

SPINAL CURVES

THE MOST ADVANCED
TREATMENT OPTIONS FOR

SCOLIOSIS

STRAIGHT TALK ON
CURVATURE OF THE SPINE

SPINAL CURVES IN
TEENS AND ADULTS

WHEN SPINAL CURVES
IMPACT YOUR LIFESPAN

TREATMENT OPTIONS FOR
FLATBACK SYNDROME

It's estimated that 2% of Americans have a spinal curve. The good news is that most never need surgery. And the ones who do can benefit from advanced surgical correction systems that can correct the curve so they can live a normal lifespan.



Spinal Curves

WHAT TO DO WHEN LIFE THROWS YOU A CURVE

When a person first learns they have an abnormal curvature of the spine, it's certainly unsettling. You learn new terms like scoliosis, kyphosis, flatback syndrome, etc.

Thanks to school programs that screen for scoliosis, most scoliotic curves are detected by a school nurse in elementary school, who then may direct the parent and child to regional scoliosis surgeons in their area.

These specialists can assess the curve, try non-surgical treatment options like bracing, and advise the parent on the best course of action, including watchful waiting. Adults with spinal curves that are progressing in many cases will have to consider scoliosis surgery to correct the problem.

But why did Mother Nature throw such a curve? What causes scoliosis in the first place?

What causes spinal curves?

Scoliosis is in most cases a painless condition that can progress unnoticed for years. Ultimately, as the curve worsens, it causes an abnormal curvature in the spine. This will often result in a rotation of the spine and rib cage, which affects the symmetry of the shoulders, trunk and waist.

Although most cases of scoliosis are mild, severe scoliosis can be disabling, inflicting excruciating back pain as a

symptom. Certain conditions like cerebral palsy, may actually cause scoliosis, but in most cases the cause of scoliosis is unknown. Sometimes there can be a hereditary tendency to pass along the problem from generation to generation.

Three common types of scoliosis are idiopathic (genetic), neuromuscular, and degenerative.



In scoliosis, the spine is not only curved, but also twisted, like a corkscrew. As the person ages, the spinal curve can worsen and begin to encroach upon and impair the function of the internal organs which can shorten lifespan.

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Spinal Curves

Idiopathic scoliosis is not linked to a known cause, but it is the most common type of scoliosis in adolescents. Doctors are unsure what causes this type of scoliosis, but it is suggested that it is hereditary because the disorder tends to run in families. Curves as small as 40 degrees can cause decreases in pulmonary function, deformity and pain. As these curves progress, problems get much worse. Curves of 70 degrees, when combined with one other common lung disease, can cause shortness of breath with simple walking.

Neuromuscular scoliosis can usually be much more severe since the condition is present at birth. This type of scoliosis is due to the failure of the spine bones to properly form, or failure to correctly separate from each other. People born with birth defects or cerebral palsy can often have neuromuscular scoliosis.

Degenerative scoliosis is found in adults where the weakening of normal

ligaments and other soft tissues of the spine can lead to an abnormal curve in the spine. Many times this can be linked to the patient having complained about arthritis.

How scoliosis progresses

Most of the time the patient is unaware of the curvature in their spine until it is noticed by someone else. The most common symptom of scoliosis is a curve in the spine.

Some of the warning signs to look for are shoulders at different heights, appearance of a uneven waist, rib cages at different heights, leaning of entire body, fatigue, backache, low-back pain and head not aligned with the pelvis.

These signs and symptoms typically begin in adolescence when boys and girls hit their growth spurt.

Boys and girls develop mild scoliosis around the same rate, but interestingly, girls have an increased risk of the scolio-

sis worsening. Severe scoliosis (a curve greater than 100 degrees) can create dangerous problems. The spinal curve can encroach upon the lungs and heart, as well as other organs, making it more difficult to breathe and for the heart to pump blood flow properly.

If there is uncertainty that you or your child might have scoliosis, you should see a scoliosis specialist to get evaluated. School examinations include Adam's Forward Bend Test for scoliosis.

