

Preview of the Medifocus Guidebook on: Spondylolisthesis

Updated October 21, 2009



This document is only a SHORT PREVIEW of the **Medifocus Guidebook on Spondylolisthesis**. It is intended primarily to give you a general overview of the **format and structure** of the Guidebook as well as select pages from each major Guidebook section listed in the Table of Contents.

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1 - Background Information

Introduction

Chronic or life-threatening illnesses can have a devastating impact on both the patient and the family. In today's new world of medicine, many consumers have come to realize that they are the ones who are primarily responsible for their own health care as well as for the health care of their loved ones.

When facing a chronic or life-threatening illness, you need to become an educated consumer in order to make an informed health care decision. Essentially that means finding out everything about the illness - the treatment options, the doctors, and the hospitals - so that you can become an educated health care consumer and make the tough decisions. In the past, consumers would go to a library and read everything available about a particular illness or medical condition. In today's world, many turn to the Internet for their medical information needs.

The first sites visited are usually the well known health "portals" or disease organizations and support groups which contain a general overview of the condition for the layperson. That's a good start but soon all of the basic information is exhausted and the need for more advanced information still exists. What are the latest "cutting-edge" treatment options? What are the results of the most up-to-date clinical trials? Who are the most notable experts? Where are the top-ranked medical institutions and hospitals?

The best source for authoritative medical information in the United States is the National Library of Medicine's medical database called PubMed®, that indexes citations and abstracts (brief summaries) of over 7 million articles from more than 3,800 medical journals published worldwide. PubMed® was developed for medical professionals and is the primary source utilized by health care providers for keeping up with the latest advances in clinical medicine.

A typical PubMed® search for a specific disease or condition, however, usually retrieves hundreds or even thousands of "hits" of journal article citations. That's an avalanche of information that needs to be evaluated and transformed into truly useful knowledge. What are the most relevant journal articles? Which ones apply to your specific situation? Which articles are considered to be the most authoritative - the ones your physician would rely on in making clinical decisions? This is where *Medifocus.com* provides an effective solution.

Medifocus.com has developed an extensive library of *MediFocus Guidebooks* covering a wide spectrum of chronic and life threatening diseases. Each *MediFocus Guidebook* is a

high quality, up- to-date digest of "professional-level" medical information consisting of the most relevant citations and abstracts of journal articles published in authoritative, trustworthy medical journals. This information represents the latest advances known to modern medicine for the treatment and management of the condition, including published results from clinical trials. Each *Guidebook* also includes a valuable index of leading authors and medical institutions as well as a directory of disease organizations and support groups. *MediFocus Guidebooks* are reviewed, revised and updated every 4-months to ensure that you receive the latest and most up-to-date information about the specific condition.

About Your MediFocus Guidebook

Introduction

Your *MediFocus Guidebook* is a valuable resource that represents a comprehensive synthesis of the most up-to-date, advanced medical information published about the condition in well-respected, trustworthy medical journals. It is the same type of professional-level information used by physicians and other health-care professionals to keep abreast of the latest developments in biomedical research and clinical medicine. The *Guidebook* is intended for patients who have a need for more advanced, in-depth medical information than is generally available to consumers from a variety of other resources. The primary goal of a *MediFocus Guidebook* is to educate patients and their families about their treatment options so that they can make informed health-care decisions and become active participants in the medical decision making process.

The *Guidebook* production process involves a team of professionals with expertise in diverse areas including experienced medical database researchers and practicing physicians who serve as members of the *Medifocus.com* Medical Advisory Board (MAB). This team approach to the development and production of the *MediFocus Guidebooks* is designed to ensure the accuracy, completeness, and clinical relevance of the information. The *Guidebook* is intended to serve as a basis for more meaningful discussions between patients and their health-care providers in a joint effort to seek the most appropriate course of treatment for the disease.

Guidebook Organization and Content

Section 1 - Background Information

This section provides detailed information about the organization and content of the *Guidebook* including tips and suggestions for conducting additional research about the condition.

Section 2 - The Intelligent Patient Overview

This section of your *MediFocus Guidebook* represents a detailed overview of the disease or condition specifically written from the patient's perspective. It is designed to satisfy the basic informational needs of consumers and their families who are confronted with the illness and are facing difficult choices. Important aspects which are addressed in "The Intelligent Patient" section include:

- The etiology or cause of the disease
- Signs and symptoms
- How the condition is diagnosed
- The current standard of care for the disease

- Treatment options
- New developments
- Important questions to ask your health care provider

Section 3 - Guide to the Medical Literature

This is a roadmap to important and up-to-date medical literature published about the condition from authoritative, trustworthy medical journals. This is the same information that is used by physicians and researchers to keep up with the latest developments and breakthroughs in clinical medicine and biomedical research. A broad spectrum of articles is included in each *MediFocus Guidebook* to provide information about standard treatments, treatment options, new clinical developments, and advances in research. To facilitate your review and analysis of this information, the articles are grouped by specific categories. A typical *MediFocus Guidebook* usually contains one or more of the following article groupings:

- *Review Articles*: Articles included in this category are broad in scope and are intended to provide the reader with a detailed overview of the condition including such important aspects as its cause, diagnosis, treatment, and new advances.
- *General Interest Articles*: These articles are broad in scope and contain supplementary information about the condition that may be of interest to select groups of patients.
- *Drug Therapy*: Articles that provide information about the effectiveness of specific drugs or other biological agents for the treatment of the condition.
- *Surgical Therapy*: Articles that provide information about specific surgical treatments for the condition.
- *Clinical Trials*: Articles in this category summarize studies which compare the safety and efficacy of a new, experimental treatment modality to currently available standard treatments for the condition. In many cases, clinical trials represent the latest advances in the field and may be considered as being on the "cutting edge" of medicine. Some of these experimental treatments may have already been incorporated into clinical practice.

The following information is provided for each of the articles referenced in this section of your *MediFocus Guidebook*:

- Article title
- Author Name(s)
- Institution where the study was done

- Journal reference (Volume, page numbers, year of publication)
- Link to Abstract (brief summary of the actual article)

Linking to Abstracts: Most of the medical journal articles referenced in this section of your *MediFocus Guidebook* include an abstract (brief summary of the actual article) that can be accessed online via the National Library of Medicine's PubMed® database. You can easily access the individual abstracts online via PubMed® from the "electronic" format of your *MediFocus Guidebook* by clicking on the corresponding URL address that is provided for each cited article. If you purchased a printed copy of a *MediFocus Guidebook*, you can still access the article abstracts online by entering the individual URL address for a particular article into your web browser.

Section 4 - Centers of Research

We've compiled a unique directory of doctors, researchers, medical centers, and research institutions with specialized research interest, and in many cases, clinical expertise in the management of the specific medical condition. The "Centers of Research" directory is a valuable resource for quickly identifying and locating leading medical authorities and medical institutions within the United States and other countries that are considered to be at the forefront in clinical research and treatment of the condition.

Inclusion of the names of specific doctors, researchers, hospitals, medical centers, or research institutions in this *Guidebook* does not imply endorsement by Medifocus.com, Inc. or any of its affiliates. Consumers are encouraged to conduct additional research to identify health-care professionals, hospitals, and medical institutions with expertise in providing specific medical advice, guidance, and treatment for this condition.

Section 5 - Tips on Finding and Choosing a Doctor

One of the most important decisions confronting patients who have been diagnosed with a serious medical condition is finding and choosing a qualified physician who will deliver high-level, quality medical care in accordance with currently accepted guidelines and standards of care. Finding the "best" doctor to manage your condition, however, can be a frustrating and time-consuming experience unless you know what you are looking for and how to go about finding it. This section of your *Guidebook* offers important tips for how to find physicians as well as suggestions for how to make informed choices about choosing a doctor who is right for you.

Section 6 - Directory of Organizations

This section of your *Guidebook* is a directory of select disease organizations and support groups that are in the business of helping patients and their families by providing access to information, resources, and services. Many of these organizations can answer your questions, enable you to network with other patients, and help you find a doctor in your geographical area who specializes in managing your condition.

2 - The Intelligent Patient Overview

SPONDYLOLISTHESIS

Introduction to Spondylolisthesis

Spondylolisthesis is a spinal condition that involves the slipping of one spinal vertebra over the one immediately underneath it. In order to understand this condition, and a related condition called *spondylolysis*, which is a precursor for some types of spondylolisthesis, it is important to review the components of the spine and how they function.

The Spine

The spine is made up of a series of interconnecting bones called *vertebrae* (an individual unit is called a *vertebra*). The *vertebral column* (spine) is the main support structure for the body and keeps it upright and balanced. Other functions of the spine include:

- Providing platforms for attachments of many muscles and ligaments that traverse the skull, the thorax, and the pelvis
- Permitting the trunk of the body to have appreciable flexibility of movement, such as twisting, bending, or arching the back
- Protecting the spinal cord while providing openings between adjacent vertebrae for the passage of spinal nerves

The spinal column consists of 33 bones and is divided into:

- 7 *cervical* vertebrae which form the upper part of the spine between the skull and the chest
- 12 *thoracic* vertebrae which are found between the upper chest and lower back
- 5 *lumbar* vertebrae which form the lower back and are the largest and strongest of the vertebrae. They are the source of attachment of many strong back muscles.
- 5 vertebrae fused together form the *sacrum*, which is triangular in shape and connects the spine to the pelvis. The sacrum also provides support for the spine.
- 4 fused vertebrae form the *coccyx* ("tail bone") which has little known function

The vertebrae are connected much like the links of a chain. Although there are differences of function among the vertebrae of the various regions of the spinal column, there is a basic design common to all of them.

A typical vertebra is comprised of several components, including:

- *Vertebral body* - main anterior bony part of the vertebra. It faces the front of the body (anterior) and is the weight-bearing segment of the vertebra. It is cylindrical in shape.

