

## The Spine and Aging

Disorders of the spine are extremely common as we age. Problems with the aging spine include spinal stenosis, disc herniation, spinal instability, fractures as a result of osteoporosis, and pain from spondylosis (arthritis). In this section, I will review the clinical presentation, diagnosis, and treatment of some of the more frequent disorders that affect seniors. My hope is that you will find this section both informative and practical if you suffer from one of these disorders.

Low back pain can be episodic or a chronic (long-term) problem. It ranks as one of the four most common reasons for a patient visit to a physician in the United States. It is estimated that between 50 to 80 percent of the adult population suffers from at least one memorable episode of low back pain per year. Low back pain can occur alone, or in conjunction with lower extremity (*radicular*) pain, depending on the etiology of the problem. When the pain is in the midline it is often referred to as *axial pain*. Pain that is experienced in the extremities is referred to as *radicular pain*. When the lower extremity pain is in the sciatic nerve's distribution, it is called *sciatica*. The sciatic nerve runs in the posterior (back) part of the lower extremity and thus sciatica refers to pain that radiates down the back or the side of the thigh and calf. The other major nerve in the lower extremity is the femoral nerve. It runs in the anterior (front) part of the lower extremity, thus causing symptoms in the front of the thigh, knee, or the inside part of the leg.

A brief introduction to spinal anatomy will be extremely helpful in understanding these disorders. The spine is made up of a series of connected bones called "Vertebrae". These vertebrae interlock via 1) bony protrusions called facets, 2) muscles and ligaments, and 3) soft jelly-like material, surrounded by a ring made of fibers and cartilage, called discs. (See Figure 1). A spinal unit can be defined as two vertebrae joined together posteriorly by their facets, on each side, and anteriorly by the disc. It is abnormalities in one or more of these areas that results in back/neck pain and/ or extremity pain.

### LOW BACK PAIN

There is significant controversy regarding the cause of low back pain. This is due in part because the spine is made up of many joints. Thus, it is difficult to determine exactly where along the spinal column lays the pain

generator for an individual patient. This is compounded by the fact that an abnormality in one of the more proximal (upper) joints can cause pain in areas much further down the spine. This is in contrast to sciatica or other lower extremity pain, which is often seen along specific areas, depending on the individual nerve root that is compressed. **Accordingly, lower extremity pain is usually more predictably treated than low back pain.**

Despite the above limitations, researchers feel that there are several potential sources of low back pain. These include the paraspinal muscles of the low back, the facet joints, the ligaments, and the discs. All of these areas are innervated by nerve fibers that can potentially cause low back pain.

Persistent pain from a muscular origin is referred to as *myofascial pain syndrome*. Pain that occurs as a result of a facet joint abnormality is referred to as *facet joint syndrome*. As previously mentioned, a facet is defined as a bony projection from one vertebrae that interlocks with another facet to form the joints of your spine. Pain that results from an abnormal disc is referred to as *discogenic* low back pain. Again, a disc is a jelly-like soft material surrounded by a ring of tough fiber and cartilage that is present between two adjacent vertebrae. The disc and the facet joints allow motion in your spine. Unfortunately, like other joints in the body, they can be injured after trauma or become painful as a result of arthritis.

**Fortunately, majority of patients who suffer from low back pain get better on their own.** They do not require long-term medications, physical therapy, or any invasive procedures. However, there is a subgroup whose pain does not improve with the above measures.

It is these patients that require repeat visits to physicians and other caregivers. All sorts of treatments, scientifically proven and unproven, have become popular for these patients. Some nonsurgical treatments include, magneto-therapy, acupuncture, chiropractic adjustments, anti-inflammatory medications, and array of physical therapy modalities and methods. These “conservative” treatments may or may not relieve the low back pain.

Invasive procedures are generally reserved for a very small group of patients that do not get better with the passage of time or respond to the above measures. These patients have chronic daily pain that has been present for months and years. The treatment is based on what the physician believes is the “pain generator” for that particular patient. Diagnostic injections or tests are performed in an attempt to better define the pain generator. These may

include facet injections, facet rhizotomies, and discograms. Facet injections involve the injection of one or more joints in your spine with a combination of a local anesthetic (such as Novocain) and steroid solution. Facet rhizotomy (also known as radiofrequency facet denervation) refers to a procedure that disrupts the nerve that innervates the facet joint with the use of various techniques (heat, cold, injection of chemical compounds). Discogram refers to the injection of an anesthetic and/or saline into the degenerated disc to determine whether the morphology of the disc is abnormal. More importantly, it is also used to see whether stimulating or injecting the disc reproduces the patients' typical back pain. Facet injections and rhizotomies are considered diagnostic and therapeutic tests while discograms are considered only diagnostic tests that do not offer any pain relief.