This test has the child bend over and touch their toes, which exposes the spine to the examiner so he or she can easily detect any abnormal spinal curvatures. Most of these screenings take place in the 5th or 6th grade.

Additional testing can be done by taking an X-ray from the front and the side to get a clearer view of the spine's alignment. Height and weight is measured because the more remaining growth the patient has, the greater potential of the



Dr. Rory Mayer specializes in adult scoliosis at Texas Spine and Scoliosis in Austin, Texas.

Spinal Curves

scoliosis to worsen.

A scoliosis specialist will monitor the patient over several follow up visits to compare the results of the previous visits to get a better idea of the pace of the progression of the spinal curve.

Ideally, the treatment of scoliosis is customized to each patient and based on the severity of the curve and the potential of the spine to curve even worse.

Most scoliosis treatment includes observation, bracing, and surgery. Observation is usually the most common route. If the doctor recommends wearing a brace, this treatment is designed to further prevent worsening of the spinal curve, rather than to reverse the scoliosis back to a completely straight spine. Bracing is typically a hedge against the curve becoming worse. Bracing can halt

SCREENING

DO YOU HAVE SCOLIOSIS?

Viewed from the side the healthy spine has natural curves. But viewed from behind, the alignment should be straight. The easiest way to screen a child or adult for scoliosis, is to have the person bend over at the waist and observe their shoulder blades to see if they are uneven. If the spine is curved, one shoulder will appear higher than the other.



a potentially progressive curve about half of the time. A brace may also slow a curve, which may make corrective surgery less complex.

When scoliosis surgery is needed

Surgery consists of using metal rods, screws or wires to de-rotate the curve, to regain a straight posture while the spine heals. Neuromuscular scoliosis typically requires spine surgery.

Experimental testing is being researched to see if a patient's blood can give doctors insight about if the scoliosis is likely to worsen in the future. School screening is especially crucial for scoliosis, as it helps parents to become aware of their child's situation before the spinal curve worsens. Early detection may prevent a surgery, or make the surgery less complex.

Scoliosis at birth

Congenital scoliosis is a condition where there is deformity in the spine present at birth, but typically it is revealed only as the baby continues to grow. The cause of congenital scoliosis is abnormally shaped or fused bones in the spine that do not grow or fuse correctly.

Neuromuscular scoliosis consists of poor neurologic or muscular control of the spine and might be evident in those children born with cerebral palsy and

muscular dystrophy.

Children diagnosed with more advanced scoliosis can often feel like they sometimes have trouble breathing. They are also prone to more back and leg pain symptoms.

Because kids are fairly flexible, spinal curves can progress unnoticed for years without any symptoms. This explains why school screenings are so critical to detect scoliosis early on. During the screening, a school nurse or pediatrician may notice a hump, uneven shoulder blades or hips, or an "S" shaped curve in their spine.

The potential for the curvature in the spine to worsen is linked to the amount of growth remaining in the bones and spine. This growth may relate to the treatment decision and recommendation from the scoliosis surgeon.

One way to determine how much growth has yet to take place is to perform an X-ray of the pelvic hip region. Another way is to note the changes of puberty in girls and boys which can give insight if the person has more growth left. In girls, evidence suggests that after their first period, there may be one to two more years of spine growth remaining.

Where spinal braces fit in

Every adolescent dreads the thought of wearing a back brace to school. They are afraid it can be a source of ridicule



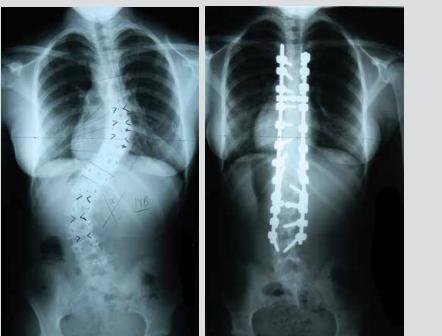
X-RAYS AND ASSESSING YOUR OPTIONS

Matthew Geck, MD, co-founder of Texas Spine and Scoliosis, shown right, has performed more than 1,000 scoliosis surgeries over 15 years in Austin, Texas. His practice has evolved into the largest scoliosis practice in Central Texas.