- *Centrum* - the thick anterior portion of the vertebra. It is the largest part of the vertebra.
- *Pedicles* - two short stalks that project off of the right and left sides of each vertebral body and function as attachment sites for muscles and ligaments of the spine. They also make up the sides of the *neural arch*.
- *Laminae*- flat bones that arise from the posterior part of the vertebra. They form the roof of the spinal canal and protect the spinal cord.
- *Vertebral (neural) arch* - arises from the posterior surface of the centrum and forms a circle of bone around the canal through which the spinal cord passes. A vertebral arch is composed of a floor at the back of the vertebra, walls (the pedicles), and a roof where two *laminae* join.
- *Vertebral foramen* (also called the *spinal canal*) - opening formed by the (anterior) centrum, and the (posterior) vertebral arch. It is an enclosed space through which the spinal cord passes.
- *Processes* - bony projections from the back of the vertebra that function as important attachment sites for spinal muscles and ligaments. There are three processes, namely:
 - *spinous process* - a projection from the posterior, midline region of the neural arch (these projections are the bumps you feel when you run your hand down the spine)
 - *superior and inferior articulating processes* - there is a pair of each of these processes on each side of the neural arch. The superior processes project upward and the inferior project downward. Each articulating process has a smooth surface that interlocks and forms a *facet joint* between the vertebra above and below it which facilitates movement of the spine and also increases the rigidity of the vertebral column.
 - *transverse processes* - processes that project outward from each side of the vertebra and are located between the superior and inferior processes
- *Facet joints* - a joint formed by the two inferior articulating processes interconnecting with the superior process of the vertebra below, like the link of a chain. Each vertebra has two facet joints. The joints provide stability while allowing movement. They are almost always in constant motion and tend to wear out or degenerate.
- *Pars interarticularis* (also called just *the pars*) - a thin isthmus of bone that forms a bridge and connects the upper and lower facet joints of contiguous vertebrae. The pars is very thin with poor blood supply which makes it vulnerable to stress fractures.
- *Intervertebral disk* - a flat cartilaginous disk that sits between the vertebrae and allows the spine to bend, stretch, and twist. It also acts as a shock absorber for any movement of the spine.

What is Spondylolisthesis?

Spondylolisthesis occurs when one vertebra slips over the vertebra just below it. Though it can occur at the level of cervical vertebrae, it occurs most often at the level of the lumbar vertebrae (the focus of this Guidebook). Its symptoms can range from being asymptomatic (no symptoms) to severe. The slippage may result in *lordosis* (swayback) for some people and in *kyphosis* (roundback) where the upper spine falls over the lower spine in others (this is a late manifestation of high-grade slippage). Most cases of spondylolisthesis are not severe and do not involve high levels of slippage. Spondylolisthesis can be caused by various conditions but the symptoms are

basically similar and include:

- Lower back pain
- Stiffness in the back
- Localized pain or tenderness in the back just above the pelvis
- Tight hamstrings
- Pain in the thighs and legs (*radiculopathy*)
- Pain in the buttocks

The standard accepted classification system for spondylolisthesis is that of Newman, Wiltse, and McNab. This system describes the etiology of five types of spondylolisthesis and also highlights the anatomic lesion responsible for the slip. The five types of spondylolisthesis include:

- Dysplastic or congenital spondylolisthesis
- Isthmic spondylolisthesis
- Degenerative spondylolisthesis
- Traumatic spondylolisthesis
- Pathologic spondylolisthesis

Recently, a sixth type of spondylolisthesis has been recognized, namely *iatrogenic spondylolisthesis*.

Dysplastic or Congenital Spondylolisthesis

This type of spondylolisthesis accounts for up to 20% of treated cases. Slippage is related to a congenital malformation of spinal structures, usually a neural arch defect of L5 or the upper sacrum or dysplastic sacral facet joint. *Spina bifida* (incomplete closure of the embryonic neural tube) is frequently present (seen in up to 94% of cases of congenital spondylolisthesis) and scoliosis (spinal curvature) at the level of the slip is noted in up to 50% of cases of congenital spondylolisthesis. There is a high rate of nerve root involvement such as compression, associated with dysplastic spondylolisthesis. Dysplastic spondylolisthesis usually causes pain during adolescence but not during childhood.

Isthmic Spondylolisthesis

This type is due to progression of *spondylolysis* (the presence of a defect or fracture of the pars) that becomes unstable and causes slippage of one vertebra (usually L5) over the one below it (S1). Isthmic spondylolisthesis is the main focus of this Guidebook. There are three subtypes of isthmic spondylolisthesis:

- Subtype IIA - a defect due to a fatigue fracture of the articulating segment and associated with complete bony separation. This is more common in individuals under 50 years of age.
- Subtype IIB - elongation of the articulating segment due to repeated microfractures, but no separation. Bony areas may form around the improperly healed microfractures. The result is an elongated pars which may eventually break and may transform to Type IIA over time.
- Subtype IIC - acute fracture of the articulating segment

Spondylolysis and isthmic spondylolisthesis are discussed in greater detail below.