**It should be emphasized that all three of the above procedures are extremely controversial and are not universally accepted for their diagnostic or therapeutic value.**

Spinal surgery for low back pain (axial) without any associated lower extremity pain (either from nerve root compression or instability such as from *spondylolisthesis*) is rarely performed by this author. It is generally considered as a last resort when the patient does not respond to other non-operative methods and continues to suffer from severe pain. The patients for surgical intervention are picked very carefully and informed that the surgical results are not always predictable. In general, it has been my experience that patients who have single level involvement do better than ones who have multi-level involvement. In addition, patients who have pain-free intervals, in between their episodes of severe pain, seem to do better than patients who have constant pain. Finally, the success rate of spinal surgery, for axial pain alone, tends to be lower with each subsequent operation. Thus, it is critical that the patient be fully aware of the difference between axial and radicular pain as it applies to success from surgical intervention.

The most common surgery performed for axial low back pain is a *fusion* or *arthrodesis*. Spinal fusion refers to the surgical procedure that deliberately unites two or more vertebrae to prevent motion between those vertebrae. The theory behind this operation is that by preventing motion across the pain generators (the facets, ligaments, and disc), the chronic pain will improve or resolve. Bone grafts, bone graft substitutes, screws, rods, hooks, plates, and cages may be used to achieve the fusion. There are many different types of

fusions performed currently and it is not yet clear which one is superior. Thus, the type of surgery is yet another major controversy in the treatment of low back pain.

## **Herniated Lumbar Disc**

**Lumbar** refers to the lower five vertebral bodies of the spine. A disc is located between the vertebral bodies and functions as a “shock absorber” and aids in the mobility of the spine. A disc is primarily composed of water with a gel like center called the *nucleus pulposus* and a fibrous outer layer called the *annulus*. Behind the discs and vertebral bodies lie the spinal canal and the nerves that travel within the canal. A disc herniation occurs when the central portion of the disc migrates backward towards the spinal canal and the nerves. (Figure 2) Other terms often used to describe a herniated disc are ruptured disc or slipped disc. In most cases, the exact causes of a disc herniation are not clear. A weakened or torn outer area of the disc can result in the herniation of the gel like nucleus. The most common reason for a herniated disc is thought to be from degenerative changes within the disc that are commonly associated with aging. Disc herniations are more common in smokers and those who perform repetitive vibratory activities such as truck driving and jack hammering.

Before I discuss the clinical presentation of a lumbar disc herniation, caution is recommended regarding interpretation of imaging studies in the older patient population. **Several excellent studies have confirmed that up to 50% of asymptomatic patients, over the age of 60, have abnormal MRI scans, with approximately 35% having a disc herniation.** Thus both the physician and the patient must interpret the imaging studies in the context of the clinical symptoms.

Common complaints after a herniated lumbar disc include low back pain and spasms followed by radicular symptoms. Often, the low back pain improves rapidly as the lower extremity complaints get worse. The symptoms may occur suddenly or gradually and depend upon the exact location and the severity of the herniation. Pain traveling from the low back and extending down through the buttock and into the leg is the most common feature. The pain may be a dull ache or a sharp stabbing sensation. Numbness and tingling may also be present. The distribution of the complaints can often lead the doctor to determine which nerve is pinched from the herniation. If

one of the branches of the sciatic nerve is involved, then the symptoms will be more posterior (towards the back) of the extremity. If a branch of the femoral nerve is involved, then the symptoms will be anterior (towards the front) part of the extremity. The symptoms are often made better or worse with certain positions and activities such as coughing or sneezing.

Weakness of the affected muscle groups may be present and may make walking or climbing stairs difficult. In general, the disc herniation only compresses one nerve root. However, **in rare cases**, if a patient herniates a particularly large fragment towards the midline, then multiple nerve roots can be involved. This can result in a syndrome called ***Cauda Equina Syndrome***. (See figure 3) The patient may develop progressive weakness and loss of sensation in lower extremities, saddle anesthesia, and difficulty controlling urination and defecation. The diffuse symptoms are a result of compression of multiple nerve roots within the thecal sac rather than compression of one nerve root. In general, patients who develop this syndrome require emergency surgery. The surgery, if done early enough, results in a good prognosis and recovery for most patients.

Initial treatment consists of rest, physical therapy, anti-inflammatories and pain medications. Most patients improve with these measures. If the symptoms continue or worsen then surgical removal of the disc herniation is recommended.