The first visit to a regional spine center like Texas Spine and Scoliosis will involve x-rays that reveal the extent of the spinal curve.

If the scoliosis is causing back pain symptoms, Dr. Geck may involve other members of the team, including specialists in Physical Medicine & Rehabilitation, who perform pain relieving spinal injections.

If corrective spine surgery is necessary, Dr. Geck now uses several surgical options, from vertebral tethering or stapling to prevent the curve from worsening, or mini scoliosis surgery to correct and de-rotate the curve. In Mini Scoliosis Surgery, Dr. Geck is able to access and correct the spinal curve through much smaller incisions than is used in traditional scoliosis surgery.



and it draws undesirable attention to their scoliosis, something most kids would like to forget.

Most scoliosis surgeons are aware of these concerns, and there are some braces that need only be worn at night. The brace applies pressure to the trunk and pelvis to stop the curve from worsening, which it can do in about 50% of cases. The brace can also slow a curve which can help with an optimal result if corrective surgery is ultimately needed. Typically, bracing is considered if the scoliosis starts to pass 20 degrees measured laterally in the curve. Most scoliosis specialists will recommend bracing for patients with a curvature angle around 20-50 degrees.

KYPHOSIS: ANOTHER CURVE

While Scoliosis resembles a sideways curve when viewed from behind, Kyphosis is a forward-bending curve, where the spine can appear straight from behind. Kyphosis is usually found in the thoracic area. This spinal curve can make the person look like they have a humpback.



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A back brace, however, is not designed to reverse the curvature, but rather to prevent the spine from worsening. There are many different types of bracing options available with specially placed padding and straps that place resistance on the certain area in the spine. Most braces are constructed of plastic and contoured to the patient's unique body.

The Boston Brace is probably the most common used to treat scoliosis. These braces are made out of plastic



components that are custom modeled to the patient's body which creates a low-profile for the brace.

On the front side, this brace extends from the lower breast to the start of the pelvic area. On the back side it extends from the upper back to the tail bone. This brace forces the low back to flex which helps flatten the curve. When scoliosis progresses to above 40 degrees — and bracing has shown no signs of arresting the curve — spine surgery is typically recommended.

Children who don't need bracing or surgery will still

need to be under observation through regular follow up visits just to monitor progression of a curve in the future.

X-rays might be done semi-annually until the child completes their growth spurt to document the degree of curve in the patient's file.

The good news is that the majority of children diagnosed with scoliosis will not need any type of treatment. Only about one in seven adolescents diagnosed with scoliosis will ever need to begin some type of treatment whether that be bracing or surgery.

Lordosis & kyphosis curves

Lordosis is a condition consisting of an excessive inward curve of the spine

causing the body to improperly distribute mechanical stress from movement such as walking. This condition can affect all ages and usually appears in the lower back but sometimes it is present in the neck. Lordosis found in the lower back can give the person an exaggerated posture, which can affect movement and cause pain as well.

Kyphosis is a progressive spinal condition effecting people ranging from kids to adults that has the potential to cause serious spinal deformity.

Both of these abnormal curves are usually found in the thoracic area and can make the person look like they have a humpback. A physical examination consisting of tests such as observation, Adam's Forward Bending Test, Range of Motion and Palpation all help reveal the current health of the patient.

The two classifications of kyphosis are postural and structural. Postural kyphosis is from poor posture, but the person can correct it. Structural kyphosis is an abnormality in the upper body such as the spine and surrounding muscles. This type of kyphosis might have to be treated medically since the patient cannot fix the curving of the spine.

Does exercise help or hurt curves?

Unfortunately, while exercise and movement are key to recovery from other cases of back and neck pain, there doesn't appear to be any specific exercises that stop scoliosis. That's because the muscles are simply no match for a spinal deformity where bone is inclined to curve out of the correct position.

