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JOURNAL OF THE SPINAL RESEARCH FOUNDATION

The Success of Spinal Health Care

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THE JOURNAL OF THE SPINAL RESEARCH FOUNDATION
A multidisciplinary journal for patients and spine specialists

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From the Editor

Brian R. Subach, M.D., F.A.C.S.

The Face of Spinal Health Care

The face of spinal health care is certainly changing. As a dedicated spinal health care practitioner, I find myself dealing not only with medical issues but also social and financial issues. I am moved by my patient's stories of inadequate funds to pay the mortgage, difficulty in trying to put food on the table and get kids through school, while also suffering from incapacitating spinal problems. Spinal disease and the economy affect everyone.

In the cases where there is neurologic damage, such as the loss of function in an arm or leg, a loss of balance or even progressive paralysis, it seems more serious or real to the patient, often pushing them toward an intervention. Typical sciatica, or leg pain from a ruptured disc, neck stiffness or low back discomfort are often thought to be less significant. I often hear that my patients are unable to afford the physical therapy or the cortisone injections recommended due to loss of a job, decreased income, or inability to maintain insurance premiums.

Unfortunately, when people are dealing with serious neck pain or low back pain, they are more likely to simply take medications while waiting for their ability to afford interventions to somehow change. What is the effect on the quality of that individual's life? How does chronic and, in my mind, unnecessary pain affect those around us as well? It is clearly a negative influence upon the patient as well as those who surround him or her.

The focus of this Journal of The Spinal Research Foundation is to demonstrate the success of spinal health care. Both non-operative and surgical interventions have made tremendous advances over the past decade. Procedures are less invasive, less uncomfortable and clearly more effective than ever before. Early intervention in many cases can eliminate pain and restore patients to a full and functional lifestyle. Physical therapy, chiropractic manipulation and pain management modalities such as ultrasound and acupuncture have become increasingly more successful in alleviating symptoms. These improvements have had a positive effect upon the lives of both physicians and patients alike.

There are significant influences in society today, both from private organizations and from the government itself, to limit access to spinal health care and to limit what physicians are able to do. We have asked our Centers of Excellence from around the country to contribute individual success stories. Spinal health care is easy to deny when it is faceless. Dollar signs are black and white. Place a name and a face on spinal health care and the whole picture changes, making it much more difficult to blame rising costs. I personally feel that what I do not only impacts the lives of my patients, but their families, coworkers and the economy as well. If I can get one person back to work, where he or she has been suffering from disabling pain, then I am doing my part to restore the strength of our country.

After you read this journal and see the faces of the successes of spinal health care, you will understand. When combined with the articles that discuss the quality and effectiveness of what we do, I believe that we together can change the minds of those who believe that access to spinal health care should be denied.

From the President

Thomas C. Schuler, M.D., F.A.C.S.

Modern Spinal Health Care Provides Millions the Hope for Freedom from Pain and Suffering

Contemporary spinal health care brings greater opportunity and potential than ever existed before! It is only over the past two decades that enhanced knowledge, improved training, and modern technology have combined to exponentially improve the treatment options available for patients who suffer with neck or back problems. While the first spinal fusion was performed in 1911 and the diagnosis of a lumbar disc herniation was first recognized in the 1940s, it was not until the early 1990s that a rapid progression towards the success of modern spinal health care really began to accelerate. Modern spinal instrumentation, which allows for smaller incisions, shorter spinal fusion segments, and improved patient outcomes, took root in the 1990s. A new era of spinal biologics was ushered in with the start of the new century. It is through the work of members of The Spinal Research Foundation that the first application of genetic engineering in surgery was performed. This evolutionary leap, the use of bone morphogenetic protein (BMP), has revolutionized the field of spinal health care. Patients have reaped the benefits of modern biologics, state of the art implant technologies, and minimally invasive surgery with much faster recoveries and improved outcomes.

Since the 1990s, the field of non-operative spinal health care has evolved as rapidly as the operative field has. Prior to the nineties, therapy consisted of passive treatments such as hot packs, ultrasounds, and massages. No significant active exercise program or joint mobilization program was utilized. Today, it is understood that exercise, flexibility, and joint mobilization are essential for any rehabilitation program to be successful. The formerly mentioned passive treatments are limited to resolving specific focal problems in a patient's symptoms, but are no longer the cornerstone of contemporary treatment. The best part about these non-operative advancements is their ability to actually improve the outcomes of patients, not just those who are successfully treated non-operatively, but also those who undergo surgical correction. It is essential in modern spinal health care that surgery is not the end of the treatment, but a step toward complete recovery. When surgical treatment is necessary, then the use of modern technologies and biologics, in the least invasive fashion possible, continues to produce results that are unparalleled with what was known in the recent past.

In this time of attempted overtake of health care, many of these modern treatments for patients are going to come under fire by the government. The entire focus of reform will be on ways for the government to spend less money providing health care. We, at The Spinal Research Foundation, are concerned that Americans, in the near future, will not have access to the great advances which are currently available. Some of the critics of spinal health care claim that since there has been a rapid increase in the utilization of spinal health care among Medicare beneficiaries during the last decade, especially for fusion procedures, unnecessary treatment is being rendered. This is completely false! The increased utilization of modern spinal procedures, especially fusion procedures in the Medicare population, is directly related to the technology, knowledge, and skills available today that were not present on a wide-spread basis until this century. With the improved potential for better outcomes, there is a natural potential for increased utilization. These advancements are intended to improve the quality of people's lives, to lessen pain, and to increase functional capability. As we live longer, we all desire to live healthier and better quality lives. It is only through the great strides that have been made in spinal research that we have the potential to offer people across the United States this

great future. It is unfortunate that this may not be available to many Americans due to attempts to limit health care expenditures at this time of health care reform.

Successful management of any medical disease problem, especially a spinal problem, requires establishing the correct diagnosis. One of the great improvements in spinal health care is the ability to understand what problem is causing an individual's pain or disability. Using modern technology and modern diagnostics to identify an individual's pain generator, we are able to much more completely and accurately diagnose a problem and, with improved precision, correct the abnormality in the best non-operative fashion or in the least invasive surgical fashion possible. To obtain the maximum advantages of modern spinal health care, the correct diagnosis needs to be made and this requires the expertise of a true spinal specialist. One of the misfortunes of the proposed health care change is to limit access to these specialists and their ability to properly diagnose and treat spinal conditions. Much of the failed treatment of medical conditions in the past is directly related to improper diagnosis combined with less effective providers attempting to treat a patient's symptoms or conditions. Improved successes and enhanced results can continue for all patients through the use of elite spinal diagnosticians and spinal specialists who apply our modern technologies.

Another area that is under attack by reformists is to disallow treatments for specific diagnosis such as degenerative discs. Most people undergoing advanced treatment for severe neck or back pain will have degenerative disc disease as one of many diagnoses. Some in control of reform are currently trying to disallow treatment for spinal problems in which this is just one of several diagnoses that afflicts a specific person. All spinal conditions are not equal. Yet the government, in its attempt to undermine the utilization of spinal surgery and even non-operative care, is trying to lump all neck and back problems into a common diagnosis. It is important to understand that there are hundreds of conditions which can lead to spinal issues necessitating non-operative or operative treatment. Clearly, some can be more successfully treated than others, but the important message is to not eliminate care for all Americans by collectively lumping together all diagnoses. The government would like to collectively group a montage of conditions to justify the elimination of payment for many spinal procedures.

The bottom line is that modern spinal health care is truly remarkable and successful! It is essential that we maintain access to these life changing procedures to keep people gainfully employed, socially involved, and active members of their families! Throughout this journal, we will discuss many success stories to showcase the benefits of quality modern spinal health care. Hopefully, you will see the truly great success that is modern spinal health care in America as we know it in 2010.

Ask the Expert

James D. Schwender, M.D.
Twin Cities Spine Center

What is Back Surgery?

Back surgery usually refers to a spinal operation that is intended to alleviate a patient's back pain. The two main categories of back surgery are fusions and decompressions. A spinal fusion describes joining two or more vertebrae together in order to stabilize the spine. Rods, screws, and bone grafts are usually used to aid in the fusion process. On the other hand, a decompression refers to the removal of small pieces of bones or discs in order to relieve pressure on the spinal cord and nerves within the spinal cavity.

Who are Candidates for Back Surgery?

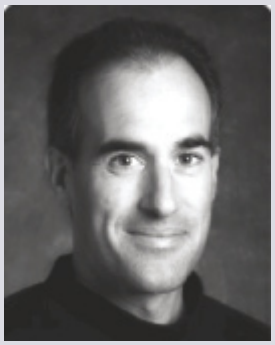
A variety of people are candidates for back surgery. There are many qualifiers to candidacy, including age, weight, smoking habits, type of surgery, etc. Different conditions will also call for different treatment approaches. Some common diagnoses that are operated on are herniated discs, vertebral fractures, spinal stenosis, and spondylolisthesis. Spinal stenosis is the narrowing of the spinal column, while spondylolisthesis describes the instability of the vertebrae of the spine. Basically, surgery is typically offered to patients with severe pain or progressive nerve damage.

What are Alternatives to Back Surgery?

Alternatives to back surgery include many non-surgical techniques aimed at reducing or eliminating back pain. These techniques include physical therapy, chiropractic adjustments, acupuncture, and epidural steroid injections. Some of the newest pain management techniques actually damage the pain-causing nerves intentionally by using heat or electricity.

What is Degenerative Disc Disease and How is it Treated?

Degenerative disc disease is not actually a disease, but rather describes the gradual degeneration of intervertebral discs. The spine is composed of 24 vertebrae, which are separated by discs that allow the spine to flex, bend, and twist. As you age, the amount of fluid in the spinal discs decreases, causing the space between vertebrae to shrink. This degeneration prompts the spine to create bone spurs, which put pressure on the spinal cord and nerves in the back, causing low back pain. Degenerative disc disease is more common in people who are smokers, obese, or engage in heavy physical labor. It is commonly treated with surgery, but can also be treated with spinal injections, physical therapy, chiropractic treatments or physiatry.



James D. Schwender, M.D.

Dr. Schwender is a staff surgeon at Twin Cities Spine Center and Assistant Professor at University of Minnesota. He is certified by the American Board of Orthopaedic Surgeons and the Minnesota State Board of Medical Examiners. His professional associations include the American Academy of Orthopaedic Surgeons, the Cervical Spine Research Society, the Minnesota Orthopaedic Society, the North American Spine Society, the Scoliosis Research Society (Fellow), and the Society for Minimally Invasive Spine Surgery (President). His specializations include cervical, thoracic, and lumbar surgeries, minimally invasive techniques, scoliosis and other spinal deformities, degenerative spine, trauma, and tumors.

Washington, DC Metro Area

Christine A. Rasmussen

This spring, The Spinal Research Foundation (SRF) challenged DC Metropolitan Area runners to watch their backs—all 684 of them. The Third Annual SRF "We've Got Your Back" Race, Walk, and Spinal Health Fair event was held on the beautiful morning of May 22nd in Reston, VA, to raise awareness of the critical issue of spinal health.

Spinal disease knows no boundaries and affects everyone, male and female, young and old, regardless of wealth or power. It touches the lives of millions of Americans every year. Even top athletes understand spinal pain. Washington Redskins players (who themselves are no strangers to back pain) Reed Doughty, Ethan Albright, Chris Samuels and James Thrash graciously agreed to kick-off the 5k run at 9:00 A.M.

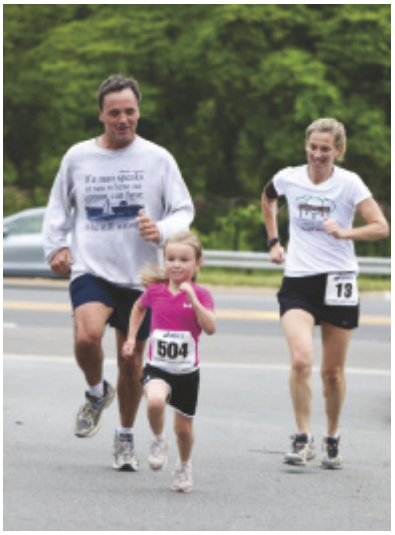
The non-runners were offered a 1 Mile Family Fun Run/Walk with commemorative medals for the first twenty kids who crossed the finish line. The Spinal Health Fair was open throughout the event to educate the community on spine function and the prevention of injuries. Exhibitors included medical device manufacturers, local area businesses and physical therapists from Virginia Therapy & Fitness Center. As the event came to a close, race winners were awarded their prizes and congratulatory remarks were delivered by The Virginia Spine Institute's (VSI) President and CEO, Dr. Thomas Schuler.

The continuing success of this inspiring event can be attributed in equal parts to the efforts of our energetic volunteers, dedicated professionals and supportive donors. As always, SRF is thankful for the contributions of The Virginia Spine Institute and its employees, without whom the event would not have been possible. The Beatty Companies, Applied Knowledge Group, HCA VA Health System, Merrill Lynch (GMMBT & R team), Bluewater Federal Solutions and many others have our sincere appreciation for their generous sponsorship.

It is difficult to estimate the full emotional toll and economic impact of the neck and back pain that currently affects Americans in epidemic proportions. SRF is fortunate to have the support of so many individuals who understand the importance of raising funds for our vital research and educational programs. We look forward to seeing you next year at the race!

WE'VE GOT YOUR BACK

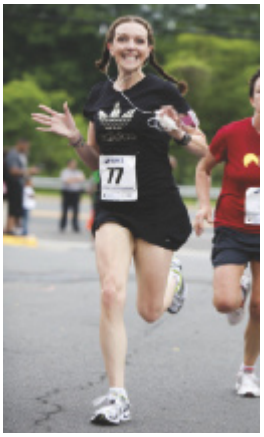










Philadelphia, Pennsylvania

Meghan J. McWilliams

The second annual Philadelphia Metro Area "We've Got Your Back" Race, Walk, and Spinal Health Fair was a great success! On Sunday, June 6th, over one hundred and fifty participants came out to run or walk the beautiful course through Tyler State Park in Newtown, Pennsylvania. Princeton Brain & Spine Care, the host of the event, encouraged its post-operative patients to participate in the race/walk as a personal goal, and many of them accomplished just that! It is a true testament to their courage and perseverance that they were able to achieve their goals despite all the obstacles thrown in their way.

Honorary Chairs of the event included Merrill Reese, better known as "The Voice of the Eagles," and Sean Landeta, a former NFL punter who was named All-Pro eight times during his career with the Eagles and the Giants. Reese and Landeta helped kick-off the event, cheer on participants, and sign autographs for fans. WBCB Radio graciously broadcasted the entire event live so that individuals who were not able to make it to the event could still enjoy the day's activities.

While patients and doctors were reuniting and swapping success stories at the Spinal Health Fair, the kids enjoyed jumping in the moon bounce at the Kids Corner. Chiropractors, physical therapists, and massage therapists also joined the Spinal Health Fair to showcase their specialized techniques to manage back pain. Even the mayor of Newtown, PA made an appearance to raise awareness and support for spinal health care.

Special thanks go out to all our participants, volunteers, and sponsors who helped make this year's event a hit. We appreciate your continued support of The Spinal Research Foundation and hope to make next year's event just as successful!

WE'VE GOT YOUR BACK

San Francisco, California

Darlynn G. Slosar

The Spinal Research Foundation's inspirational "We've Got Your Back" race/walk event has reached the West Coast! San Francisco's famous fog did not deter over 150 participants on September 18, 2010 at scenic Lake Merced.