Surgery is performed when non-surgical interventions fail to show significant improvement within four to six weeks. If the symptoms are severe or progressive weakness is present, surgery may be recommended sooner. As discussed, emergency surgery is performed when a disc herniation results in the Cauda Equina Syndrome.

The goal of surgery is to remove the portion of the disc that is compressing the nerve root. The most common procedure is called a microdiscectomy in which part of the herniated disc is removed. In order to see the disc clearly, it is often necessary to remove a small portion of the lamina, the bone that covers and protects the neural elements. Bone removal is usually minimal. During the surgery, an operating microscope is usually used for better visualization of the nerves. The incision is small and there is generally little bleeding. The success rate of lumbar disc surgery is greater than 90% in relieving the lower extremity symptom. However, the relief of low back pain is less predictable. Also, it is important to recognize that weakness due to a disc herniation does not consistently resolve after surgery. Pain is the

most reliable complaint to resolve. The complication rate for a discectomy is low and the patient usually goes home the same day or the day after the surgery. Most patients resume normal activities by six weeks.

## Herniated Cervical and Thoracic Disc

*Cervical* refers to the first seven vertebral bodies of the spine. *Thoracic* refers to the twelve rib-bearing vertebral bodies of the spine. There are three points worth discussing regarding these herniations. First, These herniations, unlike the lumbar, involve that portion of the spine that includes the *spinal cord*. The spinal cord is a structure that begins in the brain and usually ends at the first lumbar vertebrae (L1). Beyond L1, the nerves that are present in the spinal column are called the cauda equina and behave similarly to the peripheral nerves seen in our arms and legs. Unlike the spinal cord, they are more "resilient" and can be manipulated during surgery without risking further damage. As a result of this anatomic difference, surgery for disc herniation that involve the cervical and thoracic spine are typically done from an anterior (front) approach. This is because most symptomatic herniations are in front of the neural elements. In the lumbar spine, the surgeon simply manipulates the neural elements out of harm's way and pulls the offending disc fragment out without any additional risk from the manipulation. This is not possible in the cervical and thoracic spine, which "house" the spinal cord. The spinal cord is not a peripheral nerve and it is fixed by important ligaments, and thus, cannot safely be manipulated without causing further neurologic damage. Secondly, the thoracic spine is surrounded by the fairly rigid rib cage. Thus, there is little motion in the thoracic spine and hence there are fewer disc herniations in the thoracic spine. Remember, the less motion that is present, the less chance there is of developing spinal disorders. Lastly, most thoracic disc herniations occur in older patients and are usually asymptomatic.

As in the lumbar spine, a disc herniation in the cervical and thoracic spine can cause axial and radicular pain. The radicular pain is in the upper extremity for a cervical herniation and along the rib cage or the trunk of the body for thoracic herniation. However, as in the case of the cauda equina syndrome, a large herniation that is in the midline can cause more diffuse symptoms resulting in *Myelopathy* (see section).

Because cervical pathology is far more common than thoracic, I will now limit the discussion on the clinical presentation and treatment of a cervical Radiculopathy. It is important to recognize that, in the older population, a cervical radiculopathy is often caused by an *osteophyte* or a "hard disc"

rather than a soft disc (nucleus pulposus). This is due to various changes that occur in the aging spine. For example, a disc may bulge and later become “calcified” (harden). This is often called a disc-osteophyte complex and the Radiculopathy that results from this is called cervical spondylitic Radiculopathy. The symptoms that occur are similar whether one suffers from a hard or a soft disc. If the disc-osteophyte complex is causing a Myelopathy, then it is called cervical spondylitic Myelopathy. (See section).

Pain traveling from the neck extending down through the shoulder blade and the arm is the most common feature. The pain may be a dull ache or a sharp stabbing sensation. Numbness and tingling may also be present. The symptoms are often made better or worse with certain positions. Typically, extension of the neck combined with a head turn on the side of the symptoms, will make the symptoms worse. In contrast, placing the hand, of the involved extremity, on top of the head and holding the neck in a neutral position will often decrease the intensity of the radicular pain. (See figure 4) Weakness of the affected muscle groups may be present and may make using the arm more difficult.

Initial treatment consists of rest, physical therapy, anti-inflammatories, cervical traction, and pain medications. **Most patients improve with these measures.** Surgery is recommended when non-surgical interventions fail to show significant improvement within four to six weeks. If the symptoms are severe or progressive weakness is present, surgery may be recommended sooner.