With that said, exercise doesn't hurt or worsen scoliosis and most scoliosis specialists recommend that kids stay active in their sports as well as stay active with friends. In cases where a curve is worsening, a scoliosis surgeon may advise against contact sports like football which pose special risks to the spine.

PEDIATRIC SCOLIOSIS

BRACING & WAITING

While bracing is ineffective for adult scoliosis, in half of cases a brace can stop a spinal curve from worsening in the adolescent who is still growing.



When adults have scoliosis

Adult scoliosis relates to those 18 or older. Adult scoliosis differs from pediatric scoliosis in that adults have spines that are mature and have fewer treatment options. For example, a brace is of no use typically for an established curve in an adult. Scoliosis in adults is also often accompanied with back pain, mainly because in addition to complications from the curve, poor spinal alignment can cause muscle and ligament strain.

Scoliosis can also cause discs to herniate from the pressure placed on them from the curve. Another complication can be osteoporosis, where the vertebrae in the spine become porous and brittle, causing vertebral



fractures. When the scoliosis patient has osteoporosis, it can limit the spine surgeon's surgical treatment options.

When surgery is necessary, the concern with adults is that the older the patient, the less flexible the spine is for correction, and the more risk for spinal cord damage during correction. In this case, waiting years to deal with progressing curve is not advised.

There are some non-surgical treatment options for adult scoliosis. Exercises can reduce some back pain symptoms. Steroid injections can also help relieve pain symptoms. Bracing is rarely used in adults as it doesn't reverse the existing curve. Surgery is often the recommended treatment option for curves that have gradually worsened or when pain cannot be relieved non-surgically.

Some patients, because of severe curves, can have several levels of degenerative discs, which can require fusions over multiple levels.

Recovery after scoliosis surgery is dependent on the length of the incision and scope of surgery, as well as the age of the patient. Some patients will be back to full activity in three months, while others may need as much as six months

to recover and return to activities.

During scoliosis surgery, an incision is made in the back so the surgeon can access the vertebrae and install the necessary instrumentation, rods and screws. In some cases an anterior incision may be made to access the front of the spine.

Scoliosis surgery is based on a two-rod instrumentation system that attaches to each vertebral level, to de-rotate and straighten the abnormal curve. The instruments are left inside the body attached to the spine even after the spinal fusions heal to provide additional support. After the surgery, the patient's spine will appear much straighter. The surgical procedure may require a three-day hospital stay.

After three months most patients can begin to return to most normal activities with the exception of any contact sports, or sports like skiing that could result in a fall or trauma. Because the spine and spinal cord is being repositioned during scoliosis surgery, paralysis is a real risk involved. Consequently, the patient should seek out a very experienced scoliosis surgeon.

New option for stopping pediatric scoliosis: Vertebral Tethering

In a child or adolescent, where the bones are not fully formed as in an adult, wearing an external brace can sometimes be effective at stopping progression of the curve.

When bracing fails to work or is not an option, there are now two new minimally invasive options that access the spine through tiny incisions near the ribs:

1. Vertebral Body Stapling uses a series of staples on one side of the vertebrae to correct scoliosis like braces on teeth.

2. Vertebral Body Tethering uses a cable attached to one side of the vertebrae to correct and then control the curve.

Both techniques work on one side of the curve to prevent it from worsening during the adolescent growth spurt. Sometimes it may be the only surgery needed. A second benefit of both minimally invasive techniques is that they don't burn any bridges and more traditional corrective instrumentation can be used later on if necessary.

As with any new procedure, there is great hope that Vertebral Body Tethering can arrest a spinal curve in the young scoliosis patient and possibly eliminate the need for a more complex and invasive spine surgery. Tethering applies mostly to adolescent spinal curves that are still in the growth spurt stage.

Both bracing and Vertebral Body Tethering involve the concept of bone growth modulation which is based off the Hueter-Volkmann principle, which states that bone under more pressure will grow slower and denser than bone not under stress. So with bracing or tethering the

bone on the inside part of the curve will grow slower and denser than the bone on the outer part of the curve which in turn creates a vertebrae more wedge shaped.