This event provided the opportunity for people in the Bay Area affected by back and/or neck pain to come together in support of the cause. Patients, family, and friends gathered together to share stories, goodwill, and a yogurt parfait or two.

Our goal was to raise money for research and increase awareness in the community of the challenges faced by people with disabling back and neck injuries. We encouraged our patients to use this event as a rehabilitation goal and were humbled by their participation. The racers without spinal problems were equally inspired and came away with a great respect for these patient-athletes.

Two of Dr. Paul Slosar's success stories were on hand to participate in this inaugural event. Mike K., a marathon runner, has been able to return to a "pain-free life" as a runner after a laminectomy and fusion. Tony L. completed the Escape from Alcatraz triathlon six months to the day after surgery, finishing 139th out of 2000! Both of these inspiring men placed with medals in their age groups at our San Francisco event. Many other patients were able to complete the run and walk events as well.

The presenting sponsor for this event was SpineCare Medical Group. Thanks to all of our national sponsors and local donors for their generosity and willingness to be involved in our first event. Our race volunteers were unequaled, and they are already coming up with great ideas for next year's event.

We look forward to bigger and better in 2011!

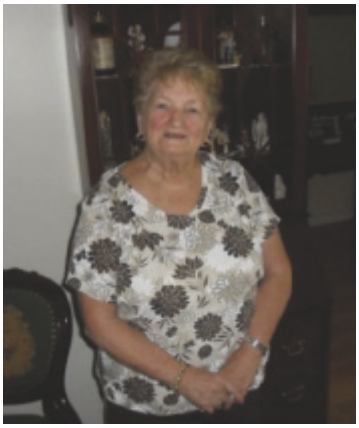
WE'VE GOT YOUR BACK






Spine Tales

Spondylolisthesis—Anne Marie Barba

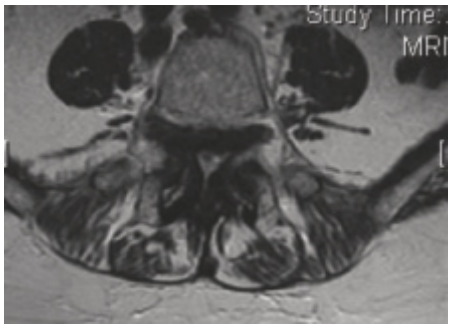


For Anne Marie Barba, having major reconstructive spine surgery was not part of her plan for retirement. The lively, 71 year-old grandmother had been troubled by some back discomfort throughout her adult life, but definitely not enough to slow her down. Unfortunately, over a six month period, her occasional backache became a constant, unwelcome companion. She also began to experience increasing pain and numbness in her backside and legs. After one episode abruptly ended a trip to the store, she decided to take action. "I was afraid of this becoming a permanent problem."

T2-weighted sagittal MRI

After consulting with her primary care physician, a lumbar MRI was ordered. On the sagittal T2-weighted images, there was evidence of spondylolisthesis at L5-S1. On the axial images, severe stenosis was noted at L5-S1. A similar, but less severe narrowing of the spinal canal was noted at the L4-5 level. In addition, flexion and extension views of her lumbar spine showed that the degree of spondylolisthesis or slippage increased with bending forward.

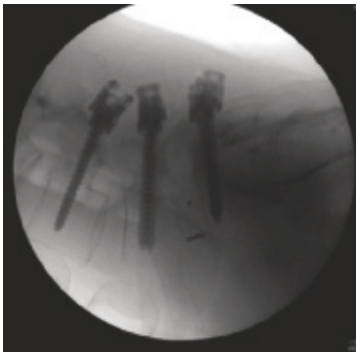
Mrs. Barba consulted a number of specialists regarding her back, buttock, and leg symptoms. Initially, she was told by one surgeon that she needed surgery but that she could not safely undergo lumbar spine surgery due to her age and weight.



Axial T2-weighted MRI shows severe stenosis at L5-S1

Mrs. Barba's primary care physician then made a referral to a spine surgeon, Dr. Christopher Comey. Based on her symptoms of pain, numbness, and neurological deficit as well as her MRI and plain x-ray findings, a decision was made to proceed with a decompression and fusion of her lower lumbar spine using instrumentation. Because of the abnormal movement of her L5-S1 (spondylolisthesis) as seen on bending x-rays, a decompression surgery alone was felt to carry a high risk of making her instability worse. A decision was therefore made to aggressively decompress her nerves, followed by a restabilization of the spine using a combination of titanium screws and rods as well as medical-grade plastic cages and bone graft.

Once she was medically cleared by her primary care physician, Mrs. Barba underwent surgery. First the nerves at L4-L5 and L5-S1 were thoroughly decompressed (un-pinched), then the reconstruction was carried out by inserting plastic cages and bone graft into the L5-S1 disc space. Titanium screws were placed at L4, L5, and S1. Bone graft was then placed along the side of the spine at L4-L5. Finally, the screws were linked together by titanium rods. The left and right rods were linked together using a titanium crosslink.



Lateral view of spine after placement of cages at L5-S1 and screws at L4, L5, and S1

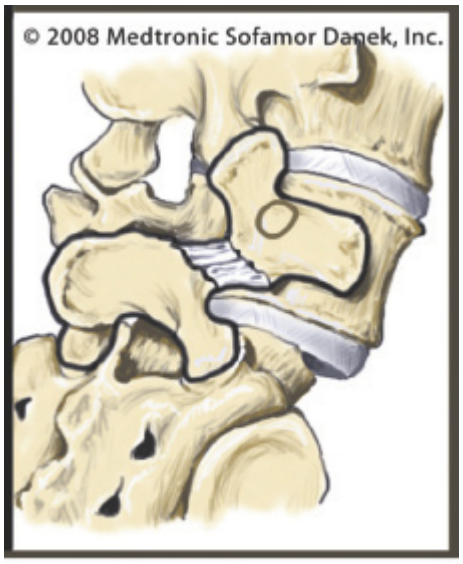
Mrs. Barba tolerated the surgery beautifully and was able to head

Final x-ray, AP view

home after several days. She was asked to use a light brace for 6 weeks and initially ambulated with the aid of a walker. Within three months, she was able to go on a cruise with her family and resume many of her activities. She is very pleased with the results. "It's been a miracle—I no longer have pain or numbness. I was recently able to go to a family function and dance all night. Before surgery, this would have been impossible."

Spondylolisthesis or vertebral slippage is caused by either a fracture of part of the joint complex in the back of the spine, or by progressive laxity and instability of the facet joint capsules. This second scenario, known as degenerative spondylolisthesis is more common in mid to late adulthood and usually

Final x-ray, lateral view



Picture courtesy of Medtronic Sofamor Danek

results in a pinching of the nerves, known as spinal stenosis. In Mrs. Barba's case, that stenosis, or narrowing, was very severe. It is important to note that in addition to the nerves supplying the legs, other very delicate nerves pass through the lower spine to supply the urinary and anal sphincters. Severe, longstanding compression of these fine, hair-like nerves can result in permanent damage to the reflexes that control bowel and bladder function.

Christopher H. Comey, M.D.

Dr. Comey is Chief of Surgery at Holyoke Medical Center. His practice encompasses all aspects of neurosurgical care with a special emphasis on minimally invasive surgical techniques and the treatment of complex spinal disorders. Despite his commitment to his patients, he also finds time to pursue his research interests and to lecture to surgeons around the country. Dr. Comey has authored over a dozen peer-reviewed publications as well as contributed to a number of textbooks on diseases of the spine. Dr. Comey is an active member of the American Association of Neurological Surgeons, the Congress of Neurological Surgeons, the North American Spine Society, the Joint Section on Disorders of the Spine, the Massachusetts Medical Society, and the Hampden District Medical Society.

Vertebral Fracture—Deborah Deitz

Deborah Deitz is a 51-year-old female with an extensive history of back problems. She underwent two prior surgical procedures before seeing Gerard J. Girasole, M.D. in 2009. Her complaints, at the time she saw Dr. Girasole, were incapacitating back pain, inability to stand upright, difficulty walking several steps, and marked disability in her activities of daily living. Deborah was unable to stand upright and stood flexed forward. This condition had persisted for six months. Her history dates back to 2004 when she developed right leg pain and was seen by a specialist. She was evaluated using an MRI and found to have a herniated disc at L4-5 compressing the nerve root corresponding to her right leg pain. She underwent a lumbar laminectomy and did fairly well from this procedure until about 2007.

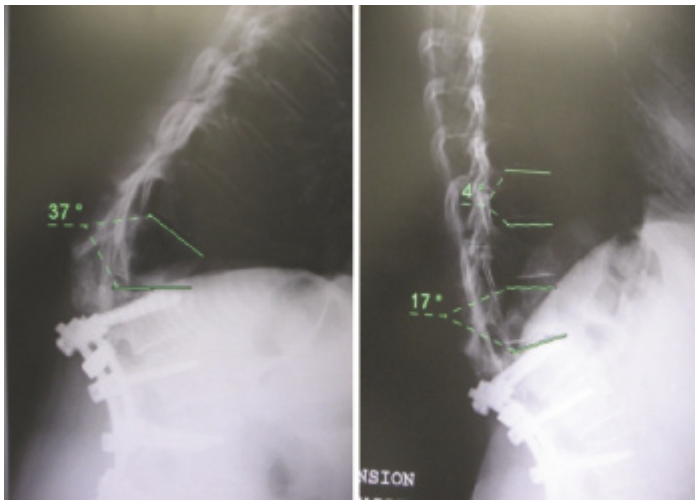
In 2007, Deborah described how one morning she sat up in bed and felt an acute, sharp pain and a snap in her back. This then exacerbated her low back pain to a point where she began developing severe right leg pain and mechanical back pain. She was treated with non-operative management consisting of physical therapy and medication. MRI studies showed that she had two other degenerative discs and had spinal stenosis at levels L3-4, L4-5 and L5-S1. She failed non-operative management which consisted of physical therapy, epidural steroid injections, and medication. Her quality of life at this point was markedly diminished. Deborah underwent a decompression and fusion from L1 to L5 by the same surgeon who did her initial procedure.

Deborah never improved from this procedure. In fact, after the initial post-operative pain dissipated, she still had a significant amount of back pain as well as inability to perform her daily activities. She felt that the quality of her life had not improved at all. This was a patient who was once an avid golfer and an active, self-supporting, hard working woman, who never had any problems with her back. Now she was incapacitated due to her spinal problem.

Lateral x-ray showing the severe deformity at the thoracolumbar junction.

After failing all pain management treatments and having the quality of her life diminish to the point where she was unable to walk, to stand upright, and to do functions that most people take for granted, Deborah sought other medical opinions. She was eventually referred to Gerard J. Girasole, M.D. who saw her in June 2009.

On examination by Dr. Girasole that day, Deborah ambulated with a significant flexed forward gait. She was unable to stand upright. She had decreased sensation in the L4-5 distribution on the right which corresponds to the right outer part of her leg and the dorsum of her foot. She had weakness and an inabil-

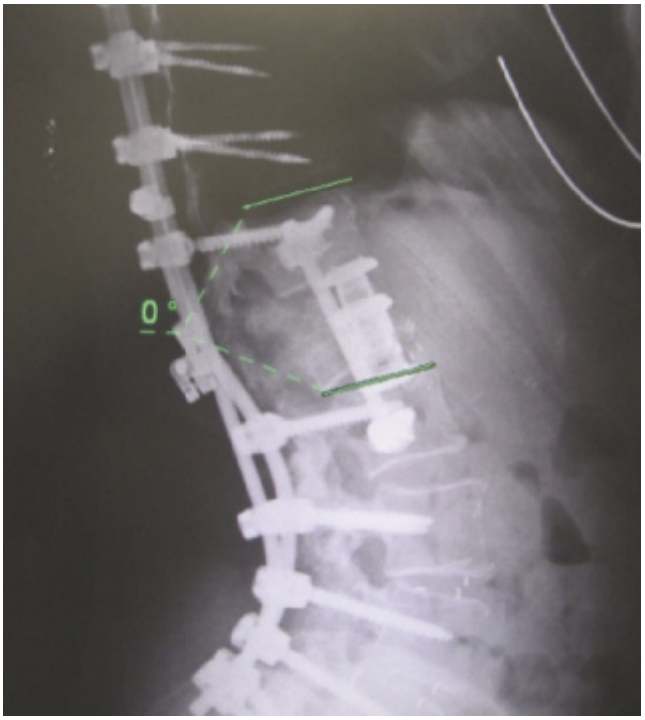


Flexion (left) and extension (right) x-rays showing the severe deformity and instability at the thoracolumbar junction.

ity to flex her foot up, known as dorsiflexion, and weakness in the great toe extension consistent with an L5 nerve deficit. Clinically, she had a "Gibbus Deformity" in her mid back which is consistent with the kyphotic deformity that was found on the subsequent x-rays.

In measurements performed standing in a neutral position, Deborah was found to have a 35 degree T12-L1 kyphotic deformity. In flexion and extension, there was a significant change in this deformity, such that when she flexed forward it increased from 35 degrees to 37 degrees and when she was in extension on the table it reduced to 17 degrees, denoting significant instability at this level. Also, a fracture of the L1 vertebral body was visible where the pedicle screws inserted from the pedicle into the vertebral body. Deborah underwent several studies including an MRI which showed no retropulsion of any fragments into the neural canal and a CAT scan which showed mal-positioning of the pedicle screws. The MRI also showed that the fracture of the L1 body was propagated by the forces at the thoracolumbar junction through the very thin pedicles that she had anatomically at this level. It was Dr. Girasole's impression that the patient had a severe kyphotic deformity because of the compression fracture and the failure of her fixation at her thoracolumbar junction.

Anterior-posterior x-ray showing the instrumentation in Deborah's spine.



Lateral x-ray showing correction of the kyphotic deformity

In order to correct her deformity, Deborah would need several procedures which could be performed under the same anesthesia. The procedures would consist of osteotomies, corpectomy of the fractured vertebral body, and reconstruction of the anterior column support using a replacement for her vertebral body, as well as stabilization up to the mid-back thoracic spine.

Deborah underwent the surgery on August 27, 2009. The first part of the surgery was done through her original posterior incision. The screws were removed and replaced into proper position. The screw fixation was extended into the thoracic spine. Osteotomies were performed at two levels of her spine in order to correct the deformity she had from her prior surgery. This incision was then temporarily closed and a sterile dressing was applied.

She was then re-positioned on a different operating table in a lateral position. An access thoracic surgeon was used to expose the spine through what

Deborah after the surgery

is known as a 'Lateral Retro' peritoneal approach. The fractured vertebral body of L1 as well as the disc material of L1-2 and L2-3 was then removed. Screws were placed into the vertebral body of L2 and L3 and distraction was applied to correct her kyphotic deformity.

The vertebral body was then replaced with an interbody cage filled with bone to maintain this correction. In the operating room, it was noted that she corrected very nicely to a neutral position and the kyphotic deformity was completely resolved.

The screws were then compressed to maintain compression on the cage. The incision was closed and the patient placed back into the prone position. The posterior incision was then re-opened and rods were placed onto the screws and fusion was performed. The incision was closed and the patient was taken to the recovery room. The patient did very well from the surgical procedure.

