



S P I N A L  
CURVES

TREATMENT OPTIONS FOR  
**SCOLIOSIS**

STRAIGHT TALK ON  
CURVATURE OF THE SPINE

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 normal life spans.

## 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.*

## 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.

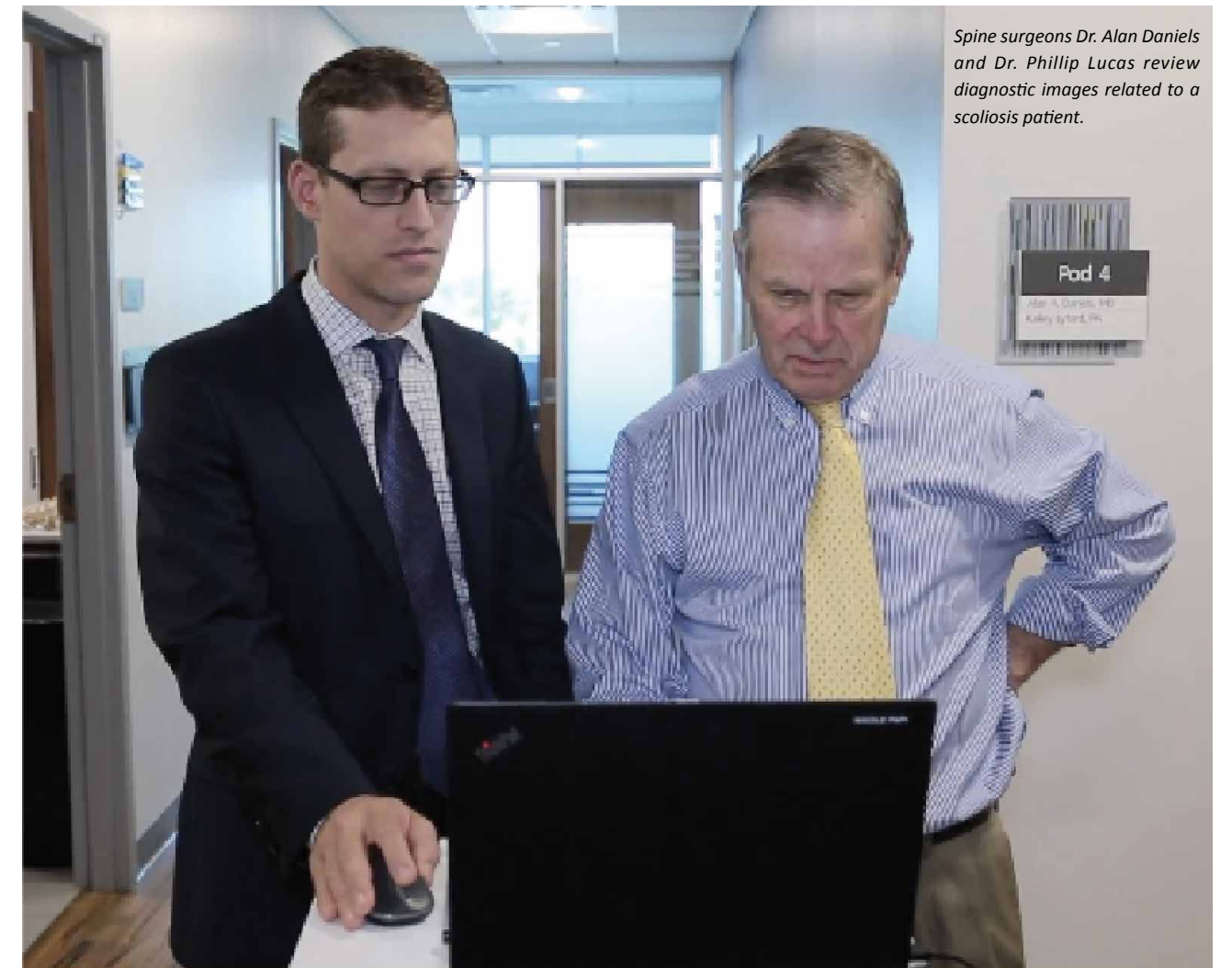
Neuromuscular scoliosis can usually be much more severe since the condition is present at birth. This type of scoliosis is due to the failure of the spine bones to properly form, or failure to correctly separate from each other. People born with birth defects or cerebral palsy can often have neuromuscular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



Spine surgeons Dr. Alan Daniels and Dr. Phillip Lucas review diagnostic images related to a scoliosis patient.

their growth spurt.