The difference between bracing and tethering is that the goal with bracing is to PREVENT THE SPINAL CURVE FROM WORSENING. It is important to understand that bracing does not correct the existing curve.

Conversely, with Vertebral Body Tethering loading is applied directly to the spine with a surgical procedure, which creates bone growth modulation and attempts to provide some correction of the spinal curve — if the patient has young with more bone growth in the future. In this sense, Vertebral Body Tethering is an early intervention option for the adolescent scoliosis patient whose bones have not fully matured, rather than someone who is now an adult.

Benefits of Vertebral Body Tethering include:

- Less invasive than open scoliosis surgery
- Less surgical hardware is used
- Provides more motion preservation than rods



Who qualifies for Vertebral Body Tethering? The patient must be young enough to still have bone growth remaining. Girls still have bone growth up to age 14 while boys can still have bone growth up to age 16.

A candidate would have idiopathic scoliosis with a curve less than 65 degrees who are generally flexible and whose bone structure is large enough to accept the installation of screws and anchors into the vertebrae. This is determined with an X-ray. The young patient should also have failed traditional bracing, or cannot tolerate wearing a brace.

Vertebral Body Tethering surgery

The Tethering System is made up of anchors, bone screws, cord and set screws.

During surgery, the scoliosis surgeon places the anchor and bone screw into the patient's spine on the side of the spinal curve. The polymer cord is then secured to the bone screws using set screws. The surgeon then applies tension to the cord to partially reduce the curve in the person's spine. The cord continues to straighten the spine as the patient continues to grow.

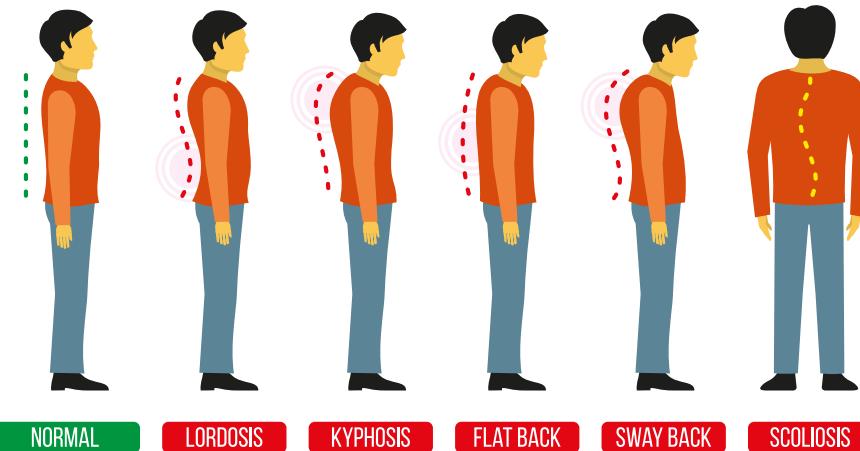
Recovery can be fairly quick with the young patient being released to return to activity and to athletics about a month to six weeks after surgery.

Vertebral Body Tethering Outcomes

According to Dr. Geck preliminary research on tethering is exciting. "We're seeing in some cases a 30% to 40% degree correction with tethering," he notes. "The key issue is performing the procedure when the teen is young enough where they have at least a third of their growth spurt left. For girls that would mean doing the procedure before age 14 or 15, and for boys, before about age 16. Overall, this new scoliosis correction method is less invasive than using rods to de-rotate and straighten the curve. But again, there is a key window of time that we must adhere to."

An array of spinal curves

The normal spine has a slight curve when viewed from the side. There can be a variety of abnormal curves. Lordosis is an excessive curve in the low back. Kyphosis is an excessive curve in the upper back. Flatback can be the result of spinal surgery that fuses vertebrae into a too flat position. Scoliosis is when the spine has an abnormal curve when viewed from behind. The key to managing any abnormal spinal curve is early detection, bracing to prevent it from worsening, and if necessary, surgery to prevent damage to internal organs.