The story of Deborah Deitz is one of a person who lived through significant pain, had extensive spinal surgery and, at one year post-op, regained the quality of life that she had lost for several years. She is, by no means, the same person she was prior to her spine problems, but she has returned to gainful employment and activities that she enjoyed. She has been very happy with her results. These are visible in her appearance, her ability to stand upright, to walk, to return to the workforce, and to enjoy the quality of life that she had prior to 2004. I find this an amazing tale of a person who has never lost faith in the medical field.

She persevered through significant pain, went through an extensive surgical procedure, and is now much happier one year post-op. It gives great satisfaction to the surgeons who performed this procedure to see a person regain her dignity and quality of life. I have received much joy and satisfaction in watching her walk into the office as early as six weeks post-op, standing upright, smiling, and being happy. As opposed to the patient that initially presented herself, barely able to stand upright, significantly disabled from the prior problems, Deborah now had her life back. For this, I salute her!

Gerard J. Girasole, M.D.

Dr. Girasole is a board certified orthopaedic surgeon at the The Orthopaedic & Sports Medicine Center. He has extensive experience in the treatment of lumbar disc disease, neck pain, scoliosis, herniated discs, and spinal stenosis using both operative and non-operative techniques. Dr. Girasole is on the forefront of minimally invasive surgical techniques for patients with low back pain and he is very active in the training of other surgeons in the various techniques. He has recently completed a FDA trial study for the treatment of patients with back pain with a Total Disc Replacement procedure. He is very active in the Academic Society for the Spine and teaches yearly at several accredited spinal courses.

Scoliosis—Richard Martin

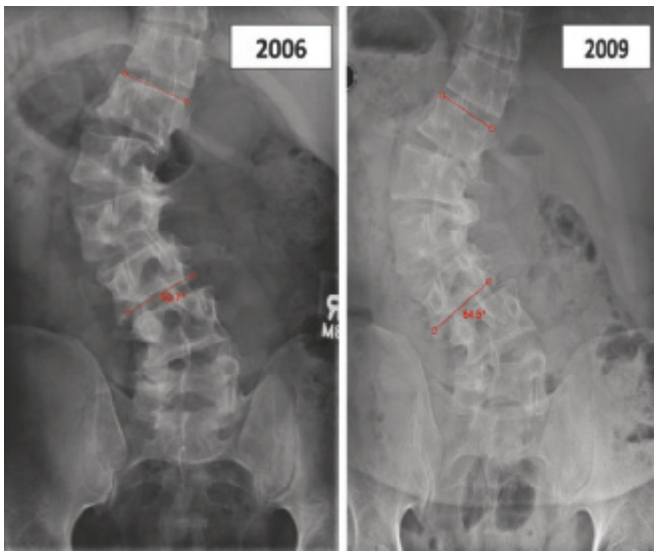
Richard Martin is a forty-one year old man who was diagnosed with scoliosis when he was sixteen years old. When he was initially diagnosed, he had no symptoms related to his scoliosis. He wore a hard plastic brace for one and a half years to try and prevent his curve from getting bigger while his spine finished growing. Once he had finished growing, he was able to stop wearing the brace. At that time, he had no pain and he was able to participate in normal activities.

Mr. Martin could feel his curve changing slowly over time and eventually he began to have difficulties with pain in his low back, as well as weakness and numbness affecting his left leg. Despite these symptoms, he continued to work full time and raise a family, but he knew that something would eventually have to be done. Since a number of members of Mr. Martin's family had also been diagnosed with scoliosis or other spinal curvature, he was very familiar with the potential for the curve to get worse and the possibility that surgical correction may be needed in the future.

Mr. Martin was first seen at The Virginia Spine Institute in November 2006, after having continued progression of his spinal curvature as well as increasing pain over the past five years. In the office, he was noted to have curvature affecting his low back and a loss of flexibility of his lumbar spine associated with his curvature. His x-rays at that time showed that his scoliosis had increased steadily over time and his curvature measured 51°.

He was dedicated to managing his symptoms while maintaining a high level of physical activity. At that point, a course of physical therapy was initiated, focusing on increasing mobility and strengthening his low back. He knew that physical therapy would not actually straighten his curvature, but it did help him to maintain his flexibility and improve his pain. He also used anti-inflammatory medications to manage his symptoms and to help to maintain a high level of physical activity. He had previously been active and athletic, however, the pain he was having in his low back and leg made it difficult to perform activities and play with his children. Richard worked in information technology and it was becoming increasingly difficult for him to sit at a computer without significant pain.

Unfortunately, the size of his scoliosis curve increased steadily over time and as the curve increased, he began to have more difficulties with back pain and neurologic symptoms into his legs. In March 2009, his scoliosis curve was noted to have progressed to 65°, indicating a significant change over the previous three years. He also started to have difficulties standing up straight because he was leaning further forward and to the side.



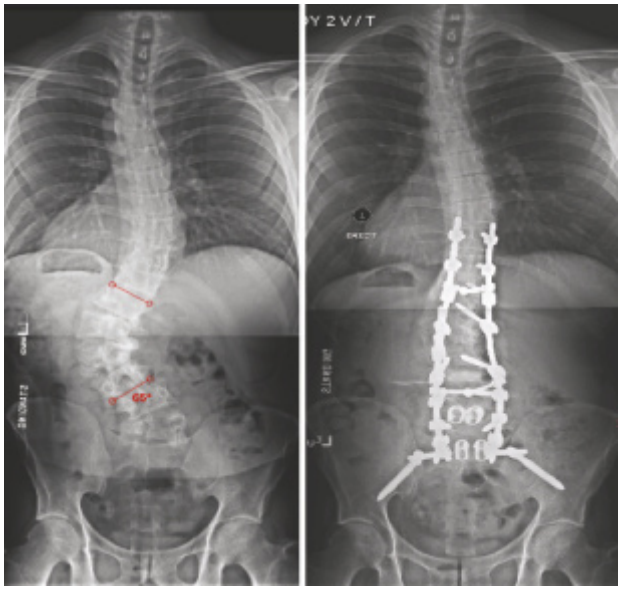
X-rays of Mr. Martin's spine taken in 2006 and 2009 show worsening of scoliosis from 51° to 65°

In November 2009, Mr. Martin was seen by Dr. Good at The Virginia Spine Institute and continued to have difficulties with progression of his spinal curvature and with low back pain and numbness on the top of his left foot. In the office, he was noted to have difficulty standing up straight due to loss of normal inward curvature of the low back or lordosis. This was getting worse along with his scoliosis. He had tenderness over the spinal curvature and the joints of his lumbar spine. Because of the steadily increasing size of his scoliosis and the ongoing difficulty with his symptoms, Mr. Martin reviewed the possibilities of a spinal reconstruction with Dr. Good. They worked together to plan ahead and made sure to time his surgery so that it would work well for his family and his job.

In preparation for his surgery, Mr. Martin saw his medical doctor as well as a cardiologist to assure that he was in optimal medical condition for a surgical procedure. He also had a test called dual energy x-ray absorptiometry (DXA) to evaluate the strength of his bones prior to the surgical procedure. Because of the symptoms he was having radiating into his legs, an MRI scan of the spine was also performed. This revealed significant curvature of the spine with degeneration of the spinal discs and some narrowing of the space for his lumbar nerves.

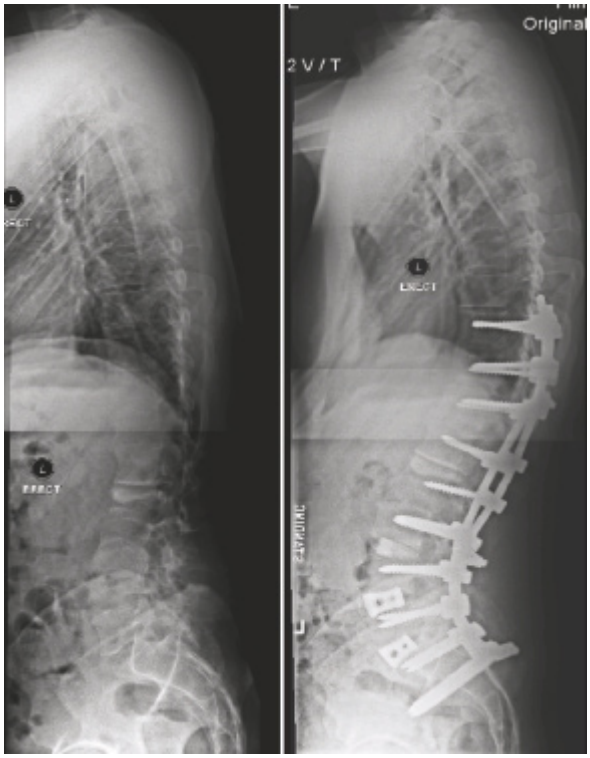
Mr. Martin's scoliosis was worsening in the lower region of the spine (the lumbar spine), and correction of the scoliosis required fusion from the top of the curve to the bottom of the lumbar spine. Dr. Good and Mr. Martin discussed the different surgical alternatives for this reconstruction. They ultimately decided to proceed with scoliosis correction, first addressing the lower discs in the lumbar spine through the front of the spine, followed by scoliosis correction with screws and rods in the back. Mr. Martin was nervous about his upcoming procedure and came in to see Dr. Good for multiple preoperative consultations to discuss his expected recovery and long term expectations after a surgical reconstruction of his scoliosis.

Mr. Martin first underwent a two hour procedure to remove the lower two discs from the front of the lumbar spine. Dr. Good was able to remove the degenerative discs and replace them with two titanium fusion cages (LT cages) filled with recombinant human bone morphogenetic protein (rh-BMP-2). This anterior fusion helped to correct the scoliosis at the bottom levels and to form a solid foundation to allow for correction of the upper scoliosis. The following day he was taken back to the operating room for correction of his scoliosis through an incision in the back. Dr. Good corrected the scoliosis curve by first removing portions of bones and ligament to increase the flexibility of the spine, and then by placing stainless steel screws and rods to restore a more normal spinal alignment. During the surgical procedure, Dr. Good used specialized nerve monitoring to test the spinal cord and nerves to be sure that they were able to tolerate the correction of the scoliosis without any neurological difficulties. A spinal fusion was performed to cause the spine in the area of the scoliosis to heal into one solid piece of bone. This was performed using small pieces of bone graft taken from the back of Mr. Martin's spine as well as rh-BMP-2.



X-rays of entire spine taken before and after scoliosis correction surgery using screws, rods, and titanium cages

Mr. Martin was hospitalized for a total of one week around the time of his surgery. The first day after his surgery, he was able to stand at the side of the bed with the help of a physical therapist. While standing, he had pain and spasms across his low back and needed to use muscle relaxant medication as well as pain medication



Side views of x-rays taken before and after Mr. Martin's surgery

to help control his pain. He slowly began to walk, first in his hospital room and then out into the hallway around the nursing station with the help of the physical therapist and nurses. Mr. Martin was not required to use a brace after his surgical procedure and was immediately allowed to walk unlimited distances. No period of bed rest or spinal casting was needed after his surgical procedure.

After one week of progress, he was ready to be discharged to be home with his family. At his two week follow-up visit after surgery, he was still using pain medications, but was doing phenomenally well. He was walking around his house and had begun taking walks outside as well. He steadily increased the distance he was walking and within six weeks of his surgery, he was walking outside an average of two and a half miles a day. At his most recent follow-up visit, excellent correction of his scoliosis was noted with good restoration of his alignment when standing. He has been able to return to work full time and has reported continued improvement in his low back pain. He also reported he was able to sit at the computer

After his surgery Mr. Martin is back to playing outside with his kids

for work for prolonged time periods without having to stop as he had to do preoperatively.

Mr. Martin has been chosen as a success story in order to highlight the courage he has shown despite having progressive scoliosis and to show his dedication to maintaining an active lifestyle, caring for his family, and continuing to work. He did not let his scoliosis keep him from living his life to the fullest and he is now back to taking care of his family and his usual activities. Mr. Martin's case is a great example of how ongoing surgical innovations have improved scoliosis correction surgery, allowing for better correction of spinal curvatures, while avoiding post-operative casting or bracing to allow for a more rapid return to normal activities.

Christopher R. Good, M.D.

Dr. Good is a spine surgeon at The Virginia Spine Institute. He has extensive training and experience in the treatment of complex spinal disorders with special expertise in non-operative and operative treatment of adult and pediatric spinal deformities including scoliosis, kyphosis, flatback, and spondylolisthesis. Dr. Good has co-authored numerous articles and has been invited to lecture nationally and internationally at the Scoliosis Research Society, the International Meeting on Advanced Spinal Techniques, the American Academy of Orthopaedic Surgeons, and the North American Spine Society.

Intradiscal Electrothermal Treatment (IDET)—Rowan Milby

In November 1998, newly-weds Rowan and Darren Milby were returning home from their honeymoon to Richmond, Virginia. Since the couple had a few remaining days off from work, they decided to drive to the Social Security office to file Rowan's paperwork to change her last name. Once on the highway, one of their car tires blew out. The Milby's pulled over, replaced the tire with the spare, and turned around to just head home.

As Rowan exited the highway, she came to a complete stop at the end of the off-ramp. Since the road she was merging onto was crowded with afternoon commuters, Rowan twisted her upper body to the left to view the oncoming traffic. After a minute, she was still waiting for an opening, when, all of the sudden, a woman exited the highway and crashed, at full speed, into the back of Rowan's car. Her husband left the scene unscathed, but since the impact occurred when her back was twisted, Rowan left the accident with immense low back pain.

At twenty three years old, it had never crossed Rowan's mind that her life could change so drastically in an instant. She had severe, intractable back pain that was mainly concentrated in the lower back, but radiated down through her buttocks and thighs as well. Her pain was aggravated by prolonged periods of sitting. Even minor movements seemed to intensify her pain.

Rowan's pain was significantly impacting both her work and family life, so she sought help from her doctor. Her primary physician referred her to a pain management specialist and a physical therapist. They prescribed her heavy painkillers, gave her steroid injections, and started her on a vigorous physical therapy routine, but nothing helped to alleviate her pain. The doctors told her that she would never live without painkillers again. Rowan was too optimistic to believe this conclusion, so she sought out more specialists to fix her back.

MRI of Rowan's lumbar spine showing a slight disc herniation at the L5-S1 level

Over the span of a year and a half, Rowan visited nine different doctors in the Richmond area, including back surgeons, pain management doctors, chiropractors, and physical therapists, all of whom offered no hope for a pain-free life. She underwent countless x-rays and MRIs, but ultimately, no one could find anything wrong with her and told her to just live with

the pain. Many of the doctors even began to believe that she was drug shopping by visiting so many different specialists, so they stopped believing that her pain was real. As a result of this, Rowan's health insurance stopped paying her medical bills, leaving her with mounting debt.