Degenerative Spondylolisthesis

This type of spondylolisthesis is due to chronic degeneration of the vertebral facets and is considered in most cases as secondary to osteoarthritis. It usually occurs later in life after the age of 50 and is the cause of spinal stenosis (narrowing of the spinal canal). The location of degeneration is most frequently at the level of L4-L5 (6-10 times more frequent than other locations), though it can also be present at the L3-L4 level. More infrequently, it may take place at the L5-S1 level. It is diagnosed in females approximately five times more frequently than males. Degenerative spondylolisthesis is the most common type of spondylolisthesis in adults. In some people, there may be a combination of disk degeneration and/or pars injury that causes the slippage. The degree of listhesis (slippage) usually does not progress beyond Grade I.

Traumatic Spondylolisthesis

The cause of this type of spondylolisthesis is an acute fracture of some part of the spinal process such as the neural arch or the pars which causes destabilization of the vertebral segments. It can occur at any age.

Pathologic Spondylolisthesis

This type of spondylolisthesis results from diseases that affect the bones and cause destabilization of the spinal structures.

Postoperative/Iatrogenic Spondylolisthesis

There is an additional type of spondylolisthesis which is gaining increasing recognition and is called *postoperative* or *iatrogenic spondylolisthesis* and results from complications of surgical intervention. This classification was recently added and results from excessive removal of the posterior elements of the pars or other spinal supporting structures after *laminectomy* (spinal surgery usually performed to correct disk herniation or nerve compression caused by spinal stenosis). The incidence of iatrogenic spondylolisthesis is thought to be approximately 3-5% of cases of treated spondylolisthesis.

Classification of Slippage in Spondylolisthesis

The severity of spondylolisthesis is determined by the degree of slippage observed on X-rays. The Meyerding's Grading System is most commonly used by clinicians to measure the degree of slippage which include:

- Grade I = 1% to 25%
- Grade II = 26% to 50%
- Grade III = 51% to 75%
- Grade IV = 76% to 100%
- Grade V is called *spondyloptosis* and occurs when the L5 vertebra completely slides over the top of the sacrum.

The majority of cases of spondylolisthesis (up to 75%) are Grade I and approximately 20% are Grade II, both of which are considered *low-grade slippage*. Grade III and above is considered to be *high-grade slippage*. Another way of characterizing slippage is to consider Grades I and II (below 50% slip) as *stable spondylolisthesis* and Stage III and higher as *unstable spondylolisthesis*

Slip progression after skeletal maturity is usually related to disk degeneration (secondary to arthritis) at the slip level. This is likely to develop during the fourth and fifth decades of life with the onset of degenerative spondylolisthesis. As the disk loses its structural and functional integrity, the lumbosacral junction (L5-S1) becomes unstable and the slip progresses and can cause severe incapacitating back and leg pain. This concurrent occurrence of disk degeneration and adult slip progression explains how asymptomatic spondylolisthesis can be present for at least two or three decades before becoming symptomatic.

In people with isthmic spondylolisthesis, slip progression is thought to occur in up to 30% of cases and takes place after the third decade of life. It is associated with signs of mechanical instability and spinal stenosis resulting in significant low back pain and possibly radicular (radiating) pain in the back of the legs. The magnitude of symptoms is not necessarily related to the grade of slippage since symptoms may be related to nerve compression which can happen with any grade.

Isthmic Spondylolisthesis

Isthmic spondylolisthesis is caused by a defect or fracture of the pars interarticularis (spondylolysis) In order to understand the progression of spondylolysis to isthmic spondylolisthesis, it is important to understand the conditions leading up to instability of the spine due to injury of the pars interarticularis.

There are three stages of injury of the pars (spondylolysis) that may result in slippage (spondylolisthesis):

- Stress reaction - this occurs from excessive wear and tear due to either activities of daily living, lifestyle, sports, or trauma (e.g., falling). Nothing unusual appears on X-ray images but a bone scan may show increased activity in the region of the pars. Stress on the pars is the initiating factor in the development of spondylolysis. Symptoms associated with this stage include:
 - low back pain
 - low back stiffness
 - tightness of the hamstring muscle - a group of large, powerful muscles that passes along the back of the thigh, from the lower pelvis to the back of the shin bone
- Fracture - fracture or crack in the pars that can be seen on X-ray. It may occur due to repetitive extension or rotation of the lower back where the pars cannot absorb the constant shock and, consequently, develops a stress fracture resulting in spondylolysis. Once the pars is injured and the defect is created, healing of the fracture is often prevented by anatomic and/or biomechanical forces and leads to instability at the level of the fracture. This paves the way for the upper vertebra to slide forward (spondylolisthesis).
- Slippage - the gap caused by the fracture widens and as a result the L5 vertebra shifts forward over the sacrum. Slippage typically results from bilateral fracture of the pars which

prevents the posterior articulating facets from providing adequate stability. At this stage, the condition is called spondylolisthesis. Because the vertebral motion is abnormal and is chronic, the pars cannot heal properly. As new bone forms around the fracture, it may compress nearby nerves.