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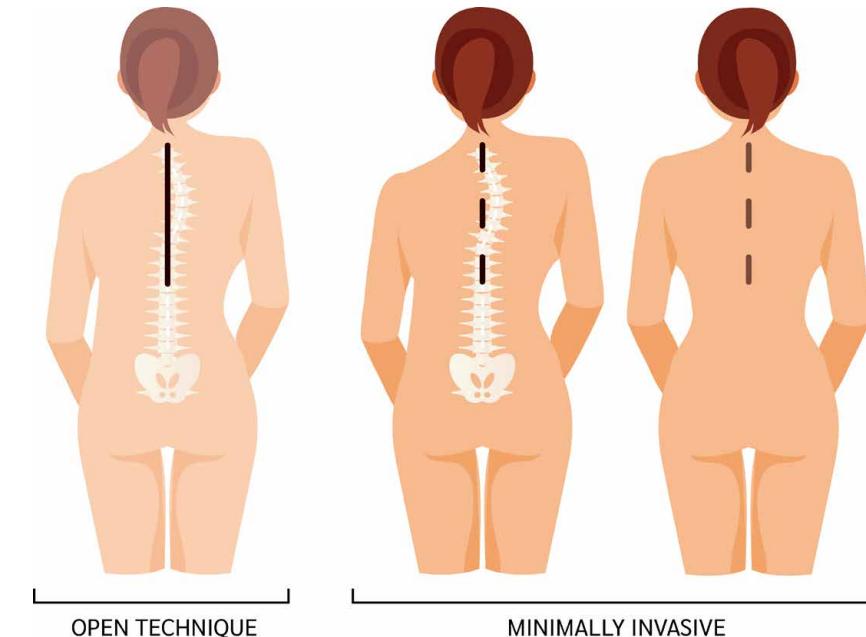
Mini Scoliosis Surgery

Smaller incisions speed return to activity

If the curve is too large or stiff, scoliosis surgery can correct the curve and restore quality of life. It is based on a two-rod instrumentation system with screws that attach to each vertebral level, to de-rotate and straighten the abnormal curve.

An incision is made in the back so the surgeon can access the vertebrae and install the necessary instrumentation, rods, hooks and screws.

Traditional scoliosis surgery can involve a long 12 to 24-inch incision to enable the surgeon to access the



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spine and correct the curve. While this surgery is effective, the recovery period is significant because of the long incision and disruption to muscles and ligaments.

- The shorter incisions cause less disruption to muscles and tissues so the patient has a less painful and quicker recovery.
- There is less risk of complications and less time in the hospital.

When should a person consider scoliosis surgery to straighten a curve? It's a complex decision, because waiting too long carries increasing risks. That's because the spine is most flexible — and more receptive to correction — when the person is under 21 years of age. In addition, younger patients get restoration of lung function and prevention of disc degeneration with scoliosis surgery.

A new advanced treatment option, however, is "mini scoliosis surgery" which is done in only a handful of scoliosis centers in the United States.

Dr. Matthew Geck at Ascension Texas Spine & Scoliosis Center is one of the developers of this new mini scoliosis surgery technique.

With mini scoliosis surgery, Dr. Geck is able to use special instruments and work through three smaller incisions to straighten the spine with far less muscle and tissue disruption.

The benefit of mini scoliosis surgery to the patient is significant:

- The shorter incisions involve less

If an aggressive spinal curve is left untreated, it can cause pain and put pressure on internal organs which can shorten a person's lifespan. Some adults can have severe degeneration of their scoliosis leading to "collapsing spine syndrome," in which they lose height, stoop forward and develop bone spurs that pinch their spinal nerves. Another complication can be osteoporosis, where the vertebrae in the spine become porous and brittle, causing vertebral fractures. This can limit surgical options.