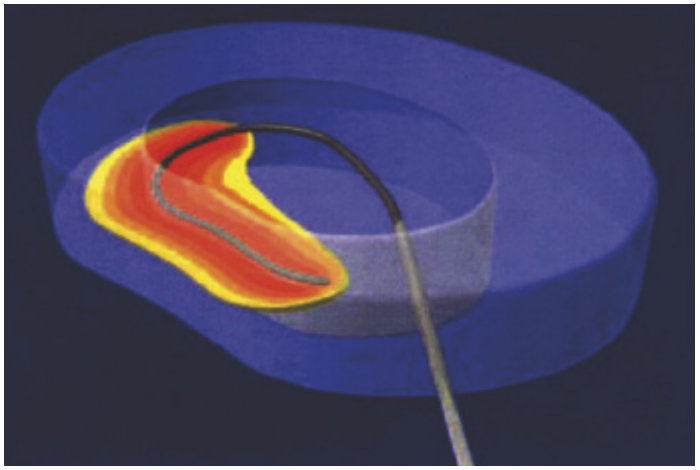
Rowan's morale was completely destroyed. She had gone from a healthy life as an optimistic newlywed to a life full of unbearable pain and doctors who doubted her valid claims. It was around this time that Rowan and her husband saw a Dateline special on the IDET procedure. Her husband was inspired and, for the next few days, he scoured the internet researching the procedure and physicians that performed it. He read about Dr. Hasz at The Virginia Spine Institute and they scheduled an appointment with him as a last ditch effort to try and fix Rowan.

Patients who suffer from episodes of back pain resulting from a motor vehicle accident usually get better. The pain is usually related to a muscle strain or a pulled ligament, which often heals with time and physical therapy. Over 80% of patients begin to feel better in the first few months after the accident, just due to the soft tissues of the back healing. However, in Rowan's case, despite the passage of time, physical therapy, and other nonsurgical treatments, her back pain persisted.

After reviewing her x-rays and MRIs, Dr. Hasz determined that she had no spinal fractures or large disc herniations. He never questioned Rowan's motives for seeking treatment like her previous doctors had, but rather thought her description of the pain was suggestive of an injured disc in her back. The next logical step was to perform a lumbar discography to identify the source of the pain.

During the discography, Dr. Hasz put contrast in the disc space. When the discs are not damaged, the dye shows a normal pattern and does not create pain. However, when Dr. Hasz injected Rowan's L5-S1 disc, it reproduced her pain directly. Rowan recalls "screaming bloody murder." Rowan's L5-S1 disc was ruptured, causing all of her back pain.

Rowan and Dr. Hasz sat down after the discography to discuss treatment options. Because she had a



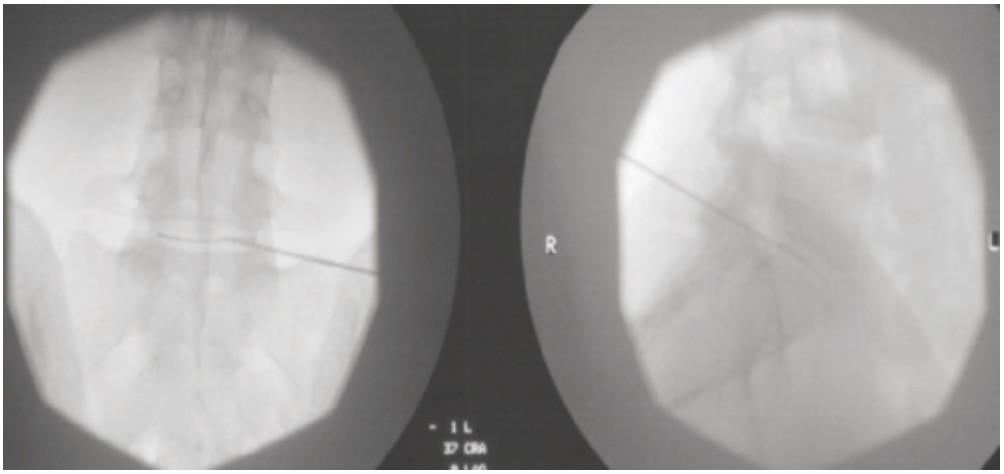
IDET (picture courtesy of the National Pain Foundation)

relatively tall disc height with no large disc herniation and had failed all of the non-operative treatments, she was a candidate for various treatments. These options included lumbar fusion surgery, artificial disc implants, and intradiscal electrothermal treatment, otherwise known as IDET.

The IDET procedure is an outpatient procedure in which a flexible catheter is inserted inside a disc. The catheter is then curled around the inside of the disc along the region of the annulus. Anatomically, the annulus is the outer portion of the disc that contains the nerve fibers responsible for the pain. With the heating of the catheter, the nerve fibers are destroyed and the collagen fibers thicken and tighten to help repair the tears and cracks in the disc.

Rowan found the IDET procedure appealing as an alternative to surgery and Dr. Hasz felt that she was a good candidate for it, so they scheduled an appointment in June 2000. For Rowan, she had "nothing to lose, and all to gain" by proceeding with the IDET procedure. If it worked, she had avoided major back surgery at a young age, and if it did not eliminate her pain, she still had the option of surgery as a last resort.

The initial healing time for the IDET procedure usually takes between three to six months. After only four months, Rowan was still in pain and began to lose hope, so she scheduled a lumbar fusion surgery for the following January. By December, Rowan became ner-



Rowan's IDET procedure

vous about the surgery and cancelled her appointment. About that time, Rowan remembers realizing that she was not taking as much pain medicine as she used to. It was hard for Rowan, who had been in pain for so long to take a step back and realize that her body was starting to heal.

This revelation revitalized Rowan's desire to live pain free, so she started consciously paying attention to her pain levels and cutting back on her pain medications when she could. After a month, she had successfully cut out narcotics and was managing her back pain with Advil alone. By March 2001, Rowan was completely pain free and she has never looked back.

Rowan became pregnant with her first child that same year and was concerned that the back pain would return, but it never did. She has since given birth to four children, including a set of twins, and is currently seven months pregnant with her fifth child. Rowan has not suffered a single episode of back pain during any of her pregnancies.

Twelve years after the accident, Rowan is a happy mother of four (soon to be five), who is completely pain free. She is very grateful to Dr. Hasz and the IDET procedure for eliminating her pain and letting her finally pursue her dream of creating a family with her husband. She even calls Dr. Hasz her "patron saint" because he gave her life back.

Michael W. Hasz, M.D., F.A.C.S.

Dr. Hasz is a spine surgeon at the Virginia Spine Institute. He is board certified by The American Board of Spine Surgery, a Fellow in the American Academy of Orthopaedic Surgeons and a member of both the American Association of Orthopaedic Surgeons and the North American Spine Society. He was Chairman of the Department of Orthopaedic Surgery and Director of Spinal Surgery at the Andrews Air Force Base/ Malcolm Grow Medical Center in Maryland. He currently holds an appointment as Clinical Instructor of Orthopaedic Surgery and Assistant Professor of Surgery at the Uniformed Services Health Science University in Bethesda, Maryland.

Inspiring Stories of Successful Spine Care

Degenerative Disc Disease—Roberta Silber

Roberta Silber first presented herself in 2008 with a chief complaint of left-sided low back and leg pain. Her symptoms initially began in the summer of 2002, when she had a severe episode of low back pain and right-sided buttock pain. At that time, she had some right leg weakness as well. She spent two weeks in bed but ultimately the pain improved.

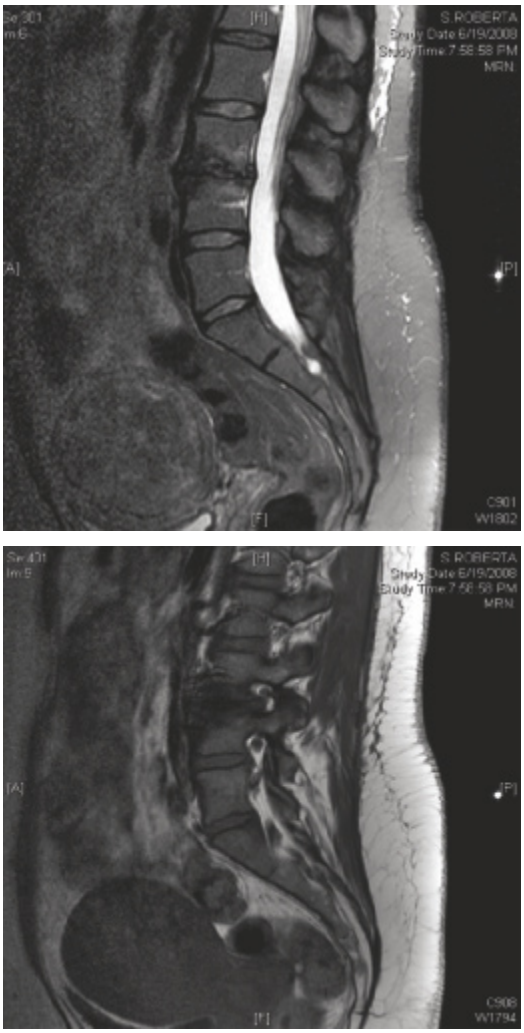
She had an MRI scan which revealed a mildly degenerated disc at L3–L4. She underwent conservative therapy and had resolution of her pain.

In 2005, she had a second flare up this time involving more of the right leg. She had spinal epidural steroid injections and again did well for three more years.

In June of 2008, she began having severe progressive low back pain with radiation into her left leg. She described the constant low back pain as 5 out of 10 in intensity. She modified her activities to limit the amount of back pain she had. As the months progressed, she began developing more and more radiating, aching, and throbbing sensations down her inner thigh and to the knee and inner shin.

Roberta was previously extremely active both personally and professionally. She enjoyed hiking and worked long hours as a very successful medical device representative. Her back and leg pain was severely impacting her life. In June 2008, her symptoms became so severe that she started pursuing more aggressive treatment for her spine.

Her symptoms were improved with lying down and she was able to continue exercising on an elliptical machine. She had good strength in all major muscle groups with some very mild left-sided iliopsoas weakness on isolated leg standing and had mild left quadriceps weakness. She had decreased sensation in the L4 dermatome on the left. EMG nerve conduction study demonstrated evidence of a left L4 radiculopathy.



Axial MRIs demonstrating a bilateral disc bulge on the left greater than on the right, causing her leg pain

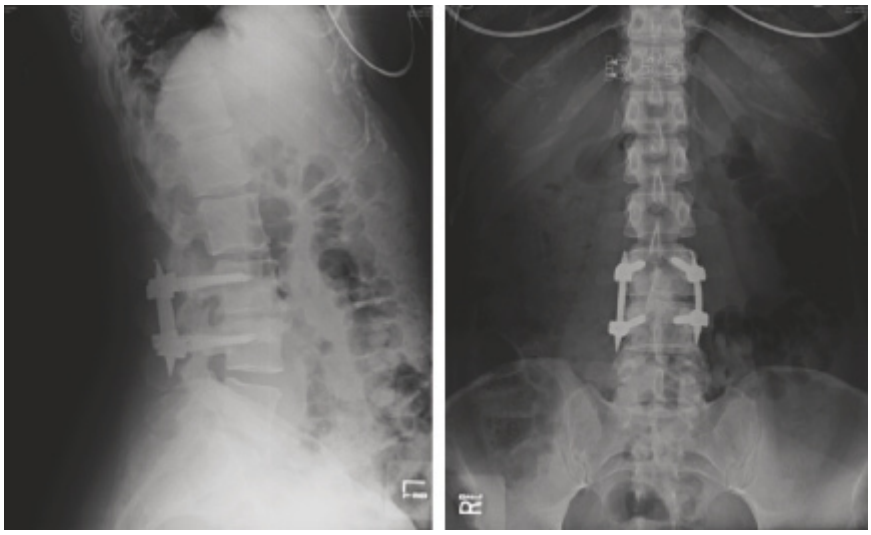
She had a series of MRI scans that demonstrated a slow progression of her degenerative changes at L3–L4. The newest scan demonstrated severe degenerative disc disease at L3–L4, with bilateral disc bulge on the left greater than the right.

Roberta underwent a L3–L4 minimally invasive transforaminal lumbar interbody fusion with pedicle screw fixation, posterolateral arthrodesis, interbody prosthesis, and bone morphogenetic protein. She tolerated the

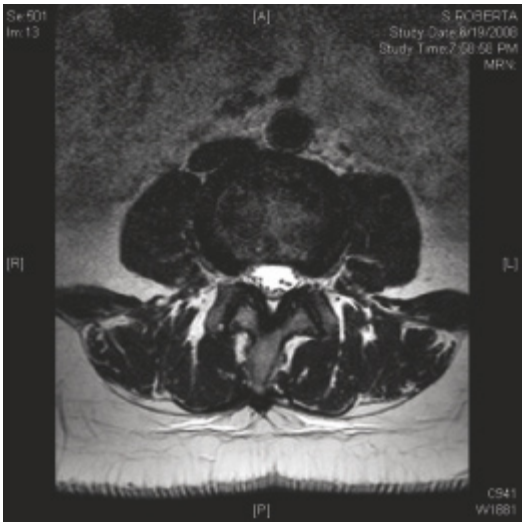
procedure well and was discharged from the hospital.

Over the course of several weeks, Roberta's leg pain and back pain resolved. She is now 20 months status post surgery and states that this is the best medical intervention she has ever had in her life. The procedure has allowed her to get back to her walking and she has returned to work without restrictions. Her last examination demonstrated normal strength, well healed incisions, and full range of motion.

The greatest privilege of being a physician is helping your patients get well. Roberta is a great example of a patient who battled with her spine disease for six years. She received excellent conservative care that was appropriate and effective. When she ran out of options, she sought a surgical solution which has now restored her functionality. It has been an honor and privilege to be Roberta's caregiver and to see her get well.



X-rays showing the restored interspace height at L3-L4 and the instrumentation that stabilized the spine.



Sagittal MRI demonstrating degenerative disc disease at L3-L4 causing Roberta's back pain.

Mark R. McLaughlin, M.D., F.A.C.S.

Dr. McLaughlin practices neurological surgery with a focus on spine disorders and specific cranial conditions at Princeton Brain and Spine Care. He served as the President of the Young Neurosurgeons' Committee, a national section of the American Association of Neurological Surgeons. He is the Scientific Program Chairman of the AANS/CNS Joint Spine Section. He is an editor of Spineuniverse.com, a website dedicated to patient and physician education of spinal disorders. He has published more than 65 articles on neurosurgery and spine surgery, and has authored two textbooks about spine surgery. He has been an invited speaker, presenter and course director at numerous scientific meetings, and teaches complex spine surgery nationally and internationally. Dr. McLaughlin was recently elected Member-at-Large of the Joint Spine Section of the Congress of Neurosurgeons.

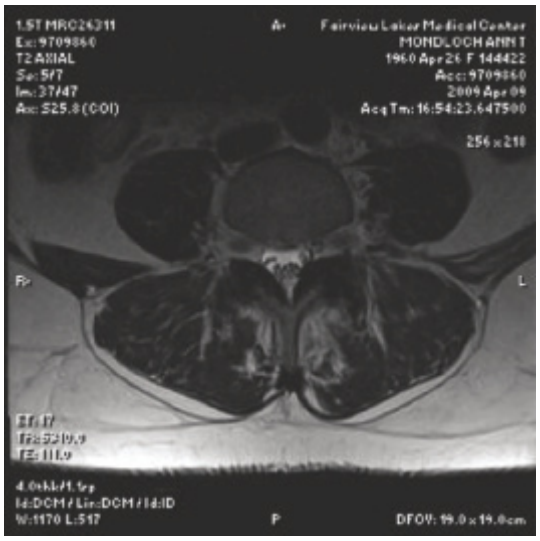
Spinal Stenosis—Ann Mondloch

Ann Mondloch, 50, has been employed in the health care field since she was 15 years old. She started as a nurses aide and today works as a radiology technologist. Assisting patients, spending all day on her feet, and lifting and carrying medical supplies and equipment have long been a part of her weekly routine. While she had always enjoyed her active job and lifestyle, she began to find them increasingly difficult due to years of ongoing back pain. In the past, the pain, while reoccurring, was manageable with nonprescription anti-inflammatory medication, occasional physical therapy, or chiropractic adjustments.

