nerve roots to reduce inflammation and treat acute pain that radiates to the hips or down a leg.
- Anesthetic injections, known as nerve blocks, near the affected nerve to temporarily relieve pain.
- Restricted activity (varies depending on extent of nerve involvement).
- Prescribed exercises and/or physical therapy to maintain motion of the spine, strengthen abdominal

[2] Brand names included in this fact sheet are provided as examples only. Their inclusion does not mean that these products are endorsed by the National Institutes of Health or another government agency. Also, if a particular brand name is not mentioned, this does not imply that the product is unsatisfactory.

and back muscles, and build endurance, all of which help stabilize the spine. Some patients may be encouraged to try slowly progressive aerobic activity such as swimming or using exercise bicycles.

- A lumbar brace or corset to provide some support and help the patient regain mobility. This approach is sometimes used for patients with weak abdominal muscles or older patients with degeneration at several levels of the spine.

What Are Some Alternative Therapies for Spinal Stenosis?

Alternative (or complementary) therapies are diverse medical and health care systems, practices, and products that are not presently considered to be part of conventional medicine. Some examples of these therapies used to treat spinal stenosis follow:

- **Chiropractic treatment**—This treatment is based on the philosophy that restricted movement in the spine reduces proper function and may cause pain. Chiropractors may manipulate (adjust) the spine in order to restore normal spinal movement. They may also employ traction, a pulling force, to help increase space between the vertebrae and reduce pressure on affected nerves. Some people report that they benefit from chiropractic care. Research thus far has shown that chiropractic treatment is about as effective as

conventional, nonoperative treatments for acute back pain.

- **Acupuncture**—This treatment involves stimulating certain places on the skin by a variety of techniques, in most cases by manipulating thin, solid, metallic needles that penetrate the skin. Research has shown that low back pain is one area in which acupuncture has benefited some people.

More research is needed before the effectiveness of these or other possible alternative therapies can be definitively stated. Health care providers may suggest these therapies in addition to more conventional treatments.

When Should Surgery Be Considered and What Is Involved?

In many cases, the conditions causing spinal stenosis cannot be permanently altered by nonsurgical treatment, even though these measures may relieve pain for a period of time. To determine how much nonsurgical treatment will help, a doctor may recommend such treatment first. However, surgery might be considered immediately if a patient has numbness or weakness that interferes with walking, impaired bowel or bladder function, or other neurological involvement. The effectiveness of nonsurgical treatments, the extent of the patient's pain, and the patient's preferences may all factor into whether or not to have surgery.

The purpose of surgery is to relieve pressure on the spinal cord or nerves and restore and maintain alignment and strength of the spine. This can be done by removing, trimming, or adjusting diseased parts that are causing the pressure or loss of alignment. The most common surgery is called decompressive laminectomy: removal of the lamina (roof) of one or more vertebrae to create more space for the nerves. A surgeon may perform a laminectomy with or without fusing vertebrae or removing part of a disk. Various devices may be used to enhance fusion and strengthen unstable segments of the spine following decompression surgery.

Patients with spinal stenosis caused by spinal trauma or achondroplasia may need surgery at a young age. When surgery is required in patients with achondroplasia, laminectomy (removal of the roof) without fusion is usually sufficient.

What Are the Major Risks of Surgery?

All surgery, particularly that involving general anesthesia and older patients, carries risks. The most common complications of surgery for spinal stenosis are a tear in the membrane covering the spinal cord at the site of the operation, infection, or a blood clot that forms in the veins. These conditions can be treated but may prolong recovery. The presence of other diseases and the physical condition of

the patient are also significant factors to consider when making decisions about surgery.

What Are the Long-Term Outcomes of Surgical Treatment for Spinal Stenosis?

Removal of the obstruction that has caused the symptoms usually gives patients some relief; most patients have less leg pain and are able to walk better following surgery. However, if nerves were badly damaged prior to surgery, there may be some remaining pain or numbness or no improvement. Also, the degenerative process will likely continue, and pain or limitation of activity may reappear after surgery.

What Research on Spinal Stenosis Is Being Supported by the NIAMS?

The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), a part of the Department of Health and Human Services' National Institutes of Health, is supporting several research projects on spinal stenosis. For example, in a 5-year clinical trial involving 11 sites throughout the country, researchers are attempting to determine whether surgical or nonsurgical treatment is more effective at treating spinal stenosis and other back problems. Another project will try to find out if specific MRI findings will help physicians determine if they can identify groups who will fare better with surgical or nonsurgical treatments.

What Are Other Sources of Information on Spinal Stenosis?

- **National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)**
  National Institutes of Health
  1 AMS Circle
  Bethesda, MD 20892–3675
  Phone: 301–495–4484 or 877–22–NIAMS (877–226–4267) (free of charge)
  Fax: 301–718–6366
  TTY: 301–565–2966
  E-mail: NIAMSinfo@mail.nih.gov
  www.niams.nih.gov

The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) provides information about rheumatic, bone, muscle, and skin diseases. It distributes patient and professional education materials and refers people to other sources of information. Additional information and updates are available on the NIAMS Web site.