Spondylolysis

Spondylolysis was first described in the medical literature in the mid-1800s and is comprised of the words 'spondylo' (vertebra) and 'lysis' (destruction). As noted above, it involves the degeneration, defective development, or fracture of the *pars interarticularis* resulting in the potential for slippage of one vertebra over another (typically L5 over S1). It may begin as a stress fracture, but sometimes the cause is unknown. If the bone does not heal normally as it should due to forces exerted on the lower back, spondylolysis develops. Normally, posterior facets, ligaments, and intervertebral disks provide resistance to forward displacement of the vertebrae. When there is a defect, fracture, or elongation of the pars, the posterior elements may no longer be strong enough to hold the vertebra in its correct anatomical position. This also increases the stress on the intervertebral disk and may cause it to stretch. If the posterior elements also slide forward, stenosis (narrowing of the spinal canal) and compression on nearby nerves occurs. If the defect in the pars is unilateral, there may be no slippage and no progression to spondylolisthesis.

Spondylolysis is the most common cause of low back pain in children and adolescents. In the majority of young children vertebral development is normal but around the age of eight, some children experience abnormal growth and development of this particular area of the vertebra making it vulnerable to injury from participating in certain sports. The bony defect is virtually nonexistent among newborns, but exists in 5% of 6 year olds and approximately 6% of adults.

Most children and adults with spondylolysis are usually asymptomatic (have no symptoms) and may discover its existence only incidentally when they seek medical advice for back pain that may not be related to the condition. Although spondylolysis develops in childhood, it remains unclear why for some people no symptoms ever appear and for others they may develop many years later. Some studies suggest that only 20% of adult patients with spondylolysis are symptomatic before the age of 20.

Spondylolysis is common in people who participate in sports such as diving, weight lifting, wrestling, bobsledding, and gymnastics - activities that require repetitive hyperextension (stretching) of the lumbar portion of the spine. But repetitive stress over time, or an acute extension injury to the lumbar spine, may also cause the condition in susceptible adults who did not experience spondylolysis as children or young adults.

In 1955, a study of 500 first graders was initiated with the intention of tracking the incidence of spondylolysis and observing its progression to spondylolisthesis. Some of the findings include:

- Approximately 22 (4.4%) of the children had either unilateral or bilateral pars defect (spondylolysis) and eight developed a defect later in early adulthood.
- Of the people who responded when contacted again in 1988 and underwent spinal X-rays, 15% showed signs of slippage indicating that spondylolysis had progressed to spondylolisthesis.
- None of the children with unilateral pars defects went on to develop spondylolisthesis

- Among those with bilateral pars defects who progressed, progression was slow and occurred mostly in the second or third decade of life.
- When contacted again in their 60s, only 5 of the 19 of the subjects with spondylolisthesis had progressed to a Grade II slip.
- The slip rate slowed with each advancing decade of age
- Pain was not correlated with slip progression and the rate of complaints of back pain was no different than in the general age-matched population. No subjects reported disability.

Pathophysiology of Spondylolisthesis

The pathophysiology of the various types of spondylolisthesis includes:

- Congenitally dysplastic joints
- Hyperextension of the lumbar spine
- Degenerative joint disease (arthritis)
- Trauma
- Bone disease
- Genetics

Congenitally Dysplastic Joints

Children who are born with dysplastic (underdeveloped) facet joints, which affect the stability of the vertebrae, may develop slippage of one vertebra over another. The presence of dysplastic (abnormal development) sacral facet joints is accompanied by forward movement of the L5 vertebra leading to stress on the pars which may then fracture and result in slippage of the L5 over the sacrum. The neural arch typically compresses the nerve as it slips.

Hyperextension of the lumbar spine

Hyperextension of the lumbar spine is typically the cause of isthmic spondylolisthesis through several mechanisms, including:

- Traumatic mechanism - Hyperextension of the lumbar spine is commonly found in children and adolescents who play impact sports and for whom repetitive impact causes stress fractures or fatigue of the pars. Up to 40% of athletes with spondylolysis recall having some type of back injury.
- Weak pars interarticularis - Researchers believe that most children with spondylolysis may be born with a weak pars that makes them more vulnerable to stress fractures that ultimately may evolve into spondylolisthesis. Biomechanical studies suggest that the pars is the weakest part of the posterior neural arch which may predispose it to injury with certain repetitive motions.
- Abnormal bone healing - If normal bone healing does not follow stress microfractures, then the pars can become elongated and cause imbalance setting the stage for slippage. Elongation of the pars can also be a congenital condition.

Degenerative Joint Disease

Chronic degenerative disk disease and arthritis (degenerative joint disease) cause instability between the affected vertebrae that leads to slippage most commonly at the level of L4-L5. Nerve roots coming out of L5 are typically compressed due to stenosis and narrowing of the spinal canal. Progression of slippage occurs in approximately 30% of people, but it usually does not exceed Grade I. Degenerative spondylolisthesis is not related to spondylolysis and may be related to the pars only in terms of the overall degenerative process in the joints.