Symptoms began to change, however, for Mondloch in January of 2009. What was previously just low back pain and soreness started to include pain radiating into her left hip, as well as pain and a tingling sensation traveling down her left leg and into her foot. Over time, she noticed a decreasing tolerance for standing and walking, both of which increased her pain and numbness.

In the spring of 2009, Mondloch underwent a series of epidural steroid injections to her lumbar spine. She had a total three injections, but reported only temporary relief of her symptoms lasting less than two weeks. By the fall, she was unable to walk farther than one block or stand at her sink to wash dishes without significant pain. Concerned that her symptoms were not resolving and that her condition was, in fact, deteriorating, Mondloch sought opinions from two spine surgeons. Both surgeons diagnosed her with spinal stenosis and offered a surgical treatment option.

Spinal stenosis refers to the narrowing of the spinal canal. This condition most often develops as a person ages. It can be caused by arthritic changes or injury. When the spinal canal becomes narrowed, the nerves which pass through it can be compressed. This may cause the nerves to become inflamed and can cause pain in the low back. Symptoms may also include pain, cold sensations, weakness, numbness, or cramping in the legs from walking or standing, and are typically relieved by sitting or lying down. The onset of these symptoms may be slow or sudden.



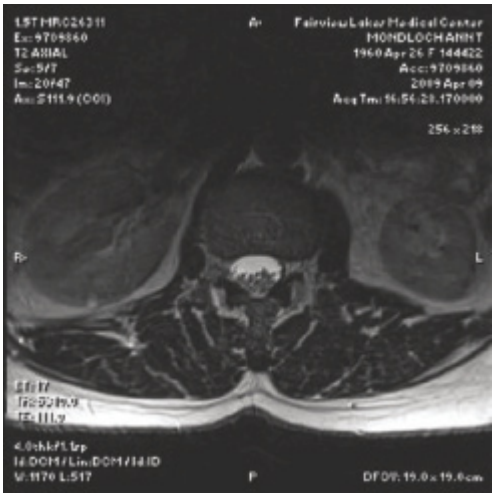
Axial MRI showing spinal stenosis at L4-L5

Treatment for spinal stenosis depends on the number of vertebrae involved, the amount and type of pain that the patient is experiencing, and the patient's general health. Non-surgical treatments may include the use of non-steroidal anti-inflammatory medication, physical therapy, spine education programs, rest and the application of ice. Steroid injections into the epidural space of the spine may be utilized in an attempt to reduce inflammation and pain. Surgical treatment, known as decompression, involves removing the portions of bone and ligament compressing the spinal cord or nerves. If this bone removal makes the spine less stable, a spinal fusion may be done to immobilize the area.

The second surgical opinion that Mondloch sought was from Dr. James D. Schwender at Twin Cities Spine Center. Co-workers and friends had recommended Dr. Schwender and Mondloch knew of his reputation as a leader in the area of minimally invasive spine sur-

gery. She was evaluated at Twin Cities Spine Center in October of 2009. At that time, she completed an Oswestry Lumbar Disability Questionnaire. Her Oswestry Disability Index (ODI) score was calculated to be 30 (moderate disability) based primarily on her inability to obtain satisfactory relief from pain killers and her pain preventing her from walking more than ¼ mile or standing for more than 30 minutes. The ODI is a standardized assessment tool referenced frequently in the effort to assess perceived disability and spinal treatment outcomes. Dr. Schwender and his team took a full history from Mondloch and performed a clinical exam, both of which correlated with her MRI findings of foraminal and lateral recess stenosis (primarily on the left hand side) at L4-5 and L5-S1.

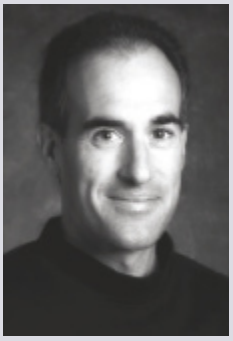
Dr. Schwender discussed with Mondloch both non-operative and operative treatments in detail. Considering the length and severity of her symptoms and her failure to respond to multiple trials of non-operative treatments, he felt that she should consider surgical intervention. His surgical recommendation was a minimally invasive lumbar decompression, left L4 to S1. Risks, benefits and alternatives were all discussed. Mondloch chose to proceed with the surgery offered by Dr. Schwender. She indicated that she felt like she had exhausted all other conservative options and still her quality of life was being severely impacted. She needed to be able to do her job and she wanted to walk and hike again. Not being able to do her regular activities had begun taking an emotional toll. As for choosing a minimally invasive approach to surgery, Mondloch said, "I wanted to take care of the problem in the most efficient way—without a big surgery if I could."



Axial MRI showing normal spine

Surgery (minimally invasive quadrant assisted decompression left L4-L5 and left L5-S1) was performed by Dr. Schwender in November. Mondloch tolerated the procedure well and without any complications. The entire incision was only 2.5 centimeters in length and estimated blood loss was just 10 mL. Mondloch reported immediate resolution of the radiating leg pain. She was kept in the hospital overnight because her surgery had been performed late in the afternoon. She was discharged home the next day in stable condition, with instructions to lift no more than 10 pounds and to avoid excessive bending or twisting.

In December, five weeks after her surgery, Mondloch followed up at Twin Cities Spine Center. Her ODI score was 0 (no perceived disability), down from a preoperative score of 30. She reported occasional back pain of level 1 on a scale of 1–10, down from a preoperative score of 6 out of 10. She rated herself as 'very satisfied' with the condition of her spine. Her restrictions were lifted and she returned back to her active job in healthcare and all the enjoyable activities of her life. To date, she has not had any recurrences of symptoms or required any additional medical care for her spine. "I'm glad I chose the treatment I did," Mondloch said recently by telephone, "I'm living my life!"



James D. Schwender, M.D.

Dr. Schwender is a staff surgeon at Twin Cities Spine Center and Assistant Professor at University of Minnesota. He is certified by the American Board of Orthopaedic Surgeons and the Minnesota State Board of Medical Examiners. His professional associations include the American Academy of Orthopaedic Surgeons, the Cervical Spine Research Society, the Minnesota Orthopaedic Society, the North American Spine Society, the Scoliosis Research Society (Fellow), and the Society for Minimally Invasive Spine Surgery (President). His specializations include cervical, thoracic, and lumbar surgeries, minimally invasive techniques, scoliosis and other spinal deformities, degenerative spine, trauma, and tumors.

Lumbar Fusion—Ryan Jannise

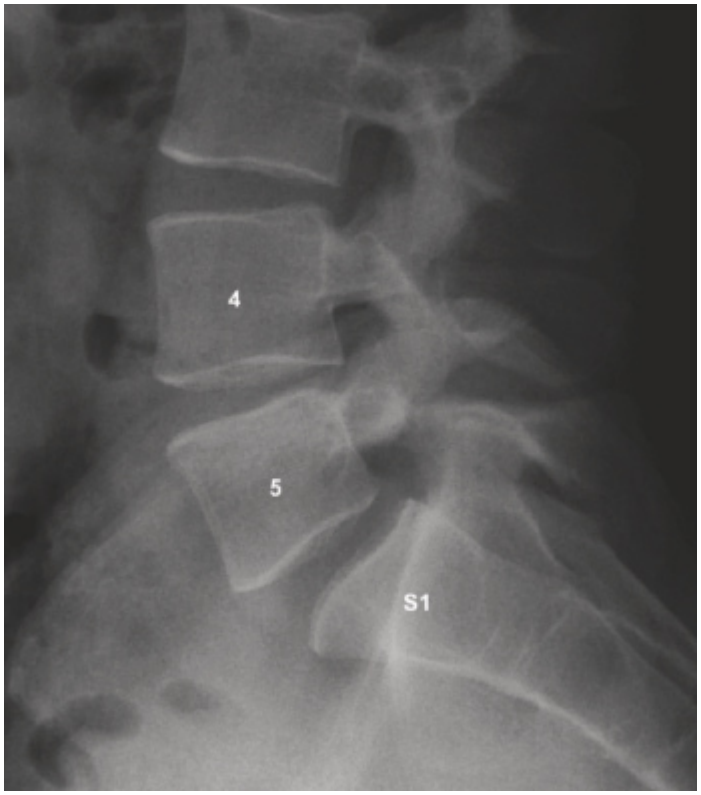
Ryan Jannise first came to The Virginia Spine Institute in September 2009, after suffering from low back pain for about a year. At that point, Ryan was thirty-five years old and was busy in the information technology sector. He was very active, but felt that the severity of his low back pain and frequency of which it affected him was progressively worsening. His back pain had started insidiously. The onset of his symptoms seemed to correlate with the workplace. He had previously been primarily office-based but, with his new job, he was required to travel extensively.

By the time Ryan sought Dr. Subach's help, his outside work activities, which include boating, jogging, biking and golf, were severely restricted. His posture and ability to walk normally were impaired. In 2008, Ryan had a motorcycle accident resulting in multiple compression fractures in his thoracic spine, but otherwise, had no specific injuries to his low back. He also had no specific family history which pointed to early onset of degeneration of the lumbar spine.

He initially had been recommended physical therapy and deep tissue massage. He also tried modifying his activities and using cold packs to help with the pain. He tried anti-inflammatory agents but, with a history of gastroesophageal reflux, he found that the pain caused by the anti-inflammatory agents was not worth the benefit for his back.

Dr. Subach initially told Ryan to pursue the route of nonoperative care. Physical therapy, a medication regimen, and something for pain should allow Ryan to strengthen his core muscles and avoid any surgical procedure.

Unfortunately, upon reviewing his initial set of imaging studies, Dr. Subach identified a lumbar spondylolisthesis: the thin bone, named the pars interarticularis, which holds the spine in alignment, had fractured. Essentially, Ryan had a stress fracture of his low back which was leading to progressive deterioration of both the L4/5 and L5/S1 discs. When he leaned forward or backward, his spondylolisthesis would wobble and cause progressive damage to the stabilizing discs. If he stood or sat for long periods of time, the pain originating from the degenerating discs was tremendous. If he tried to gain some relief from the discogenic pain, he experienced significant pain from the broken edges of the stress fracture rubbing together.



X-ray demonstrates spondylolisthesis at L5-S1 with degeneration at L4-5

Essentially, this gentleman in his mid-thirties was finding that life in any position was painful. It began to affect his work life, his family life and his social life to the point that he considered possible interventions. An MRI scan demonstrated degeneration of the two lowest

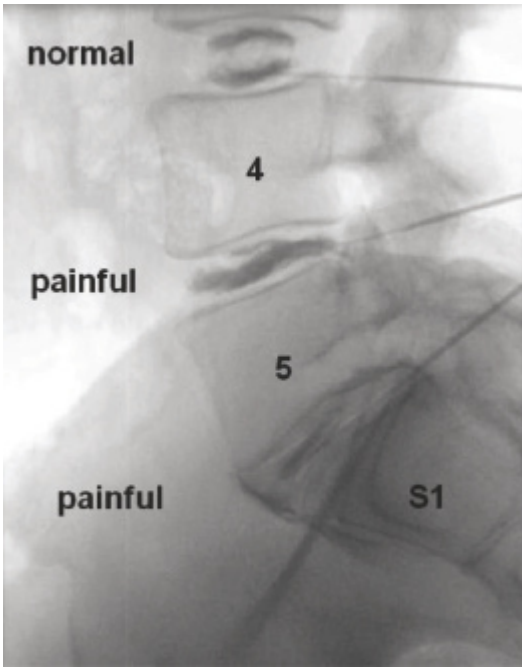
T2 weighted MRI shows dark discs at the lowest two levels of the lumbar spine, indicative of advanced degeneration

discs at L4/5 and L5/S1. Still Dr. Subach had some question about the L3/4 disc and asked him to undergo lumbar discography. The discography procedure is not a particularly comfortable test. When the dye was placed into the L3/4 disc, the disc space appeared to be normal in terms of height.

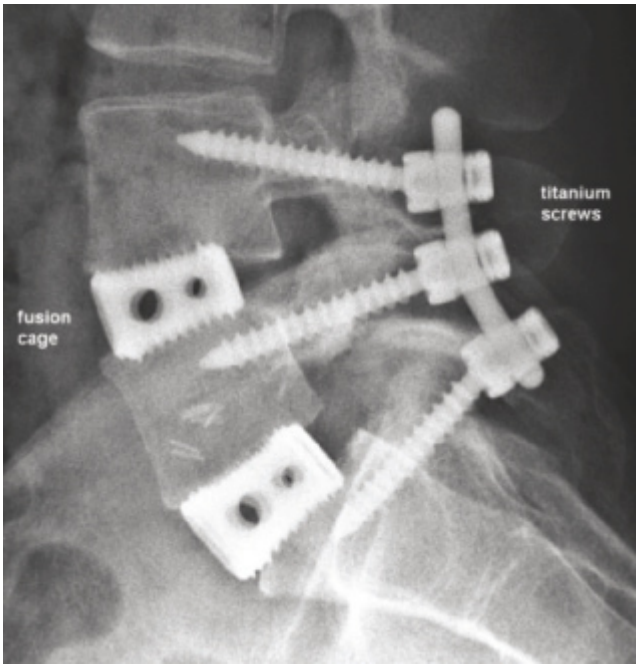
When the dye was placed into to L4/5 and the L5/S1 discs, not only were the disc spaces painful when distended by the dye, but there was also significant leakage of the dye through the front of the disc indicating incompetence of the annulus.

Ryan essentially failed all non-operative treatments and surgery was a possibility, despite his young age. Although there are a number of surgical options available, Dr. Subach and Ryan decided upon a combined approach which addressed the spine from both the front, or abdominal side, as well as from the back. On November 30, 2009, Ryan underwent an anterior abdominal surgery. Dr. Subach basically made an incision below his belly button and moved his abdominal contents to the side, allowing access to the front of his spine. Dr. Subach was able to remove the painful and degenerating discs and realign his spine by placing titanium cages where the degenerative discs used to be. Dr. Subach also used rh-BMP-2 bone graft as a means of forming new bone to solidify his spine. Two days later, on December 2, 2009, Ryan underwent a posterior lumbar operation in which a small incision was made on the back to place three stabilizing screws. Essentially, his spine was strengthened from the front, which gives him additional support when standing and bending forward, and also stabilized from the back using the three supporting screws.

Although the first few weeks after the procedure were marked by muscular soreness, Ryan knew that things were different. Despite the surgical discomfort, he knew that the problem had been addressed. Through physical therapy, he began to get stronger, he tapered down his pain medications and, by three months out from the surgery, he was back functioning at a very high level. Ryan is now pain-free, pain-medicine free and considers that the surgery had given him his life back. He proudly tells everyone that in March 2010



Lumbar discography shows painful spread of the dye throughout the lowest two lumbar discs, with a normal dye pattern at L3-L4



Lateral lumbar x-ray showing reconstruction of the lumbar spine at L4-5 and L5-S1 using cages from the abdominal side and screws from the back

(almost 4 months from surgery), he posted a 91-shot round at golf. He continues to travel extensively for work without any discomfort.