The goal of surgery is to remove any disc or osteophyte that is compressing the nerve root. The most common procedure that is performed is called an anterior cervical discectomy and fusion. (Figure 5) An incision is made in the front of the neck. The disc and osteophytes are then removed which allows the pressure to be taken off the nerve. The disc space in between the vertebral bodies is then filled with a shaped piece of bone graft. Once the bone graft is placed, a small titanium plate may be applied over the entire construct to further stabilize it. During the surgery, an operating microscope is usually used for better visualization of the spinal cord and nerves. The incision is small and there is very little pain or bleeding. If multiple nerve roots are compressed then a more extensive operation may be required.

The success rate of a single level anterior cervical discectomy and fusion, **in relieving the extremity symptoms**, is greater than 90%. Most spine

surgeons consider this operation as the most successful one they perform. Patients will often awaken from anesthesia and happily report that their extremity pain has resolved. It is important to recognize that weakness due to a disc herniation does not consistently resolve after surgery. Pain is the most reliable symptom to resolve. The complication rate for a cervical discectomy and fusion is low and patients usually go home the day after the surgery.

Unlike radicular pain, **the relief of neck pain** after this operation is not as predictable.

## SPINAL STENOSIS

Spinal stenosis is a very common syndrome that often afflicts the older population. It is most simply defined as progressive compression of nerves due to narrowing of the bony canal that surrounds these structures (Figure 6.) There are several contributing factors that lead to this problem. The most common cause is degeneration due to lumbar spondylosis, or arthritis in the lower back. The narrowing of the spinal canal that occurs as the result of this degeneration causes mechanical compression of the spinal nerves in the low back. These nerves are responsible for providing sensation and strength in the lower extremities. In many individuals, this compression leads to no symptoms, while in others, a variety of clinical symptoms can occur. Interestingly, the severity of symptoms does not necessarily correlate with the magnitude of compression seen on spinal imaging studies.

Because spinal stenosis most commonly occurs as a result of the aging process, it is not surprising that the early symptoms are slow in onset. Spinal stenosis is a progressive and dynamic process. As a result, symptoms are not identical from individual to individual. Before our more universal awareness of the diagnosis of spinal stenosis, the bizarre or frequently atypical and varying symptoms and inconsistent signs (often with a lack of any neurological deficit), commonly prompted physicians to recommend psychiatric evaluation of these older patients. Now, however, the clinical manifestation of spinal stenosis is better understood and much more precise diagnosis and treatment is available.

Although low back pain is commonly associated with spinal stenosis, the most common reason the patient consults a physician is leg and buttock pain

in one or both legs that is often made worse by standing and/or walking. The patient will typically describe symptoms in the leg such as pain, heaviness, soreness, cramping and weakness and may also report a feeling of tingling or numbness. The distribution of pain is usually in the buttock, back of the thigh, calf and top of the foot. Symptoms in the front of the thigh are less common, but may also occur.

The majority of patients with spinal stenosis describe a history of progressively decreased walking distance over a period of months. Their walking is limited by the pain, heaviness and cramping in the buttocks and legs. Neurogenic claudication is a term that is used to describe these complaints. Often, they sit or bend forward to obtain relief after walking a short distance. They will also often lean forward when they walk because it lessens buttock and leg pain. That is because with flexion of the spine (leaning forward) there is an “enlargement of the spinal canal” and, thus, more space for the nerves. The classic revelation by the patient is to volunteer that their symptoms are less aggravating in the grocery store - unbeknownst to them they are leaning on the grocery cart in a flexed position, which enlarges the spinal canal. (Figure 7) Complaints of limited spine movement are common, particularly extension of the spine (leaning backward). Occasionally, the extension leads to “jolts of lightning” down the buttocks and legs. This is because there is more compression of the nerves in the extended position. Treatment of this problem begins with obtaining the correct diagnosis. As mentioned, the symptoms are often vague and can be similar to symptoms from vascular disease, a hip problem or other musculoskeletal problems.

Vascular claudication (see chapter) can be very similar to neurogenic claudication. (See Table 1) There are several distinctions, however, that sets them apart. First, unlike spinal stenosis, claudication from vascular disease generally resolves when the patient stops walking and simply stands. This is mainly because the demand for oxygen diminishes greatly when the patient stops walking. Secondly, in a great majority of patients, claudication from spinal disorders diminishes significantly if the patient walks in a forward flexed posture. Lastly, the patient with spinal stenosis may have tingling and numbness in the lower extremity as well as significant low back pain. Thus, a vascular study may be necessary if there is any doubt regarding the peripheral circulation.

A hip joint problem, such as arthritis, may also mimic spinal stenosis. Typically, the patient with a hip problem will have pain that begins in the groin and radiates to the front of the thigh. Occasionally, however, the pain can be in the buttock and even radiate to the front of the knee from the groin. Pertinent physical exam findings with a hip problem include 1) limited rotation of the hip joint, 2) exacerbation of the pain with flexion and internal rotation of the hip. If the diagnosis is not clear, an injection of a local anesthetic (such as Novocain) in to the hip joint can be performed. A patient who suffers from a hip problem will experience immediate relief, from their specific type of pain, as a result of the anesthetic. This injection only takes minutes and is performed by a Radiologist on an outpatient basis.