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

## DETECTING A SPINAL CURVE EARLY

Scoliosis is seen more in young girls than boys, but it can affect both. It can appear at birth, or later on as the child grows into their teens.

Many school programs have a scoliosis screening program with a school nurse who can easily detect scoliosis by having the child bend over and look for a high or uneven shoulder blades.

If scoliosis is suspected, the next step is to have an orthopedic surgeon perform X-rays and measure the degree of curve. This will be important to document if the curve is worsening or staying the same.

Having the child wear a brace can sometimes prevent the curve from worsening. In other cases, scoliosis surgery may be performed to untwist and correct the spinal curve.

The key is to detect an abnormal spinal curve early before it worsens and requires more aggressive surgery to correct it.



# EOS technology provides 3D X-rays of the spine for optimal scoliosis treatment

University Orthopedics is one of the few orthopedic centers in the region with the new EOS® diagnostic system that provides frontal and side X-ray images as the patient is scanned in a sitting or standing position, while limiting the dose of X-rays to the patient.

According to Dr. Craig Ebersson, a fellowship-trained spine surgeon at University Orthopedics who specializes in pediatric deformity, the EOS® system uses two perpendicular beams of X-rays that simultaneously scan the patient. "In a few seconds, EOS produces two simultaneous frontal and lateral, low dose images of the whole body," explains Dr. Ebersson. "There is also a micro-dose option for follow up exams that further reduces the X-ray exposure. The physician can select which functional position is needed, including standing, bending, squatting or sitting."

Dr. Alan Daniels, another fellowship-trained spine surgeon at University Orthopedics who specializes in scoliosis and deformity, notes that the EOS system provides new diagnostic information that improves the outcome of surgery to correct a spinal curve. "With EOS, we now can create 3D models for the spine," says Dr. Daniels. "We can see the patient's alignment, and see the rotational components of the spinal curve. We can see how patients are compensating for that curve with their knees and hips."

Dr. Daniels also notes that the application of EOS also benefits the other orthopedic specialists at University Orthopedics. "For orthopedic reconstruction, such as after a complex fracture in the leg, EOS provides a full long leg diagnostic image, to see if there is difference in the length of the legs in

3D, and that helps the surgeon plan and simulate their reconstructive surgery to improve the outcome. This is revolutionary and ground-breaking technology."



Dr. Alan Daniels, spine surgeon, uses the EOS X-ray system for 3D full body images.



# Spinal Curves

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.

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 children 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 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.

A back brace, however, is not



designed to reverse the curvature, but rather to prevent the curve 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 patients 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

# Spinal Curves

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?

Exercise is an important part of everyone’s health. Most scoliosis specialists recommend that kids stay active in their sports, maintain their physical fitness and remain active with friends. Scoliosis specific exercise, such as Schroth Therapy, can help manage some of the symptoms associated with scoliosis and improve posture even though exercise does not appear to stop scoliosis. In cases where a curve is worsening, a scoliosis surgeon may advise against contact sports like football which pose special risks to the spine. A scoliosis specialist can help decide the role of exercise in a treatment plan and if additional treatment is needed.

### 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 options

for adult scoliosis. Steroid injections can help relieve pain symptoms. Bracing is rarely used in adults as it doesn’t reverse the existing curve. Scoliosis specific exercise can, at times, help manage the discomfort associated with the curvature. Surgery is often the recommended treatment option for curves that have gradually worsened or when pain cannot be relieved non-surgically.

## PEDIATRIC SCOLIOSIS

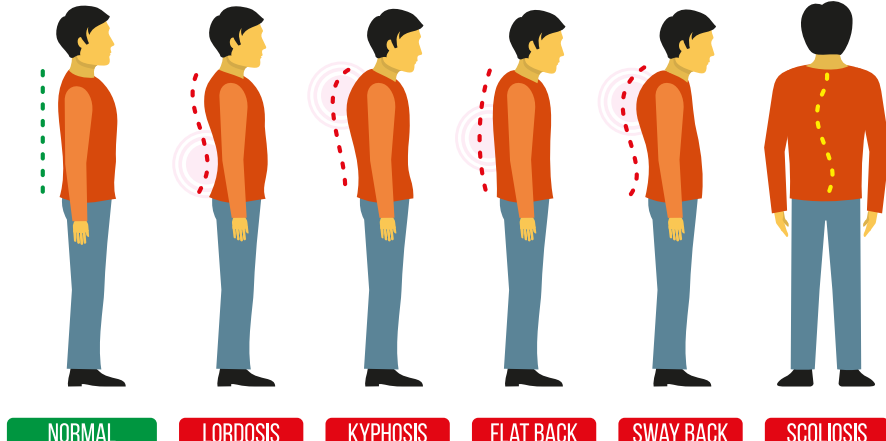
### BRACING & WAITING

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.