Obviously, Ryan is a motivated individual. However, his results are extremely common. In patients who suffer from degenerative changes in the lumbar spine, particularly those associated with fractures, we have the ability to reconstruct the spine, taking away pain and instability which cause tremendous negative impact upon lives. Our goal was to restore his posture and his alignment and essentially to give him back a spine as strong, if not stronger, than the one he was born with.

Ryan Jannise is a Spine Tale for this issue of The Journal of The Spinal Research Foundation because he has been a resource for other patients contemplating this surgery. He has talked to dozens of patients via telephone and e-mail and shared his experience. Not only is he a success, but through his unselfish willingness to communicate with other patients, he has touched the lives of many.

Brian R. Subach, M.D., F.A.C.S.

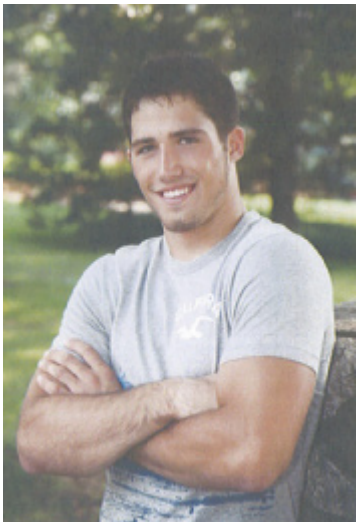
Dr. Subach is a spine surgeon and the Director of Research at The Virginia Spine Institute. He is a nationally recognized expert in the treatment of spinal disorders and an active member of the American Association of Neurological Surgery, the Congress of Neurological Surgeons, and the North American Spine Society. He is an invited member of the international Lumbar Spine Study Group and a Fellow in the American College of Surgeons. He lectures extensively regarding the management of complex spinal disorders in both national and international forums.

He is the Director of Research and Board Member for the non-profit Spinal Research Foundation (SRF) and Editor-in-Chief of the Journal of The Spinal Research Foundation (JSRF). He has written 15 book chapters and more than 50 published articles regarding treatment of the spine.

What is spinal fusion surgery?

Spinal fusion surgery involves the joining or fusing of two or more vertebra of the spine. The purpose of the surgery is to resolve pain caused by motion of the vertebrae by fusing them together. The surgery can be performed from the front, back, or side of the patient, depending on the individual. A surgeon will often use bone grafts, plates, rods, and screws to assist in the spinal fusion.

Microdiscectomy—Jonathan Ameen



In March 2007, spring football training was underway at Union High School in Tulsa, Oklahoma. Junior Jonathan Ameen played a strong safety/punt returner on the football team. His goal was to earn a scholarship to play college football. On March 9, Jonathan was working out with weights and felt pain in his back. He immediately knew something was wrong. He went home, took over-the-counter pain killers, and thought he had just pulled a muscle. A few days later he was back at the gym working out with his team. While performing a squat, he felt the same back pain intensify. Jonathan complained of pain in his lower back that radiated into the left hip and buttock. He also had some numbness and tingling in the left foot and pain in the lateral aspect of the calf. He stopped lifting weights because he also had pain with the Valsalva maneuver.

Soon after, Jonathan went to see a local orthopedic specialist and had an MRI performed. He was found to have a disc protrusion at L4-5, a pars defect and a L5-S1 spondylolisthesis with a fairly large disc herniation towards the left that extended into the neuroforamen on the left side. On physical examination, he had lost some strength in his left foot. He had a negative straight leg raise with a positive slump, indicating a possible disc herniation. He was referred to pain management and underwent three lumbar selective epidural steroid injections. He had temporary relief for a very short amount of time.

The doctors in Tulsa said they could not help him because, genetically, his spine was not aligned. Jonathan was told that he would have to learn to live with the pain. This meant that his days of playing football were over, not to mention he was facing life with limitations in performing everyday tasks.

Kay Ameen, Jonathan's mother, did not accept that this was all that could be done. Kay's father, who is a neuroradiologist, remembered that Dr. Najeeb Thomas, a neurosurgeon with Southern Brain & Spine in New Orleans, Louisiana, had performed surgery on his sister a few years earlier. After doing some research, he found out that Dr. Thomas had an excellent reputation for performing minimally invasive spine surgeries with great success.

With his MRI films and all medical records in hand, on July 24, 2007, Jonathan and his mother Kay left Tulsa and drove 10 hours for an appointment to see Dr. Thomas. On the first visit, Kay told Dr. Thomas that "football was Jonathan's life and it was very important that he get back on the field." Dr. Thomas said, "I will fix you, but you have to come back and play for LSU." That was fine with Jonathan as he too is a huge LSU fan!

Jonathan was experiencing left foot drop, weakened calf muscle and the inability to curl his left toes. After examining Jonathan and his medical records, the sensory exam assessment showed areas of paresthesia remaining on the left lower extremity, especially on the lateral lower leg and over the dorsum of the foot. He also had a positive slump test and straight leg raise test.

Knowing the pain Jonathan was in, Dr. Thomas decided it was best to perform surgery immediately to save the Ameen's another trip from Tulsa back to New Orleans. Dr. Thomas rearranged his schedule and prepared to perform a left L4-5 minimally invasive microdiscectomy using the METRx System. Surgery was done on July 27, 2007. The procedure performed on Jonathan was a left minimally invasive laminotomy/foraminotomy and excision of the herniated disc at L4-L5 on the left.

Immediately after surgery, Jonathan felt relief. He no longer had pinching in his left leg. At his six-day post operative visit, Jonathan stated, "Since the surgery, I have had no nerve pain whatsoever!"

Dr. Thomas noted that Jonathan had resolved radicular syndrome status post microdiscectomy at L4-5 on the left. Since Jonathan was feeling much better, Dr. Thomas released him to use the elliptical machine and the treadmill only, but not to run or play any contact sports. Dr. Thomas wanted to see him again during his fall break from school.

Jonathan started his senior year, but did not play football because Dr. Thomas had not released him. He did, however, dress out with his teammates, go to every practice, and stand on the sidelines at all the games. Since he was well liked and respected by the team, they voted him the team captain.

Because Jonathan has a passion for football, he would try to run a little at the practices, but he would experience some pain. By November, he was staying after practice and running with his teammates. Miraculously, he did not experience any pain.

His team won its way to the State Championship. Jonathan desperately wanted to play in the final game of the season and his high school career. He called Dr. Thomas on numerous occasions and pleaded his case to play in this final game. Finally, Dr. Thomas medically cleared Jonathan to play in the game. At the very end of the Championship game, Union's strong safety was injured and the coach put Jonathan in. He ran out on the field and during his one and only play of the game, he sacked the quarterback! Although Union High School lost the game, Jonathan knows he is a winner in the game of life.

Today, Jonathan is a junior at Oklahoma University. His majors are Finance and Economics and he carries a grade point average of 4.0. Even though he does not play college football because of the high risk involved, he is active in his fraternity, competing in flag-football, volleyball, baseball, basketball and badminton. He is an amazing young man who sees difficulties not as obstacles, but as challenges to rise above.

Two years after the surgery, Jonathan wrote this testimonial to Dr. Thomas:

> "Due to a severe back injury during my senior year of high school football, I was stuck looking for answers to return to health. This injury kept me from doing even the simple things such as picking up a pencil off the floor or taking large steps. Because of the unique curvature of my spine, Dr. Najeeb Thomas was the only doctor I saw that was confident in successfully removing a piece of my disc. I now live a perfectly healthy life, enjoying every activity that I desire to participate in! I owe my restored health and answered prayers to the expertise of Dr. Najeeb Thomas."

Najeeb M. Thomas, M.D.

Dr. Thomas is a neurological surgeon at Southern Brain & Spine in New Orleans. He specializes in minimally invasive surgical techniques for the spine. He has lectured about spinal procedures on four continents and had interactions with hundreds of surgeons around the world. He is recognized as an innovator, and continues to be active in the latest development of minimally invasive spine procedures so that his patients may receive the most advanced spinal care in the world.

The Value of Spine Surgery: An Overview

Research Notes

Charles Gerald T. Ledonio, M.D.
David W. Polly, Jr., M.D.

Cost effectiveness analysis is an increasingly important component of health care policy decision-making. In spite of this, many spine surgeons are quite unfamiliar with the standard evaluation tools, which perhaps are expected to drive health care policy. One such tool, and perhaps the most commonly used currency for comparing the value of competing health care interventions, is the cost per Quality-Adjusted Life Year (QALY) gained.[1–4] In general, interventions with a cost per QALY gained (cost/QALY) less than or between $50,000 and $100,000 are considered cost effective.[5–9]

Recently, there has been a surge of clinical outcome studies in spinal surgery which utilize Health-Related Quality of Life (HRQOL) measures, including the Medical Outcomes Short Form (SF-36)[10] and Oswestry Disability Index (ODI),[11,12] as their main assessment tools.[13–16] Thresholds of a clinically significant magnitude of change in HRQOL score, such as Minimal Clinically Important Difference (MCID) and Substantial Clinical Benefit (SCB) have been established.[17,18] These thresholds determine what change is necessary for a patient to be able to tell a difference (MCID) and what change they would consider to be a good or very good result (SCB).

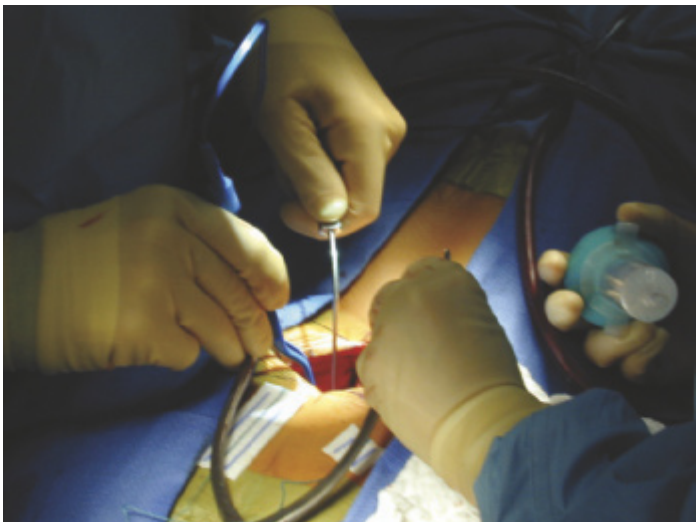
Cost per QALY is the method preferred by economists and policy makers as it can be directly assessed with preference-based techniques such as the Standard Gamble and Time Trade Off and by using validated health utility instruments such as the EQ-5D and HUI, or can be calculated from broader health status measures such as the SF-36 or ODI.[19–21] Importantly, the score also represents an assessment of patient preference for a given health state for a period of time which may be reflected as a continued incremental QALY gain over subsequent years. This incremental gain is therefore also reflective of the durability of the intervention. This methodology allows decision makers to compare amount of benefit per dollar spent across all different medical treatments (diabetes, hypertension, cancer, joint replacement, etc.). The intent of this article is to present an overview of the value of spinal surgery through a review of current literature.

Quality-adjusted life years is a metric of health effect which assigns to each period of time a weight that ranges from 0 to 1, corresponding to the quality of life during that period. A weight of 1 corresponds to perfect health while a weight of 0 corresponds to a health state equivalent to death. QALYs are currently the method of choice of assigning values to lifetimes of varying Health-Related Quality-of-life (HRQL)

Pictures courtesy of Medtronic Sofamor Danek.

measures because they are relatively simple to use and easy to implement.

Over the last several years, the quality of evidence supporting the clinical efficacy of lumbar fusion in well defined populations has improved substantially.[13–16] Given rising health care costs and the drive for efficient reform, there is greater motivation to merge clinical efficacy with economic responsibility in order to utilize finite resources sustainably. This has lead to the concept of comparative effectiveness research and to the benchmark of cost/QALY as a measure of the relative value of a health care intervention.[24–25]



COST EFFECTIVENESS OF LUMBAR FUSIONS

Kuntz et al. estimated cost-effectiveness of laminectomy with and without lumbar fusion based on modeled costs and outcomes derived from literature generated assumptions.[22] The authors noted wide variability in cost/QALY gained with lumbar fusion over a 10 year time period, depending on fluctuations in model assumptions. They concluded that non-instrumented fusion compares favorably to other surgical interventions, but depends greatly on the true effectiveness to alleviate symptoms and on how patients value the quality-of-life effect of relieving severe stenosis symptoms.

In contrast, a recent comprehensive analysis of cost effectiveness, based on directly measured parameters from the Spine Patient Outcome Research Trial (SPORT), suggested that instrumented fusion might be more cost effective than noninstrumented fusion.[23] Tosteson et al. analyzed both direct medical costs, based on the Medicare fee schedule and associated indirect costs. They reported a cost/QALY gained of $118,000 (range, $91,200–$153,100) over a 2-year interval for instrumented lumbar fusion in degenerative spondylolisthesis with spinal stenosis. They concluded that the economic value of spinal stenosis surgery at 2 years compares favorably with many health interventions. Degenerative spondylolisthesis surgery is not highly cost-effective over 2 years but could show value over a longer time horizon.[23] Interestingly, it appears that the SPORT data suggests that the benefit of surgery over non-operative treatment remains consistent out to 4 years. This would essentially cut the cost per QALY in half, bringing these treatments into the well accepted cost effectiveness range.

Pictures courtesy of Medtronic Sofamor Danek.

A study by Glassman and Polly et al. observed a cost/QALY gained of $98,270, based on the Medicare fee schedule and work productivity cost at the 2-year postoperative interval.[26] This is reasonably consistent with the SPORT data, with the slightly lower cost accounted for by the omission of caregiver costs. Over a 5-year interval, the authors demonstrated a lower cost/

QALY gained of $50,949 based on the Medicare fee schedule or $53,914 based on actual reimbursement. The continued improvement in cost effectiveness is primarily due to maintained incremental benefit in clinical outcome with relatively limited additional costs over an extended period of time.[26] It is important to note that, as with much of the cost effectiveness literature, specific dollar values may not translate exactly between studies. The literature is inconsistent with regard to the inclusion of indirect costs such as lost work productivity or the need to replace homemaker functions.[26–29] Also, indirect costs are generally estimated and therefore less accurate than direct medical costs. Similarly, measures of health utility vary between studies and may not be exactly equivalent. For example, data from the SPORT study suggested that QALY gains were somewhat lower when estimated with the SF-6D versus the EQ-5D. This implies that our results might underestimate the relative cost effectiveness of a 5-year analysis using the EQ-5D measure.[23]

Given the new techniques of converting the SF-36 and the ODI into QALY's, surgeons can now generate their own patient specific data related to improvements in health states. An estimate of what that intervention is worth to society can be made. If 0.1 QALY of improvement is obtained and it is durable for 5 years, then the value to society (using $50,000 per QALY as the benchmark) would be $25,000. If the benchmark is changed to $100,000 per QALY the value would be $50,000. Most surgeons will find it difficult to capture reliable cost data. However, knowing the QALY change generated allows surgeons to be well informed about the key metrics driving future health care policy decisions.

SUMMARY

Moving foward, surgeons will need to demonstrate cost effectiveness as well as clinical efficacy in order to justify payment for medical and surgical interventions, including lumbar spine fusion. This review indicates that spine fusion with or without instrumentation is both effective and durable resulting in a favorable cost/QALY gain as compared to other widely accepted health care interventions.[30–31] Further studies are necessary to examine cost/QALY parameters for more complex procedures and specific diagnostic groups. Perhaps a more standardized collection of clinical outcomes data specific for cost/QALY analysis is needed to eliminate variability in determining true economic costs.