Once a diagnosis of spinal stenosis is accurately established, patient education is extremely important. Patients should be reassured that their pain is not dangerous and is the result of degenerative changes in the spine.

Anti-inflammatory medications and controlled physical activity are the safest and most effective initial treatments. A program of lumbar isometric flexion exercises followed by a gradual increase in activities may result in a return to more normal living. Patients who complain of persistent lower extremity and back pain after six weeks of conservative treatment may require more aggressive intervention. This may be in the form of an epidural steroid injection, in the spinal canal, and/or a nerve root block, to decrease inflammation surrounding the involved nerve or nerves. Some patients seem to respond very well to these injections, while others do not experience any significant lasting benefit. Unfortunately, there are no obvious reliable predictors as to which patient will respond favorably to the epidural injection. In general, the injection is very safe and is similar to the one given to women at childbirth for anesthesia. It is done as an outpatient procedure and only takes minutes to perform. If the first one is successful, the patient can have two more in the next 6-month period for any recurrence of pain.

A significant percentage of patients may not respond to any of these treatments on a long-term basis. In these cases, surgical intervention is recommended if the symptoms are severe enough to adversely affect quality of life. A special test such as *magnetic resonance imaging (MRI)*, *Computed Tomography (CAT Scan)*, or a *myelogram* may be required to confirm the diagnosis and to prepare for the surgery. A Closed MRI scan is the test of choice as it offers the clearest images. If a patient has a pacemaker then an MRI can not be performed. Fortunately, the success rate for spinal stenosis

surgery is quite high. It is one of the most common reasons for spinal surgery. Most patients experience complete resolution of their lower extremity symptoms. The low back pain is not as predictably relieved, however. Thus, the best candidate for spinal stenosis surgery is the one who suffers from lower extremity pain, as the predominant complaint, rather than low back pain.

The surgical treatment involves either an isolated *laminectomy* or a laminectomy with a fusion. (Figure 8) A laminectomy is defined as the removal of the back part of the vertebrae (lamina and part of the facet joint and supporting ligament) in order to create more space for the neural elements. In essence, you “unzip” the spine to make more room for the nerves. There is controversy, among spine surgeons, as to when a fusion should be added to the laminectomy in the treatment of spinal stenosis. The most common reason is a “slipped vertebrae” or spondylolisthesis in the presence of spinal stenosis. (See Chapter) A spondylolisthesis is defined as a forward slip of a vertebra in relation to the one below it. (Figure 9) The presence of this slip indicates instability between the two vertebrae. Moreover, the slip often contributes to a tighter spinal canal. It is felt by most surgeons that a slip can progress further with the destabilizing effects of the laminectomy. Thus, a fusion is often performed with the laminectomy to prevent further slippage of an already unstable segment.

Another common reason to add a fusion is the presence of spinal stenosis in conjunction with a deformity such as scoliosis. (Figure 10) A laminectomy alone may not decompress the nerve adequately and may actually make the deformity worse. A fusion using spinal instrumentation can often correct the deformity and thus allow more space for the exiting nerve as it leaves the spinal canal. Similarly, if a disk space has collapsed enough as a result of the degenerative process, it can lead to nerve root compression in the foramen. The foramen is the space through which a nerve root leaves the spinal column in the low back to enter the abdomen. This is called foraminal spinal stenosis. (Figure 11) A laminectomy alone may not adequately decompress the nerve root that is pinched in the foramen. A fusion that restores the disc height is the procedure of choice for this particular type of stenosis. This is often accomplished, by the placement of structural bone graft or metallic devices in between the two vertebrae, to “Jack-Up” the disc space and thus make more room for the nerve root in the foramen. (Figure 12) There are two other reasons to include a fusion with a laminectomy. First one is a patient who develops recurrent spinal stenosis

after a previous laminectomy. These patients often continue to recur with their lower extremity pain and/or develop new back pain unless they are both fused and decompressed during the second operation. The second one is the patient who has lower extremity symptoms from spinal stenosis but who also has significant low back pain. As mentioned, the lower extremity symptoms usually resolve with the laminectomy. Unfortunately, the relief of low back pain after a laminectomy, in a patient with a tight spinal canal, is often unpredictable. Thus, a fusion may be added to the laminectomy to increase the success rate of back pain relief. The rationale for the relief of back pain is that there will no longer be any abnormal motion across the fused segment.