Some researchers theorize that degenerative spondylolisthesis may also be related to increased laxity of ligaments due to hormonal changes.

Trauma

Trauma can lead to spondylolisthesis by a variety of different mechanisms:

- Fracture of the neural arch
- Fracture of the pars interarticularis
- Fracture of the articulating processes of the vertebrae
- Fracture of the facet joints
- Traumatic subluxation or dislocation of the facet joints

Bone Disease

Certain bone diseases can cause abnormal mineralization of the bone which results in remodeling (effort of the bone to repair itself) or attenuation (reduced density of bone). When the vertebrae are affected, instability ensues that can lead to spondylolisthesis. Some examples of bone disease include:

- Syphilis - a sexually transmitted disease (STD) which in the late stage can cause bone damage
- Paget's disease - causes a malfunction in the normal process of bone breaking down (resorption) and rebuilding (regeneration)
- Albers-Schonberg's disease - an inherited disorder characterized by an increase in bone density
- Osteogenesis imperfecta - a genetic disorder characterized by bones that break easily, often from little or no apparent cause

Genetic Factors

Evidence of a genetic link to spondylolisthesis includes:

- Family history - increased incidence of spondylolysis in up to 70% of first-degree relatives of individuals with either congenital or isthmic spondylolisthesis
- Gender - spondylolysis is 2-3 times more prevalent in males than females while spondylolisthesis is 2-3 times more prevalent in females than males
- Race - the prevalence of spondylolysis in Caucasians (approximately 6%) is thought to be 2-3 times higher than in African Americans who have an incidence of only approximately

1.5%. Also, certain ethnic groups such as Eskimos have very high rates of spondylolysis (25-50%), indicating a strong genetic component.

Recently, investigators have studied radiographic and surgical reports of patients with spondylolisthesis and have noted that patients with high-grade slips appear to have in common an abnormality of the growth plate on the sacrum. Another study of 27 patients with spondyloptosis indicated that all of them exhibited a rounding of one area of the sacral plate. This has led investigators to ponder whether some cases of spondylolysis and spondylolisthesis are caused by a defect in the pars interarticularis or by an abnormality of the sacral plate.

Risk Factors for Spondylolisthesis

- Age - progression is highly likely during adolescent growth spurts. The younger the age at onset of a vertebral lesion, the higher the probability of slip progression
- Gender - females are four times more likely to develop spondylolisthesis than males.
- Pregnancy may be a risk factor
- Osteoarthritis in older people can lead to degenerative spondylolisthesis
- Diabetics appear to be more prone to degenerative spondylolisthesis
- Traumatic injury - if an injury which causes spondylolysis does not heal properly in an adolescent, it can progress to spondylolisthesis
- Activity in sports - certain types of sports appear to put some children and adolescents in a high-risk category for spondylolysis due to continued hyperextension of the lumbar spine. Damage to the pars is noted in 25-40% of sports-related lower back pain. High risk sports include:
 - gymnastics
 - diving
 - football
 - pole-vaulting
 - weight-lifting
 - wrestling
 - dancing
 - high-jumping
- Back pain - investigation into generalized back pain may uncover existent but possibly asymptomatic spondylolysis or spondylolisthesis

Incidence of Spondylolisthesis

Spondylolysis is present in approximately 4-6% of asymptomatic school children. It is rarely seen before the age of 4 and the incidence goes up with age. It is estimated that 5-10% of people who come to a physician for lower back pain have either spondylolysis or spondylolisthesis. By the age of 18, the incidence of spondylolysis is approximately 7% with prevalence appearing in individuals who practice sports that require repetitive hyperextension or flexion and extension the spine. Spondylolysis is twice as common in male children as female children but females are more

likely to exhibit progressive slippage of the vertebra. It is estimated that up to 50% of cases of spondylolysis progress and develop into spondylolisthesis.

Approximately 4% of adults have isthmic spondylolisthesis. Approximately 87% of cases occur at the level of L5-S1 while close to 10% occur at L4-L5 and up to 3% occur at the level of L3-L4.

The incidence of degenerative spondylolisthesis increases with age. The slip associated with degenerative spondylolisthesis occurs most commonly at the level of L4-L5 and is found more frequently in females (9.1%) than males (5.8%). African-American women are affected 3 times more commonly than Caucasian women. Degenerative spondylolisthesis is the most common form of spondylolisthesis in adults.

The **Intelligent Patient Overview** in the complete **Medifocus Guidebook on Spondylolisthesis** also includes the following additional sections:

- **Diagnosis of Spondylolisthesis**
- **Treatment Options for Spondylolisthesis**
- **Quality of Life and Psychosocial Considerations in Spondylolisthesis**
- **New Developments in Spondylolisthesis**
- **Questions to Ask Your Health Care Provider About Spondylolisthesis**

To Order the Complete **Guidebook on Spondylolisthesis** [Click Here](#)
Or Call 800-965-3002 (USA) or 301-649-9300 (Outside USA)

3 - Guide to the Medical Literature

Introduction

This section of your *MediFocus Guidebook* is a comprehensive bibliography of important recent medical literature published about the condition from authoritative, trustworthy medical journals. This is the same information that is used by physicians and researchers to keep up with the latest advances in clinical medicine and biomedical research. A broad spectrum of articles is included in each *MediFocus Guidebook* to provide information about standard treatments, treatment options, new developments, and advances in research.