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David W. Polly, Jr., M.D. is professor and chief of spine surgery at the University of Minnesota. He attended undergraduate at West Point, did his residency at Walter Reed and his fellowship at the University of Minnesota. He then returned to Walter Reed as chief of spine surgery, eventually becoming chair of the department. He then retired from the Army and assumed his current position at the University of Minnesota. His particular interests are in spinal deformity, spinal biomechanics, precise diagnosis, improving the technical execution of surgical procedures and the cost benefit analysis of therapeutic interventions.

The SPORT Study: Four-Year Outcomes

Research Notes

Brian R. Subach, M.D., F.A.C.S.

Over the past ten years, a number of studies have been published comparing the effectiveness of surgical and non-surgical treatment of patients with herniated lumbar discs. Most of the studies have had difficulty matching the two treatment groups, making it difficult to draw relevant conclusions. In some cases, the surgical group was much larger than the non-surgical group. In other cases, there were important differences between the two treatment groups, such as the surgical approach used, the medications prescribed, or the measures used to evaluate the outcomes. A multi-center study entitled *The Spine Patient Outcomes Research Trial* (SPORT) was initiated in early 2000 in an attempt to compare the outcomes of both nonoperative and operative interventions for lumbar disc herniation, lumbar spinal stenosis, and degenerative lumbar spondylolisthesis. The study involved a treatment group, blindly randomized to either surgery or nonsurgical treatment, and an observational cohort. Essentially, the observational cohort is the group of patients who decided that they did not wish to participate in the randomized study, but agreed to fill out forms and have their information recorded after they chose their own treatment plan.[1]

First, a comment on the study design of the SPORT trial. The trial was conducted at thirteen different spine practices across eleven states. It was performed with Institutional Review Board (IRB) approval and appropriate informed consent. Enrollment criteria for the study included a minimum 18 years of age, the diagnosis of acute lumbar disc herniation and persistent symptoms for a minimum of six weeks. The patient had symptoms in the appropriate nerve distribution (affecting strength, sensation or reflex) with a positive straight leg raising sign on exam. Each patient had an MRI scan and x-rays performed to determine if the disc herniation corresponded to the symptoms. Any patients having undergone previous lumbar surgery, those having scoliosis or other comorbid conditions contraindicating surgery were excluded from the study.

In 2006, the publication of the first results of the SPORT study[2] concluded that patients in both the surgical and nonsurgical treatment groups improved substantially over the first two years after diagnosis. There were consistent improvements seen in the surgery group, favoring all outcomes over all time periods, but these improvements did not reach statistical significance. The release of these first results from the SPORT study created some controversy: a large number of patients who were assigned a treatment had crossed-over to the other treatment. Specifically, 50% of the surgical patients had not undergone surgery and 30% of the non-operative patients had undergone surgery. Nevertheless, 'intent-to-treat' statistical analyses used in the SPORT study reported patients' outcomes according to their assigned treatment and not their actual treatment. 'Intent-to-treat' analyses are designed to minimize some bias due to patients dropping out or non-complying with their treatment. In the SPORT study, the large proportion of cross-over patients underestimated the positive impact of surgery.

Lumbar Disc Herniation[2,3] Changes in Outcomes After Two and Four Years

Outcomes	Baseline Average	2-Year Surgery *N* = 662	2-Year Non-op *N* = 344	4-Year Surgery *N* = 511	4-Year Non-op *N* = 283
SF-36 Bodily Pain (0–100)	26.6	+43.0	+31.6*	+45.6	+30.7*
SF-36 Physical Functioning (0–100)	37.9	+43.6	+30.2*	+44.6	+29.7*
Oswestry Disability Index (0–100)	49.3	−37.2	−24.6*	−38.1	−24.9*
Leg pain (0–6)	4.7	−3.5	−2.7*	−3.7	−2.8*
Low back pain (0–6)	3.9	−2.1	−1.5*	−2.2	−1.4*
Patients rating as major improvement		85.4%	58.7%	79.2%	51.7%

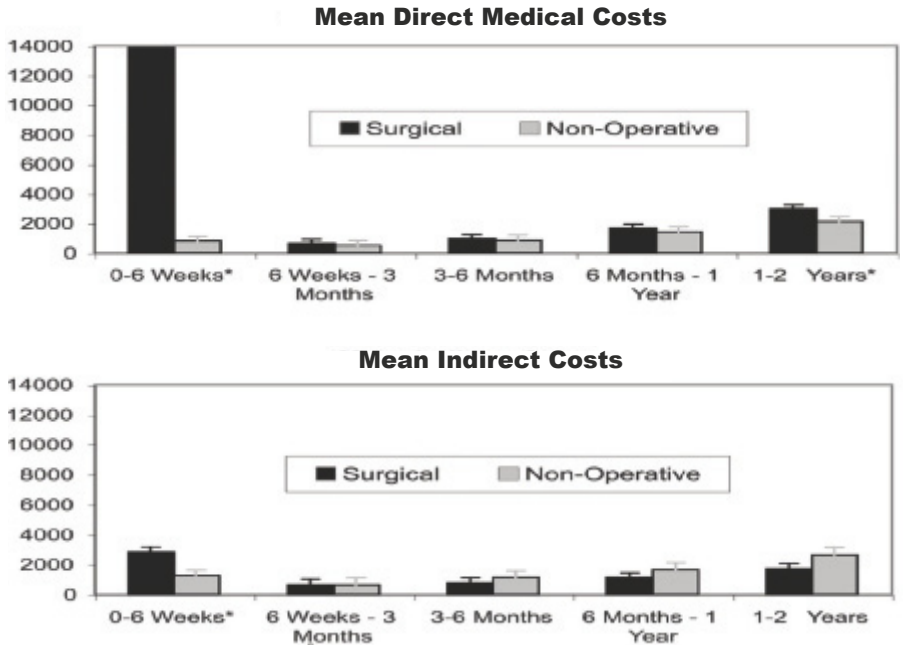
Spondylolisthesis[4,5] Changes in Outcomes After Two and Four Years

Outcomes	Baseline Average	2-Year Surgery *N* = 324	2-Year Non-op *N* = 187	4-Year Surgery *N* = 264	4-Year Non-op *N* = 131
SF-36 Bodily Pain (0–100)	32.6	+29.9	+11.7*	+31.1	+15.8*
SF-36 Physical Functioning (0–100)	33.7	+26.6	+8.3*	+26.6	+7.7*
Oswestry Disability Index (0–100)	42.6	−24.2	−7.5*	−23.1	−8.6*
Leg pain (0–6)	4.6	−2.9	−1.4*	−3.0	−1.5*
Low back pain (0–6)	4.2	−2.2	−1.2*	−2.1	−1.2*
Patients rating as major improvement		74.1%	24.1%	67.1%	21%*

Stenosis[6,7] Changes in Outcomes After Two and Four Years

Outcomes	Baseline Average	2-Year Surgery *N* = 350	2-Year Non-op *N* = 199	4-Year Surgery *N* = 275	4-Year Non-op *N* = 144
SF-36 Bodily Pain (0–100)	31.4	+27.0	+12.9*	+25.1	+12.5*
SF-36 Physical Functioning (0–100)	34.9	+22.2	+12.7*	+20.3	+11.6*
Oswestry Disability Index (0–100)	43.2	−20.3	−9.4*	−18.7	−9.3*
Leg pain (0–6)	4.3	−2.6	−1.3*	−2.5	−1.4*
Low back pain (0–6)	4.1	−2.1	−1.0*	−1.8	−0.9*
Patients rating as major improvement		63.6%	27.9%*	52.8%	23.1%*

*The improvement in scores is higher for surgical patients than non-operative patients ($p < .05$).
The SF-36 scores range from 0 to 100, with higher scores indicating less severe symptoms.
The Oswestry Disability Index ranges from 0 to 100, with lower scores indicating less severe symptoms.
The leg pain and back pain scales range from 0 to 6 with lower scores indicating less severe symptoms.



Reproduced from Tosteson et al. (2008)[8]

Subsequent analyses and 4-year follow-up data from the SPORT study reported patients' outcomes according to the actual treatment. These data demonstrate that surgery produces a substantially greater improvement in pain and function. These results hold true for surgery performed to treat lumbar disc herniation, stenosis and degenerative spondylolisthesis. In all three conditions, the positive effect of surgery was seen as early as six weeks, was maximum by six to twelve months, and persisted over four years.

A final issue worth discussing regarding the SPORT study is the cost effectiveness of the treatments involved. By estimating the direct and indirect costs of treatments over two years, the SPORT study calculated that the cost of surgery for disc herniation was $27,341 versus $13,108 for non-operative treatment. Although surgery was more costly, health outcomes over two years were better in the surgically treated patients.

Altogether, the SPORT study concluded that "surgical treatment of herniated disc represents a reasonably cost-effective health care intervention when compared with other common health care interventions."[8]

Obviously, spinal surgery is expensive. Hospitalization, anesthesia costs, and surgical costs all combine to lend a hefty price tag to such interventions. Although the cost up-front for surgery may be greater, the cost is often diminished by the rapid return of the patient to a functional and working status. For example, if you compare the cost of a patient in conservative treatment for a period of three months on a limited work status, with the cost of the patient having a minimally invasive discectomy who may be back to work within forty-eight hours, it seems intuitive that the surgical procedure is more effective. I believe that both surgery and extended conservative treatment, such as repetitive cortisone injections and physical therapy, ultimately may have the same cost. In my own life, I would not be interested in suffering for a period of three months when a minimally invasive procedure can get me back to work and my family sooner. On the other hand, if I had minimal symptoms and I realized that by performing an aggressive rehabilitation program, I could avoid the surgical procedure, I am all for it.

In general, a few basic rules should guide patient care. These rules include a bias toward nonoperative care first, since it is generally effective in the majority of patients. In patients having significant pain, progressive neurologic dysfunction, or prolonged symptoms, then surgery is a real and effective option. The best we can do is keep our patients informed as to our decision-making so we can come to a decision together.

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Chondromyxoid Fibroma With Secondary Aneurysmal Bone Cyst in the Cervical Spine*

CASE REPORT

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This case report describes a rare bony cervical tumor, chondromyxoid fibroma (CMF) which has features of an aneurysmal bone cyst (ABC). The true etiology of CMF and ABC is unknown. The aneurismal bone cyst may be the result of a specific pathophysiologic change, which is probably the result of trauma or a tumor-induced anomalous vascular process. In approximately one third of cases, the preexisting lesion can be clearly identified. The most common of these is the giant cell tumor, which accounts for 19-39% of cases in which the preceding lesion is found. Other common precursor lesions include osteoblastoma, angioma, and chondroblastoma. Less common lesions include fibrous dysplasia, fibroxanthoma (nonossifying fibroma), chondromyxoid fibroma, solitary bone cyst, fibrous histiocytoma, eosinophilic granuloma, and even osteosarcoma. The treatment of the secondary ABC is based on the appropriate treatment for the underlying tumor. Complete local excision with tumor-free margins avoids the recurrence of CMF, the underlying tumor in this case report.

M.I. was a 27-year-old female administrative assistant. Her chief complaint was of right-sided neck pain with numbness and paresthesias radiating into the right upper extremity, gradually worsening over the preceding six months. The sensory abnormalities began proximally in the right shoulder and progressed to involve the right lateral arm, radial forearm, and eventually the thumb and index finger. She had sustained no memorable injury and her symptoms had failed to improve with non-steroidal anti-inflammatory agents (NSAIDs) and physical therapy. She described her neck pain as moderately severe (pain score of 4 on a visual analog scale of 0–10). The family history was significant for a malignant brain neoplasm, but the patient had an unremarkable medical history and review of systems.

Physical examination demonstrated no evidence of paraspinous muscular spasm or tenderness to palpation. Her cervical range of motion was normal and painless. Spurling's sign was positive on the right side. Axial compression and facet loading caused no pain. Motor examination was intact. Sensory examination was intact to both light touch and pinprick. Reflexes were brisk 3+ and symmetric in both the upper and lower extremities. Tinel's sign and Phalen's sign were negative at both the wrist and elbow.

Imaging studies demonstrated an obvious abnormality. A lateral cervical radiograph demonstrated lucency in the base of the C6 spinous process (Figure 1). T2-weighted sagittal magnetic resonance imaging (MRI) showed lamina and right lateral mass of C6 extending into the neural foramen (Figure 2). T1-weighted axial MRI with gadolinium showed a homogenous pattern of enhancement in the C6 lamina and right lateral mass (Figure 3).

Figure 1. Lateral cervical radiograph demonstrating lucency in the base of the C6 spinous process (arrow).

*This case has been previously published in *The Spine Journal* 10(2010) e5–e9.

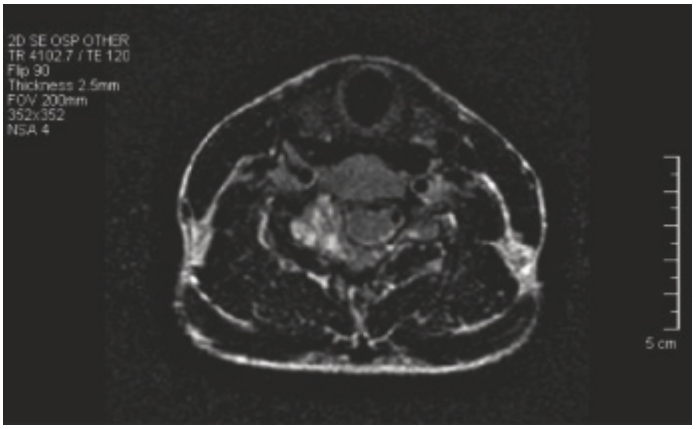

Figure 2. T2-weighted sagittal MRI demonstrating a hyperintense lesion involving the lamina and right lateral mass of C6 extending into the neural foramen.

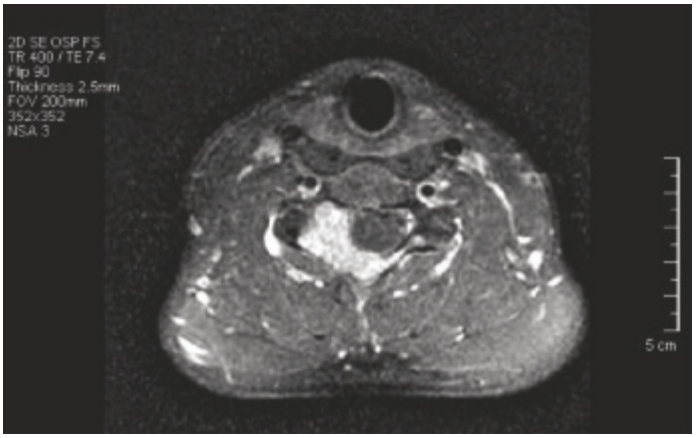

Figure 3. T1-weighted axial MRI with gadolinium demonstrating a homogenous pattern of enhancement in the C6 lamina and right lateral mass.