## 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.



# Scoliosis Surgery

## When is the right time to correct a curve?

If the curve is too large or stiff, scoliosis surgery can correct the curve and restore quality of life. Scoliosis corrective surgery is typically based on a two-rod instrumentation system with screws that attach to each vertebral level, to de-rotate and straighten the 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-inch or longer incision to enable the surgeon to access the 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.

### When to consider corrective surgery

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.

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. Harrington rods were 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, Harrington Rods would take a twisted spine and merely bend it straight without de-rotation. This has become a problem for all those treated more than 20 years ago with this now-obsolete Harrington Rod 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. 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.

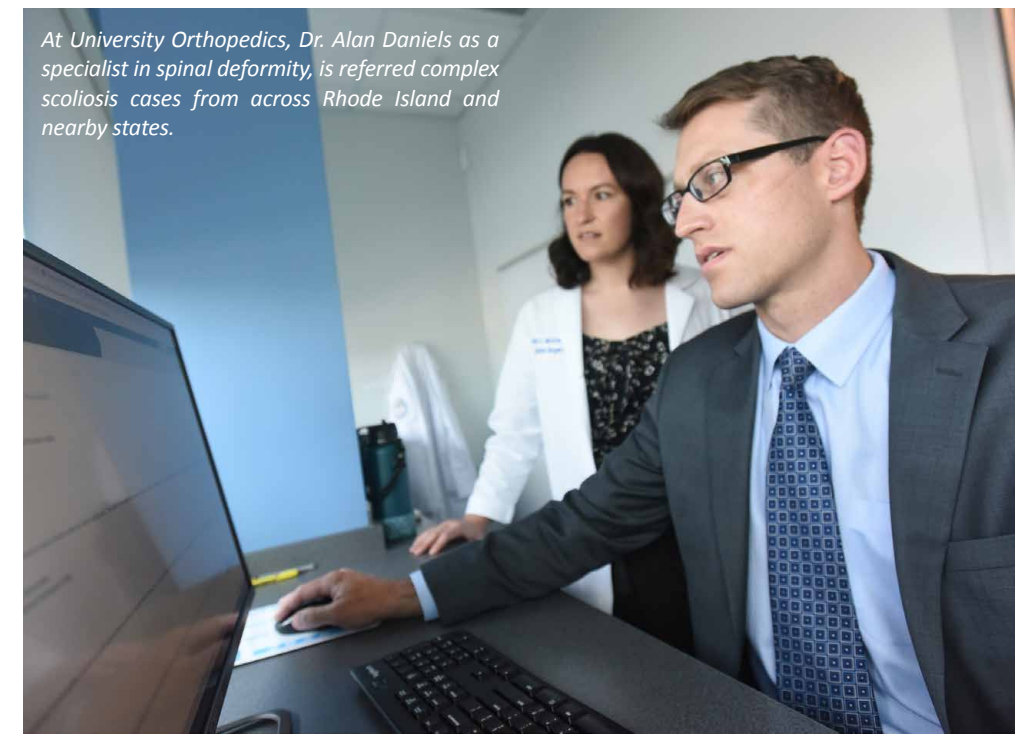
### Flatback syndrome: Treatment options

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.

In some cases of Flatback Syndrome, the unnatural spinal curve can cause discs to herniate resulting in even more pain symptoms. 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.



At University Orthopedics, Dr. Alan Daniels as a specialist in spinal deformity, is referred complex scoliosis cases from across Rhode Island and nearby states.

## New technology provides increased precision during spine surgery

University Orthopedics installed new spinal navigation technology into the surgical suite that enables the spine surgery team to position instrumentation and implants with much greater precision. "This new Spine Navigation System places the spine surgeons at University Orthopedics Center for Spine Health at the forefront of computer assisted spine surgery in the United States," says Dr. Phillip Lucas, fellowship-trained spine surgeon. "The Spine Navigation System is a vast improvement on the standard C-arm fluoroscopy which most hospital use. The traditional C-arm system used historically is limited to a 2-dimensional view during a surgical

procedure. The Stryker Spine Navigation System improves on that by providing the surgeon a detailed fluid 3-D picture of the surgical site. This imaging technology effectively provides an exact road map of the patient's spine to enable the spine surgeon to more accurately place screws and other fixation instrumentation. Because of the precision involved in the technology the surgical spine team as well as the patient spend less time in surgery and with less exposure to radiography during the surgical procedure. With the 3D images and computer assisted technology the spine surgeons are more precise with placement of screws and fixation plates."