Harrington Rods & revision surgery

Harrington Rods date back to the 1960s. It was a stainless steel rod that was the precursor to current instruments. Harrington Rods were the most common system for scoliosis surgery for a couple decades. However, while the new instruments de-rotate and straighten the spine, Harrington Rods take a corkscrew-like spine and merely bend it straight without de-rotation. This has unfortunately become a problem for all those treated in that era with this now-obsolete system.

It is estimated that around

one million people had Harrington Rods implanted over 30 years. And unfortunately, many people developed Flatback Syndrome as a result of this scoliosis system. Consequently, scoliosis surgeons today are busy doing revision surgery on the thousands of middle-aged scoliosis patients who need these obsolete rods replaced with new instrumentation.

Flatback syndrome: Treatment options

A healthy spine has a natural spinal curve that requires minimum energy to stand or walk. When the spinal curve has been removed, the result is a condition called "Flatback Syndrome."

Some of the symptoms of Flatback Syndrome include having trouble maintaining one's posture, low back pain and upper leg pain. Since the person has trouble maintaining proper alignment, the symptoms can increase throughout the day causing extreme pain and fatigue.

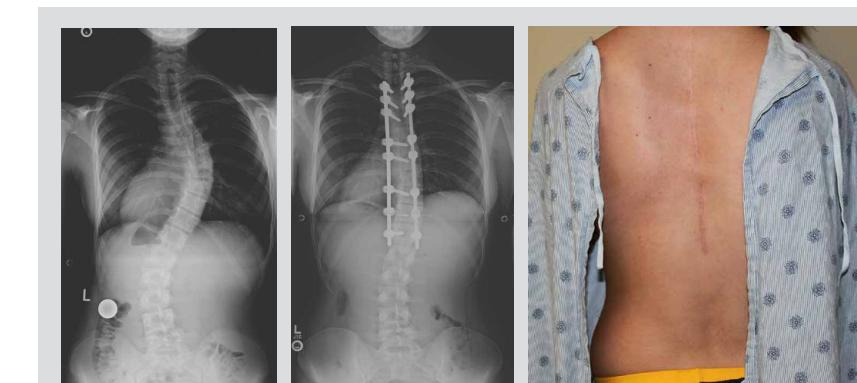
Patients might also have upper back and neck pain due to constantly trying to realign themselves. With some people, the pain symptoms can result in

dependency on painkilling drugs.

In some cases of Flatback Syndrome, the unnatural spinal curve can cause discs to herniate resulting in even more pain symptoms. Other conditions that may cause flatback syndrome include having a collapsed vertebrae. Arthritis can also contribute to flatback syndrome and cause inflammations in the spine, which may cause pain and stiffness. Most patients with flatback syndrome will complain of pain while standing upright.

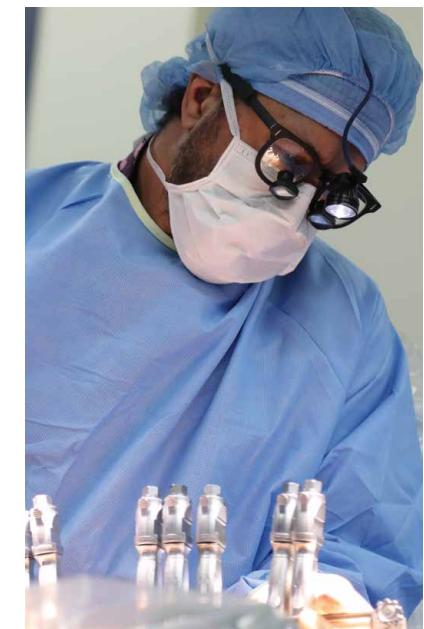
Treatment starts with full-length X-rays of the spine. An MRI or CT scan might also be taken. If all non-surgical options fail to relieve symptoms, then surgery may be recommended to remove the Harrington Rods, treat the herniated discs and to address other pain symptoms. During surgery, the scoliosis surgeon replaces the old rods with new technology that provides a more correct curve that relieves symptoms.

The good news about scoliosis is that the vast majority of people diagnosed with scoliosis will often live normal, active and healthy lives.