## **SPONDYLOLISTHESIS**

Spondylolisthesis is defined as a forward slip of a vertebra in relation to the one below it. There are two main kinds of spondylolisthesis — isthmic and degenerative (see figure 13). In isthmic spondylolisthesis, a fracture in the posterior part of the vertebrae leads to instability or a slip. In the case of degenerative spondylolisthesis, the failure is generally either where the facets join together to form the “joints” in the spine or in the surrounding ligaments. If the joints or ligaments become lax, the vertebrae can slip forward over the one below it.

### **Degenerative Spondylolisthesis**

Women are affected more frequently than men. Diabetics are also more frequently affected. It is estimated that 10% of the female population has this condition. Oddly enough, there are people who have spondylolisthesis and are completely asymptomatic. If it does become symptomatic, the most common complaint seems to be low back pain. However, a radiculopathy (pain radiating down the thigh and/or leg) may also occur if the patient develops spinal stenosis. In general, both the low back pain and the radiculopathy improve with rest and are exacerbated by standing and walking. Activities such as bending and twisting can also make the symptoms worse.

In general, non-operative care is initiated unless the pain is unrelenting and /or the patient is developing progressive neurologic deficit. Non-operative care may include anti-inflammatory medications, a short course

of steroids by mouth, narcotics, and physical therapy. A series of epidural steroid injections may also be prescribed when there is significant lower extremity pain. The epidurals seem to be more successful when the patients have predominance of lower extremity pain, rather than low back pain. In general, no more than three epidurals in any given six-month period are performed. Many patients seem to improve to their satisfaction with these non-operative treatment methods.

Surgery is reserved for those patients who are not happy with their progress with the above measures. In addition, surgery is recommended for those few patients who develop a neurologic deficit or have progression of their neurologic deficit. There are several different types of surgeries performed for degenerative spondylolisthesis. If there is symptomatic spinal stenosis associated with the slip, then a laminectomy and a fusion is performed. A laminectomy is defined as the removal of the back part of the vertebrae (lamina and part of the facet joint and supporting ligament) in order to create more space for the neural elements. In essence, you “unzip” the spine to make more room for the nerves. A fusion is often performed with the laminectomy to prevent further slippage of already unstable vertebrae. It is felt by most surgeons that a slip can progress further with the destabilizing effects of the laminectomy. A fusion is defined as a deliberate surgical union of two or more vertebrae such that motion is prevented between these fused vertebrae. Bone graft, bone graft substitutes, screws, rods, and cages are used to achieve this union. Once the fusion occurs, the vertebrae can no longer slip and the nerves can no longer be pinched.

In general, the lower extremity pain is more successfully treated than the low back pain. Most patients experience complete resolution of their lower extremity symptoms. The relief of back pain is not as predictable. Patients who have not had chronic (long-term) back pain generally do better than patients who have had low back trouble for years and years.

## ISTHMIC SPONDYLOLISTHESIS

This type of slip is a result of *spondylolysis*. Spondylolysis is defined as a crack or a fracture that occurs in the *pars interarticularis* (see Figure 14) of the vertebrae as a result of repetitive extension forces. Thus, this kind of a spondylolisthesis is more common in athletes who play sports that require hyperextension of their lower spine (Gymnasts, Football Lineman, Weight

Lifters) In addition, unlike degenerative spondylolisthesis, Isthmic spondylolisthesis generally starts when you are much younger. The symptoms, however, may be dormant until the patient reaches adulthood. It should also be pointed out that one could have the fracture in the pars (spondylolysis) without the spondylolisthesis. In fact, it is postulated that some children go on to unite the fracture of the pars and thus do not develop the spondylolisthesis.

Unlike degenerative spondylolisthesis, the isthmic slip can occasionally progress to a high degree. This is because the back part of the vertebrae is not connected and thus there is no limit to how far it can slip. In degenerative spondylolisthesis, the facet joints may be “loose” but they will prevent the superior vertebrae from sliding no more than 25% of the width of the body.

As with degenerative spondylolisthesis, the patient can be totally asymptomatic with isthmic spondylolisthesis. If symptoms do occur, they include low back pain, radicular pain, claudication, and hamstring tightness. Physical therapy, anti-inflammatories, epidural or selective nerve root injection can all be tried to alleviate these symptoms. Surgical indications and treatments are very similar to the ones for degenerative spondylolisthesis.