T1-weighted coronal MRI with gadolinium demonstrated contrast-enhancing epidural tumor extension (Figure 4). Computed tomography (CT) demonstrated evidence of a hypodense lesion causing diffuse expansion of the right C6 lamina with extension through the anterior cortex into the epidural space (Figure 5). There was obvious canal compromise and foraminal stenosis caused by a soft tissue mass. A chest radiograph (negative) and nuclear medicine bone scan were performed to rule out metastatic disease finding only abnormal signal uptake in the lower cervical spine.

The surgical intervention consisted of complete resection of the C6 lamina and right lateral mass, complete resection of the extradural cervical mass, posterolateral fusion at C5-C7, and posterior segmental instrumentation from C5 to C7. (Figure 6).

Figure 4. T1-weighted coronal MRI with gadolinium demonstrating contrast enhancing epidural tumor extension.

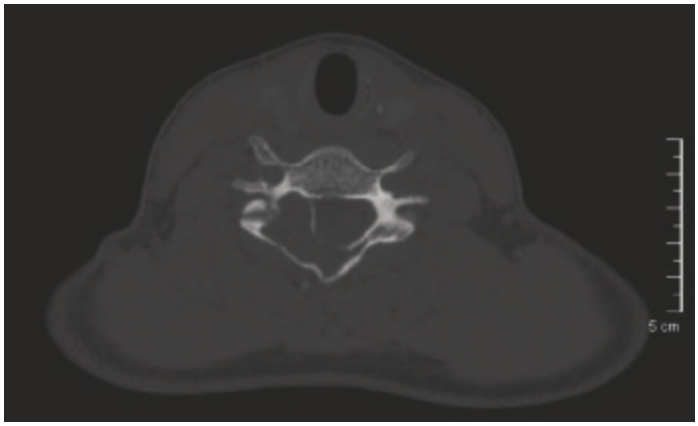

Figure 5. Computed tomography (CT) demonstrating evidence of a hypodense lesion causing diffuse expansion of the right C6 lamina with extension through the anterior cortex into the epidural space.

Coronal CT reconstructions demonstrated complete resection of the involved bony structures (Figure 7).

Histopathological examination of the resected reddish purple epidural mass demonstrated no evidence of necrosis or mitotic figures on frozen section while permanent section showed groups of spindle-shaped or stellate cells

Figure 6. Lateral cervical radiograph demonstrating a posterior cervical arthrodesis with lateral mass screw fixation in anatomic alignment.

Figure 7. Coronal CT reconstructions demonstrating complete resection of the involved bony structures. Lateral mass screws are present.

with abundant myxoid or chondroid intercellular material. Microscopic evaluation further identified a pale blue myxoid matrix containing intertwined strands of spindle and stellate cells with bland nuclei, finely dispersed chromatin, and inconspicuous nucleoli. These were rimmed by hypercellular areas that contained similar fusiform to spindle cells mingled with variable numbers of osteoclast-like giant cells. In certain areas, it appeared that there were small hemorrhagic cystic and cavernous spaces surrounded by fibrous septa composed of mildly to moderately mitotically active spindle cells intermixed with scattered osteoclast-like multinucleated giant cells. These findings were consistent with a chondromyxoid fibroma with cystic change and, in focal areas, degenerative conversion to aneurysmal bone cyst (Figures 8–10).

Nine months postoperatively, all numbness and paresthesias in the right upper extremity had subsided. The patient still experienced intermittent right neck soreness (which she attributed to fatigue and weather changes), but the prior neck pain had disappeared. Solid bony fusion was documented without any evidence of tumor recurrence.

DISCUSSION

Chondromyxoid Fibroma

Chondromyxoid fibroma (CMF), a rare benign primary bone neoplasm, was first described in 1948.[1] It is

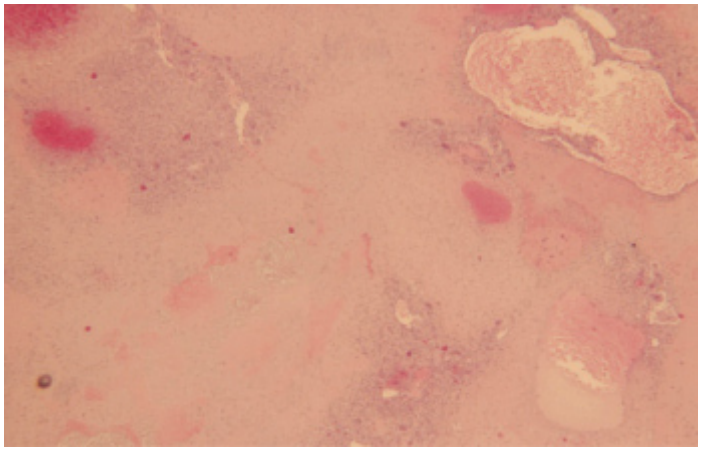

Figure 8. Chondromyxoid fibroma. Low power microscopy reveals spindle-shaped cells in a chondromyxoid background. Hypo and hypercellular regions are seen with scattered osteoclast-like giant cells. Also, several blood-filled cystic spaces are present.

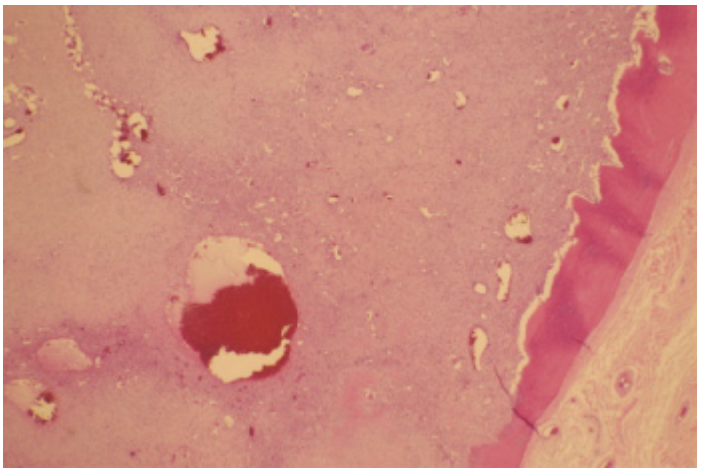

Figure 9. Chondromyxoid fibroma with bone cyst formation. Low power microscopy shows expansion of bone by a well demarcated moderately cellular spindle cell proliferation in a background of chondromyxoid stroma. Also note several hemorrhagic cystic spaces present.

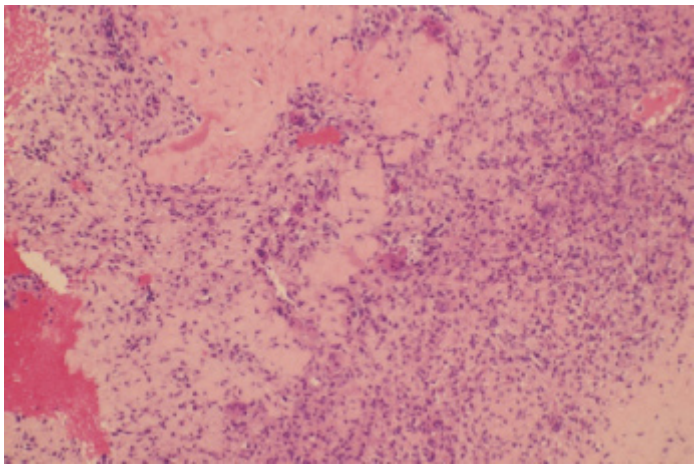

Figure 10. Chondromyxoid fibroma. High power microscopy shows lobulated pattern of growth. Cellular regions with benign giant cells are present peripheral to the chondroid lobules. The spindle cells are stellate in shape and no mitosis is seen.

believed to be one of the least common bone tumors, accounting for less than 0.5% of all primary bone neoplasms.[2] CMF may affect any bone in the body but typically involves the metaphysic of long bones, most commonly the proximal tibia[3]. CMF is uncommon in the spine, with only 8 to 12% of all lesions located in the spine.[4,5] A recent review found a total of 42 spinal CMF cases reported in the modern English literature.[2] In the cervical spine, benign primary bone tumors most commonly occur at C2, C4, & C7.[6]

The radiographic appearance of metaphyseal CMF is typical: oval, eccentric, with scalloped and sclerotic margins. However, the typical CMF radiographic appearance may not apply to vertebral lesions. Vertebral CMF causes extensive erosion of the cortex and extends beyond the periosteum into the spinal canal or surrounding soft tissue.[2,4] The vertebral posterior elements are most commonly affected.

CMF histopathology shows "lobulated areas of spindle-shaped or stellate cells with abundant myxoid or chondroid intercellular material separated by zones of more cellular tissue rich in spindle-shaped or round cells with a varying number of multinucleated giant cells of different sizes."[7]

The typical treatment of CMF by curettage has a 20–25% recurrence rate, possibly due to unremoved tumor lobules.[2] Compared to curettage alone, curettage with concurrent bone grafting reduces the recurrence rate to 7%.[8] Resection provides lower recurrence rates but is not always feasible depending on the location of the lesion.[9] Spinal CMF with extensive local invasion and cord compression requires extensive surgery and tends to have a higher recurrence rate.[2]

Aneurysmal Bone Cyst

Aneurysmal bone cyst (ABC) is also a rare benign condition, accounting for about 2.5% of all primary bone tumors.[10] ABCs appear in any bone but most are found within the spinal column and large long bones. Within the spinal column, the posterior elements and the pedicles are affected first and, in 60 to 70% of the cases, the lesion extends to the vertebral body.[11] The sacrum is affected in 13% of the cases, the lumbar spine in 31%, the thoracic spine in 34%, and the cervical spine in 22%.[12]

In 20 to 30 % of ABC cases, it is associated with an underlying skeletal lesion, such as giant cell tumor, osteoblastoma, hemangioma, chondroblastoma, nonossifying fibroma, fibrous dysplasia, CMF, telangiectatic osteosarcoma, and brown tumor of primary hyperparathyroidism.[11] In large case series, areas of ABC were found in 7 to 8% of CMF cases.[4,5,13] ABC causes cortical expansion but CMF does not necessarily do so.

Expansion of the bone is typically evident on x-rays. ABCs appear as blood-filled cavities separated by thin, fibrous septa made of fibroblasts, myofibroblast, multinucleated osteoclast-like giant cells, blood vessels, hemosiderin deposits, and fields of osteoid and woven bone.[11]

As was the case for CMF, the treatment choice is dependent on the location of the lesion and recurrence rates vary considerably with the type of treatment: 19% recurrence for curettage alone, 25% for subtotal excision and 60% for en bloc excision. Total excision must remove the entire cyst wall, all abnormal tissue that feels spongy, and bone surfaces that are lined with fragile and hypervascular membranes. Recurrence is due to the incomplete removal of the lesion, including the cyst wall.[11]

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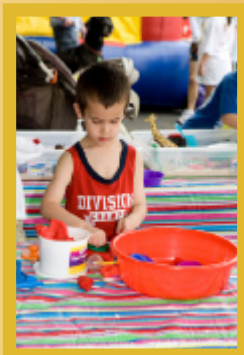

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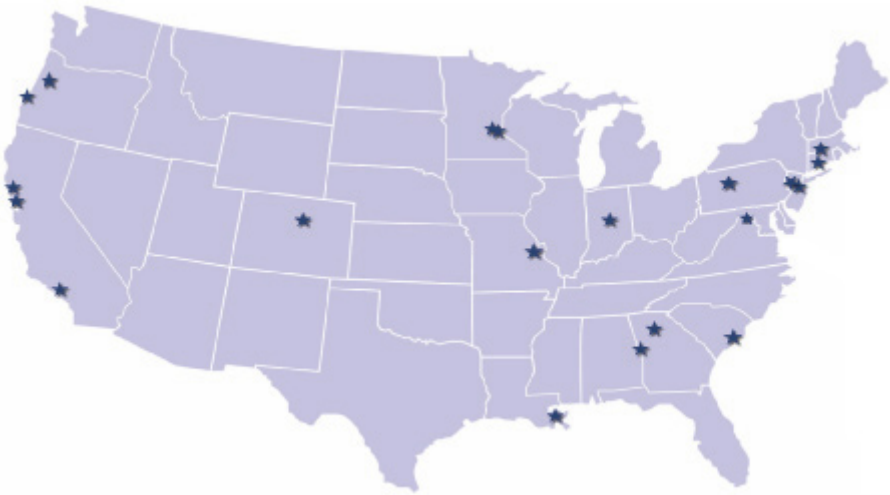
The Spinal Research Foundation has named 22 Regional Research Affiliates across the country that share one core mission: improving spinal health care for the future. These centers offer the best quality spinal health care while focusing on research programs designed to advance spinal treatments and techniques.



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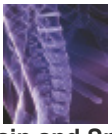

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- ***The evaluation of medical devices for the relief of back pain.***
- ***The evaluation of analgesic drug regimens.***
- ***The development of non-operative techniques to resolve disabling neck and back pain.***
- ***Investigating the use of BMP (Bone Morphogenetic Protein) in minimally invasive spinal surgery to minimize post-operative pain and dysfunction.***
- ***The development of cervical and lumbar disc replacement technologies.***
- ***The development of disc regeneration technology through the use of stem cells derived from the bone marrow.***
- ***The investigation of lactic acid polymers to prevent fibroblast in-growth in surgical wounds.***
- ***A nation-wide multi-center prospective spine treatment outcomes study.***

The Spinal Research Foundation is an international non-profit organization dedicated to improving spinal health care through research and education. The Foundation collaborates with spinal research centers of excellence around the world to prove the success of traditional approaches, as well as develop new techniques and technologies. These results are shared with both the medical profession and the general public to improve the overall quality and understanding of optimal spinal health care.

More than 85% of the population will suffer from severe neck and/or low back pain during their lifetime. Eight percent of these people develop chronic pain, which means that at any given time, 25 million people in the United States are directly affected by this condition and many more indirectly. Techniques to cure, manage, and prevent this limiting and disabling condition need to be developed. Educating the public, health care providers, and insurance providers is the first step in advancing spinal health care.

You can help!

The Spinal Research Foundation is America's leading non-profit health organization dedicated to spinal health. Friends like you have made it possible for us to make huge strides and groundbreaking research discoveries. Join us in our mission to promote spinal health. Support cutting edge research by making a donation to The Spinal Research Foundation.

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"Spine disease is rarely suffered alone. Its reach extends to the families and communities of affected individuals. As such, successful treatment dramatically improves not only the lives of the patients, but also the lives of the people around them. I ardently work to improve the spine health of my patients and enhance their quality of life. I feel a great deal of fulfillment when I am able to help patients restart their lives and regain their smiles."

SPINAL CHAMPION

Christopher H. Comey, MD

New England Neurosurgical Associates, LLC

The Spinal Research Foundation recognizes our outstanding clinicians and researchers in the field of spine research and profiles them as Spinal Champions. These dedicated spine care professionals embrace excellence in both research and education, contributing significantly to improvements in the diagnosis and treatment of spinal disorders. We recognize Christopher H. Comey, MD, of New England Neurosurgical Associates, LLC in Springfield, MA as a Spinal Champion.

Thank You!

The Board of Directors of The Spinal Research Foundation is grateful for the continued investment of our donors and extends its appreciation to all who have contributed.

Through the generous support of our donors, The Spinal Research Foundation has been able to significantly expand the scope of our scientific research and educational programs. These gifts have been utilized to establish scholarship programs and embark on projects geared toward understanding the mechanism of spinal diseases, and develop new treatments for these conditions. This work would not be possible without the support of our donors.

To make a donation in order to improve the quality of spinal health care in America visit:

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