The benefit of Mini-Scoliosis Surgery to the patient is significant:

- The shorter incisions involve less blood loss and less need for outside blood.
- The shorter incisions are less disruptive to muscles and tissues so the patient has a less painful and much quicker recovery.
- The patient has less risk of complications and the patient has less time in the hospital.



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Ascension Texas Spine & Scoliosis

Appointments & Referrals: **512-324-3580**

SECOND OPINIONS

Patients can submit a second opinion form at TexasSpineandScoliosis.com, or request an appointment by calling 512-324-3580.

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HOME REMEDY BOOK & EDUCATIONAL INTERNET SITE

Texas Spine and Scoliosis believes the best healthcare quality comes from a well-informed health care consumer. As a community service, the spine center produces an educational Back to Life Journal, a free 36-page Home Remedy Book and an online spine encyclopedia at TexasSpineandScoliosis.com. Patients can request the Home Remedy Book online at TexasSpineandScoliosis.com. The web site has symptom charts, home remedies, medical illustrations and video animations on spine conditions and surgeries.



Texas Spine & Scoliosis was created to take a specialized approach to back pain, neck pain, scoliosis and spinal deformity with an integrated approach that combines the expertise of fellowship-trained spine surgeons, physical medicine MDs, spine therapists & diagnostics — all under one roof. Ascension Texas Spine & Scoliosis Center was designated as a Blue Distinction regional spine center by Blue Cross Blue Shield. The spine surgeons perform the majority of their surgical procedures at Ascension Seton Medical Center Austin which has obtained The Joint Commission Disease Specific Care Certification for Spine Surgery. Texas Spine & Scoliosis is the only spine center in Texas to be included in SpineCenterNetwork.com, a national listing of credentialed spine centers of excellence. To be included, a spine center must have board-certified spine surgeons and physical medicine physicians; and an emphasis on non-surgical options. Texas Spine & Scoliosis is also featured on the national site CentersforArtificialDisc.com.



Blue
Distinction
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Spine



SCOLIOSIS SURGEONS

MATTHEW GECK, MD Fellowship-Trained Spine Surgeon Board-Certified Orthopedic Spine Surgeon Co-Chief, Texas Spine & Scoliosis



Dr. Geck is a board certified orthopedic surgeon, fellowship-trained in spine surgery. Since 2003 Dr. Geck has developed the largest spinal deformity practice in central Texas treating adult and pediatric scoliosis, kyphosis and other complex spinal problems. He has performed more than 3,500 scoliosis surgeries and more than 100 mini scoliosis surgeries. Dr. Geck was awarded the Patients' Choice award by MDx Medical, an independent patient research organization. This award goes to fewer than 5% of physicians nationwide. Dr. Geck completed two fellowships in spine surgery, the first in adult and pediatric spine surgery at Jackson Memorial Hospital and a second fellowship at Miami Children's Hospital on scoliosis and kyphosis surgery. Dr. Geck is the co-founder of the SpineHope program, a non profit organization that transforms the lives of children with spinal deformities worldwide through surgery, education and research.

RORY MAYER, MD Fellowship-Trained NeuroSpine Surgeon Board-Certified Neurosurgeon



Dr. Rory Mayer is a dual fellowship-trained neurosurgeon with expertise in adult scoliosis and spinal deformity surgery. Dr. Mayer completed medical school at Baylor College of Medicine in 2012 and later became Chief Resident there in the Department of Neurosurgery. He completed a fellowship in Complex and Minimally Invasive Spine Surgery at the University of California San Francisco (UCSF) in 2020. Dr. Mayer also completed an enfolded fellowship in neurocritical care and spine trauma while at Baylor College of Medicine. He completed additional sub-specialty training in neurosurgical oncology and spine tumor surgery at the world-renowned MD Anderson Cancer Center in Houston and pediatric spinal deformity at Texas Children's Hospital. He has served as a clinical instructor in the Department of Neurosurgery at UCSF and has been a consulting neurotrauma surgeon to the National Football League.