## **Cervical Myelopathy**

Cervical Myelopathy is the clinical syndrome that occurs as a result of narrowing of the spinal canal in the cervical spine. The narrowing of the spinal canal causes compression of the spinal cord. (Figure 15) Often, affected individuals are born with a narrow spinal canal. There may be several contributing factors that lead to the problem. The most common cause is degeneration due to cervical spondylosis, a term used to describe arthritic changes in the cervical spine. Over time, these arthritic changes lead to narrowing and mechanical compression of the spinal cord. A large central disc herniation can also cause or contribute to the problem.

The spinal cord is responsible for sending signals to and receiving signals from the arms and legs. These signals within the spinal cord are responsible for pain, sensation, position sense and motor strength in the arms and legs. In some individuals the compression of the spinal cord does not lead to symptoms. However, in others, spinal cord compression can cause a variety of complex symptoms. Interestingly, the severity of symptoms does not necessarily correlate with the magnitude of compression seen on spinal imaging studies. Patients with severe spinal cord compression can be completely without symptoms. Thus, the diagnosis is made by the presence of both the clinical syndrome and compression of the spinal cord on imaging studies such as a MRI scan, CAT scan, or a Myelogram. It is one of the most commonly misdiagnosed syndromes as it often occurs in elderly patients who attribute their symptoms to “arthritis and old age” and do not seek medical attention. In addition, the early findings are often very subtle and protean such that the diagnosis is difficult to make even for a well-trained health care provider. Symptoms are not identical from patient to patient. Cervical Myelopathy is generally a progressive process.

Neck pain is commonly associated with cervical myelopathy but is not always present. The most common reasons why patients consult a physician are numbness and tingling in the arms or hands, problems with function of the hands, and weakness in the arms or hands. Patients often complain of difficulty with fine motor movements of their hands and fingers (combing hair, buttoning a shirt, or difficulty turning the ignition key in a car).

Symptoms in the legs may include difficulty with walking (wide broad based gait with frequent falls) or a sense of imbalance. Weakness in one or both legs may be present. If there are pinched nerves in the neck along with compression of the spinal cord, arm pain may be an associated feature. Another common symptom includes a sharp, stinging, shock-like sensation extending from the neck down the spine or into the arms by looking directly up or down. Burning, tingling, and spasticity of the arms and legs with a change in bowel and bladder habits can also occur.

If any of these symptoms and signs are present, then a plain x ray and an MRI scan of the cervical spine are generally ordered. MRI is the best study to assess the size of the spinal canal, degree of compression, and overall condition of the spinal cord. X-rays are best used to assess the bony structure around the spinal cord and to show the degree of arthritic changes in the cervical spine. Cervical alignment and stability are also best assessed with x-rays.

If the clinical syndrome of cervical myelopathy is present with compression of the spinal cord noted on the MRI, initial treatment will usually consist of physical therapy to address any painful symptoms in the neck or extremity weakness. Medications such as anti-inflammatories or pain medications may be prescribed to address any painful symptoms. Should the symptoms be mild or not progressive, monitoring the clinical course over time may be recommended. Should the symptoms be progressive, advanced, or if weakness is noted in the arms or legs, surgery is usually recommended. Surgery consists of removing the arthritic bone that has narrowed the spinal canal and can be approached from the front of the spine or from the back, depending on several variables. A fusion procedure to stabilize the affected areas is usually performed at the same time. The type of surgery is dependent on the age and general condition of the patient, number of levels involved, location of the compression, and alignment of the cervical spine. The main objective of surgery is to stop the progression of myelopathy. Significant improvement in symptoms can occur, but it is often difficult to predict which patients will have noticeable clinical improvement once the compression is relieved from the spinal cord. **Fortunately, the success rate for halting the progression of myelopathy with surgery is quite high.**

Briefly, I would like to discuss the syndrome of Thoracic Myelopathy. It is caused by essentially the same problem except that it occurs in the

thoracic spine. Thus, the upper extremities are spared because nerves that control these areas have already exited the spinal canal. However, when the thoracic cord is compressed, the lower extremities are not spared because the lumbar nerves have not yet exited the spinal canal. Thoracic Myelopathy is often a hard problem to treat because the thoracic spine is within the rib cage. The compression of the thoracic cord is usually anterior and thus the surgical approach has to be anterior. Remember, unlike the lumbar spine, one cannot manipulate the neural elements in the cervical and thoracic spine without risking neurologic injury. Accordingly, a *thoracotomy* is often necessary to adequately decompress the thoracic cord. A thoracotomy is a procedure where the surgeon removes part of one rib and enters the chest or the upper abdomen through an interval created by the rib excision. Obviously, this is a substantial operation with more risks involved, particularly in the older patient population. **Fortunately, as mentioned, the thoracic cord does not often require a decompression and thoracic myelopathy is rather rare.**

## COMPRESSION FRACTURES

Compression fractures refer to low energy fractures that occur in the spine. They are not as serious as other fractures such as burst fractures and fractures associated with dislocations. As a person ages, they may develop osteoporosis. (See Chapter) A compression fracture can occur in these individuals even with the most trivial trauma. Moreover, a compression fracture can occur even without any trauma. These fractures represent one of the greatest challenges to any health care provider that treats the geriatric population. The incidence of compression fracture is (get Data From IZZY/JOE LANE papers). The incidence of a fracture at a distant site after one fracture is DATA.