### Benefits of 3D imaging include:

1. Helps reduce the radiation exposure of both the patient and medical staff.
2. Provides a complete picture of patient anatomy which shortens time in surgery.
3. Surgeons can more accurately visualize the implant position during surgery.



Because a scoliosis curve resembles a bent corkscrew, the scoliosis surgeon has to also de-rotate the spine to straighten the curve. Scoliosis surgery can involve a lengthy incision to access the spine and attach rods and screws. But the result can be life changing for the patient with a spinal curve.

### The benefit of scoliosis corrective surgery:

- Surgery can often relieve back pain symptoms, improve posture and add height.
- Surgery can relieve pressure on internal organs, including the lungs, making breathing easier.
- Surgery can lengthen a person's lifespan because of reduced complications on internal organs, etc.

# The benefits of corrective surgery can be dramatic & life-changing

Spinal deformity can be the result of scoliosis or trauma. In Grace's case, an industrial truck slammed her car, fracturing her spine and requiring seven surgeries on her spine. The accident and the surgeries, however, left her spine deformed — and it was worsening.

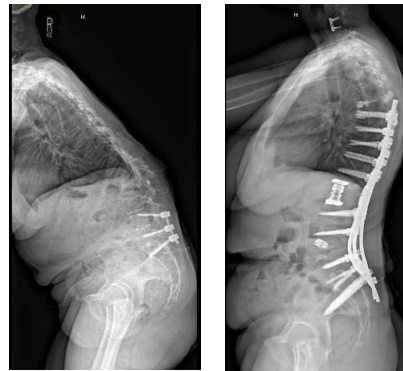
At the time she walked into Dr. Alan Daniels' office, Grace was completely hunched over. "Grace was in great pain from the car accident and all the subsequent surgeries," remembers Dr. Daniels. "She saw several spine surgeons who said she couldn't be fixed, and was increasing reliant on pain meds."

Grace recalls her visit clearly. "Dr. Daniels did several diagnostic tests, came back into the room and asked me how much I wanted to be able to stand straight again," Grace says. "I said 'very much', and Dr. Daniels replied, 'I think I can fix you.' I looked him in the eye and just knew I could trust him."

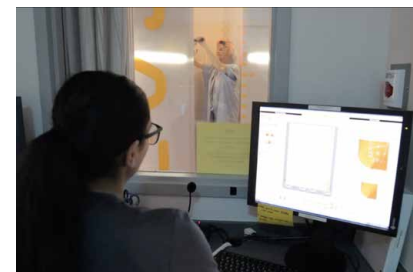
Grace required a complex multi-stage surgery, explains Dr. Daniels. "We had to do one surgical approach from the back, another from the front, and a final one from the back to lock everything in place," he says. "Grace did fabulously from the surgery. She is off of

all pain medications. She looks like a new person."

Grace is looking forward to a new life going forward. "It's a magnificent gift," she enthuses. "I haven't been on a bike in 16 years. I'm looking forward to that and swimming again. I'm looking forward to going hiking again, going way up into the woods. I'm a normal woman again, able to stand up straight. I have a second chance in life and I'm so thankful to Dr. Daniels for that."



When she first arrived to Dr. Alan Daniels' office at University Orthopedics, Grace's spinal curve had progressed to the point she was completely bent over. The corrective surgery was life-changing, enabling Grace to be able to walk erect once again.



## PHYSICIAN BIOS

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The Center for Spine Health is the only spine center in the Rhode Island region to be included in SpineCenterNetwork.com — a national listing of credentialed spine centers. To be included, a spine center must have board-certified spine surgeons; physical medicine physicians; spine therapists; and an emphasis on non-surgical capabilities. The clinical team specializes in back and neck pain, disc herniations, stenosis, tumors, trauma and scoliosis.

### HOME REMEDY BOOK & EDUCATIONAL INTERNET SITE

University Orthopedics believes the best healthcare starts with a well-informed consumer. The spine center has an on-line encyclopedia on spine conditions at [UniversityOrthopedics.com](http://UniversityOrthopedics.com) with video animations, symptom charts, home remedies and spine exercise library. Once an individual encounters back or neck pain, he or she is four times as likely to experience it again. This is why prevention is essential to long-term recovery. As a community service, the spine center provides a free, 36-page Home Remedy Book that has helped thousands of people with symptom relief. The book is provided to residents of Rhode Island and primary care physicians for their patients with back and neck symptoms.