- **National Institute of Neurological Disorders and Stroke**
  NIH Neurological Institute
  P.O. Box 5801
  Bethesda, MD 20824
  Phone: 301–496–5751 or 800–352–9424 (free of charge)
  TTY: 301–468–5981
  www.ninds.nih.gov

The National Institute of Neurological Disorders and Stroke collects and disseminates research information related to neurological disorders.

- **American Academy of Orthopaedic Surgeons**
  P.O. Box 2058
  Des Plaines, IL 60017
  Phone: 800–824–BONE (2663)
  www.aaos.org

The academy provides education and practice management services for orthopaedic surgeons and allied health professionals. It also serves as an advocate for improved patient care and informs the public about the science of orthopaedics. The orthopaedist's scope of practice includes disorders of the body's bones, joints, ligaments, muscles, and tendons. For a single copy of an AAOS brochure, send a self-addressed stamped envelope to the address above or visit the AAOS Web site.

- **American College of Rheumatology**
  1800 Century Place, Suite 250
  Atlanta, GA 30345
  Phone: 404–633–3777
  Fax: 404–633–1870
  E-mail: acr@rheumatology.org
  www.rheumatology.org

This national professional organization can provide referrals to rheumatologists and allied health professionals, such as physical therapists. One-page fact sheets are available on various forms of arthritis. Lists of specialists by geographic area and fact sheets are also available on the American College of Rheumatology's Web site.

- **North American Spine Society**
  22 Calendar Court, 2nd floor
  La Grange, IL 60525
  Phone: 877–SpineDr (877–774–6337)
  www.spine.org

This professional association can identify specialists throughout the country who treat disorders of the spine.

- **Arthritis Foundation**
  1330 West Peachtree Street, Suite 100
  Atlanta, GA 30309
  Phone: 404–872–7100 or 800–568–4045 (free of charge) or contact your local chapter (listed in your local telephone directory)
  www.arthritis.org

The foundation has a free brochure on back pain and several free brochures about coping with arthritis, taking nonsteroid and steroid medicines, and exercise. The foundation also provides referrals to doctors treating various forms of arthritis.

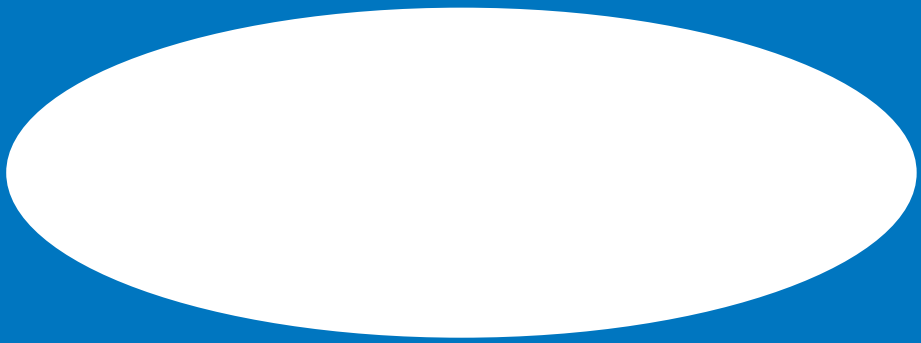
- **Spondylitis Association of America**
  P.O. Box 5872
  Sherman Oaks, CA 91413
  Phone: 818–981–1616 or 800–777–8189 (free of charge)
  Fax: 818–981–9826
  E-mail: info@spondylitis.org
  www.spondylitis.org

This association provides physician referrals and information on spondylitis.

Acknowledgments

The NIAMS gratefully acknowledges the assistance of David G. Borenstein, M.D., Arthritis and Rheumatism Associates, Washington, DC; James S. Panagis, M.D., M.P.H., NIAMS; Peter C. Gerszten, M.D., M.P.H, University of Pittsburgh Medical Center, PA; and James N. Weinstein, D.O., M.S., Dartmouth Medical School, Hanover, NH, in the preparation and review of this publication.

The mission of the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), a part of the Department of Health and Human Services' National Institutes of Health (NIH), is to support research into the causes, treatment, and prevention of arthritis and musculoskeletal and skin diseases; the training of basic and clinical scientists to carry out this research; and the dissemination of information on research progress in these diseases. The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse is a public service sponsored by the NIAMS that provides health information and information sources. Additional information can be found on the NIAMS Web site at www.niams.nih.gov.



U.S. Department of Health and Human Services
Public Health Service
National Institutes of Health
National Institute of Arthritis and
Musculoskeletal and Skin Diseases

NIH Publication No. 05–5327
November 2004