The patient will typically present with sudden onset of pain near the area of the fracture. However, the pain can even be at an area remote from the fracture site. This pain is usually worse with increase in activity, deep breathing, coughing, and sneezing. Multiple or recurrent compression fractures can cause kyphosis (hunchback) and decrease in the overall height of the patient. This may lead to chronic pain and pulmonary problems. Plain x-rays may be diagnostic. However, an MRI or a cat scan is often needed to determine the stability and or morphology

of the fracture. A bone scan is often used to determine whether the fracture is old or new.

The type of treatment is dependent on the severity of the pain and the extent of the fracture and deformity. A stable fracture without much associated pain is treated with short period of bed rest and some medications. A light brace is offered but is not always tolerated by the patient due to their age as well as their kyphosis (hunchback). If there is severe pain and the fracture is stable, a vertebroplasty or kyphoplasty is usually recommended. In unstable fractures and fractures associated with neurologic deficits and severe kyphosis, bracing and/or surgery may be recommended.

These are two relatively new procedures that are used to treat stable compression fractures. In vertebroplasty, methyl methacrylate (bone cement) is injected directly into the fractured vertebrae through two small stab wounds in the back. The cement hardens and gives the fractured vertebrae more stability. This causes a reduction in the pain level. A kyphoplasty is very similar to vertebroplasty. In kyphoplasty, however, a balloon is inflated and then deflated in the vertebrae to create a void in the bone. This is followed by injection of the cement. It is controversial as to whether one procedure is better than the other. Central to this controversy is whether Kyphoplasty corrects the deformity better than vertebroplasty and whether correction of the deformity has any effect on pain relief or prevention of future fractures at other levels. Vertebroplasty is generally done with a local anesthetic while kyphoplasty is generally done with a general anesthetic. Patients can go home the same day after either procedure.

Most patients seem to do very well with these procedures. The pain relief is significant. It has been my experience that mild, stable, single-level fractures respond more favorably than other fractures. It should be emphasized, however, that if the underlying osteoporosis is not treated the patient is still at risk for developing another fracture in the spine. The incidence of refracture after these procedures is DATA

Preventive treatment is aimed at treating the underlying osteoporosis. A DEXA scan can be used to diagnose and monitor osteoporosis. Treatment includes many different types of medications that affect bone

metabolism. In addition, an exercise program that involves impact-type activities is strongly recommended.

## GLOSSARY OF SPINAL TERMINOLOGY

<b>Annulus</b>	Any ring-shaped, circular structure.
<b>Arthrodesis</b>	The surgical immobilization of a joint. Also known as a fusion.
<b>Axial Pain</b>	Pain relating to or situated in the central part of the body, in the head and trunk as distinguished from the limbs, e.g., axial skeleton.
<b>CAT</b>	Computerized Axial Tomography: A non-invasive radiologic method of imaging in which a computer graphically reconstructs the anatomic features registered by axial tomography.
<b>Cauda Equina Syndrome</b>	The clinical result of compression due to intrinsic pressure on the caudal sac and usually results from a large central herniated disc. Signs and symptoms include low back pain, bilateral lower extremity weakness, bilateral radiculopathy, subtle anesthesia, and bowel and bladder incontinence. Treatment requires prompt surgical decompression.
<b>Cervical</b>	Of or pertaining to the neck.
<b>Discogenic</b>	Caused by derangement of an intervertebral disc.
<b>Facet Syndrome</b>	A disorder of the lumbar spine characterized by the sudden onset of low back pain that is positional in nature, relieved in certain postures, and exaggerated in others. The “locking-type” pain usually involves the articular facets of the spinal column.
<b>Fusion</b>	The surgical formation of a bony ankylosis. (Synonym: arthrodesis)
<b>Laminectomy</b>	The surgical removal of the posterior bony arches of one or more vertebrae in order to expose and decompress the neural elements in the spinal cord or the cauda equina.
<b>Lumbar</b>	Relating to the part of the back and sides between the ribs and the pelvis.
<b>MRI</b>	Magnetic Resonance Imaging: An imaging technique that employs radio frequency waves and a strong magnetic field to produce clinically useful images.