To facilitate your review and analysis of this information, the articles in this *MediFocus Guidebook* are grouped in the following categories:

- Review Articles - 24 Articles
- General Interest Articles - 28 Articles
- Surgical Therapy Articles - 53 Articles
- Clinical Trials Articles - 18 Articles

The following information is provided for each of the articles referenced in this section of your *MediFocus Guidebook*:

- Title of the article
- Name of the authors
- Institution where the study was done
- Journal reference (Volume, page numbers, year of publication)
- Link to Abstract (brief summary of the actual article)

Linking to Abstracts: Most of the medical journal articles referenced in this section of your *MediFocus Guidebook* include an abstract (brief summary of the actual article) that can be accessed online via the National Library of Medicine's PubMed® database. You can easily access the individual abstracts online via PubMed® from the "electronic" format of your *MediFocus Guidebook* by clicking on the URI that is provided for each cited article. If you purchased a printed copy of the *MediFocus Guidebook*, you can still access the abstracts online by entering the individual URI for a particular abstract into your computer's web browser.

Recent Literature: What Your Doctor Reads

Database: PubMed <January 2006 to October 2009>

Review Articles

1.

Surgical management of traumatic L2-L3 spondyloptosis.

Authors: Martin S; Raup G; Hunter S; Cho P
Institution: Emergency Medicine Department, John Peter Smith Hospital, Ft Worth, TX, USA.
Journal: AORN J. 2009 Apr;89(4):657-76; quiz 673-6.
Abstract Link: <http://www.medifocus.com/abstracts.php?gid=RT015&ID=19434947>

2.

Fusion and nonsurgical treatment for symptomatic lumbar degenerative disease: a systematic review of Oswestry Disability Index and MOS Short Form-36 outcomes.

Authors: Carreon LY; Glassman SD; Howard J
Institution: Leatherman Spine Center, Louisville, KY 40202, USA.
lcarreon@spinemds.com
Journal: Spine J. 2008 Sep-Oct;8(5):747-55. Epub 2007 Nov 26.
Abstract Link: <http://www.medifocus.com/abstracts.php?gid=RT015&ID=18037354>

3.

The role of reduction in operative treatment of spondylolytic spondylolisthesis.

Authors: Hakalo J; Wronski J
Institution: Private Orthopaedic Practice, ul. Konarskiego 16, 66-200 Swiebodzin.
hakalo@poczta.onet.pl
Journal: Neurol Neurochir Pol. 2008 Jul-Aug;42(4):345-52.
Abstract Link: <http://www.medifocus.com/abstracts.php?gid=RT015&ID=18975240>

The **Guide to the Medical Literature** in the complete **Medifocus Guidebook on Spondylolisthesis** includes the following sections:

- Review Articles - 24 Articles
- General Interest Articles - 28 Articles
- Surgical Therapy Articles - 53 Articles
- Clinical Trials Articles - 18 Articles

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4 - Centers of Research

This section of your *MediFocus Guidebook* is a unique directory of doctors, researchers, medical centers, and research institutions with specialized research interest, and in many cases, clinical expertise in the management of this specific medical condition. The *Centers of Research* directory is a valuable resource for quickly identifying and locating leading medical authorities and medical institutions within the United States and other countries that are considered to be at the forefront in clinical research and treatment of this disorder.

Use the *Centers of Research* directory to contact, consult, or network with leading experts in the field and to locate a hospital or medical center that can help you.

The following information is provided in the *Centers of Research* directory:

- **Geographic Location**

- United States: the information is divided by individual states listed in alphabetical order. Not all states may be included.
- Other Countries: information is presented for select countries worldwide listed in alphabetical order. Not all countries may be included.

- **Names of Authors**

- Select names of individual authors (doctors, researchers, or other health-care professionals) with specialized research interest, and in many cases, clinical expertise in the management of this specific medical condition, who have recently published articles in leading medical journals about the condition.
- E-mail addresses for individual authors, if listed on their specific publications, is also provided.

- **Institutional Affiliations**

- Next to each individual author's name is their **institutional affiliation** (hospital, medical center, or research institution) where the study was conducted as listed in their publication(s).
- In many cases, information about the specific **department** within the medical institution where the individual author was located at the time the study was conducted is also provided.

Centers of Research

United States

AZ - Arizona

Name of Author

Dickman CA

Klopfenstein JD

Institutional Affiliation

Division of Neurological Surgery, Barrow Neurological Institute, St Joseph's Hospital and Medical Center, Phoenix, AZ 85013, USA.

Division of Neurological Surgery, Barrow Neurological Institute, St Joseph's Hospital and Medical Center, Phoenix, AZ 85013, USA.

CA - California

Name of Author

Ames CP

Aryan HE

Boakye M

Carragee E

Dhall SS

Ghanayem AJ

Haid RW Jr

Hu SS

Kalanithi PS

Institutional Affiliation

Department of Neurosurgery, University of California-San Francisco, CA, USA.

Department of Neurosurgery, University of California-San Francisco, CA, USA.

Department of Neurosurgery, Stanford University Medical Center, 300 Pasteur Drive, Stanford, CA 94305, USA.
pkalanithi@stanford.edu

Department of Orthopaedic Surgery, Spine Surgery Section, Stanford University Medical Center, 300 Pasteur Drive, Stanford, CA 94305-5326, USA.

Department of Neurosurgery, University of California, San Francisco, California, USA.

Department of Orthopaedic Surgery, University of California, San Francisco, San Francisco, California, USA.

Department of Neurosurgery, University of California at San Francisco, San Francisco, California 94143, USA. vmum@aol.com

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Department of Neurosurgery, Stanford University Medical Center, 300 Pasteur Drive, Stanford, CA 94305, USA.
pkalanithi@stanford.edu

The **Centers of Research** in the complete **Medifocus Guidebook on Spondylolisthesis** includes the following sections:

- Centers of Research for relevant states in the United States
- Centers of Research listed for relevant countries outside the United States

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5 - Tips on Finding and Choosing a Doctor

Introduction

One of the most important decisions confronting patients who have been diagnosed with a serious medical condition is finding and choosing a qualified physician who will deliver a high level and quality of medical care in accordance with currently accepted guidelines and standards of care. Finding the "best" doctor to manage your condition, however, can be a frustrating and time-consuming experience unless you know what you are looking for and how to go about finding it.

The process of finding and choosing a physician to manage your specific illness or condition is, in some respects, analogous to the process of making a decision about whether or not to invest in a particular stock or mutual fund. After all, you wouldn't invest your hard earned money in a stock or mutual fund without first doing exhaustive research about the stock or fund's past performance, current financial status, and projected future earnings. More than likely you would spend a considerable amount of time and energy doing your own research and consulting with your stock broker before making an informed decision about investing. The same general principle applies to the process of finding and choosing a physician. Although the process requires a considerable investment in terms of both time and energy, the potential payoff can be well worth it--after all, what can be more important than your health and well-being?

This section of your Guidebook offers important tips for how to find physicians as well as suggestions for how to make informed choices about choosing a doctor who is right for you.

Tips for Finding Physicians

Finding a highly qualified, competent, and compassionate physician to manage your specific illness or condition takes a lot of hard work and energy but is an investment that is well-worth the effort. It is important to keep in mind that you are not looking for just any general physician but rather for a physician who has expertise in the treatment and management of your specific illness or condition. Here are some suggestions for where you can turn to identify and locate physicians who specialize in managing your disorder:

- **Your Doctor** - Your family physician (family medicine or internal medicine specialist) is a good starting point for finding a physician who specializes in your illness. Chances are that your doctor already knows several specialists in your geographic area who specialize in your illness and can recommend several names to you. Your doctor can also provide you with information about their qualifications, training, and hospital affiliations.

The **Tips on Finding and Choosing a Doctor** in the complete **Medifocus Guidebook on Spondylolisthesis** includes additional information that will assist you in locating a highly qualified and competent physician to manage your specific illness.

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6 - Directory of Organizations

American Academy of Neurology

1080 Montreal Avenue; St. Paul, Minnesota 55116

800.879.1960 651.695.2717

memberservices@aan.com

www.aan.com

American Academy of Orthopaedic Manual Physical Therapists

2104 Delta Way; Suite 7; Tallahassee, FL 32303

850.222.0397

-

www.aaompt.org

American Academy of Orthopaedic Surgeons

6300 North River Road; Rosemont, IL 60018-4262

847.823.7186

-

www.aaos.org

American Academy of Physical Medicine & Rehabilitation

330 North Wabash Avenue; Suite 2500; Chicago, IL 60611

312.464.9700 312.464.0227 (fax)

info@aapmr.org

www.aapmr.org

American Board of Orthopaedic Surgery

400 Silver Cedar Court; Chapel Hill, NC 27514

919.929.7103

www.abos.org

American Physical Therapy Association

1111 North Fairfax Street; Alexandria, VA 22314-1488

800.999.2782; 703.684.2782; 703.683.6748 (TDD)

www.apta.org

The **Directory of Organizations** in the complete **Medifocus Guidebook on Spondylolisthesis** includes a list of selected disease organizations and support groups that are helping people diagnosed with Spondylolisthesis.

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This document is only a SHORT PREVIEW of the **Medifocus Guidebook on Spondylolisthesis**. It is intended primarily to give you a general overview of the **format and structure** of the Guidebook as well as select pages from each major Guidebook section listed in the Table of Contents.

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