HOSPITAL
FOR
SPECIAL
SURGERY

Horizon

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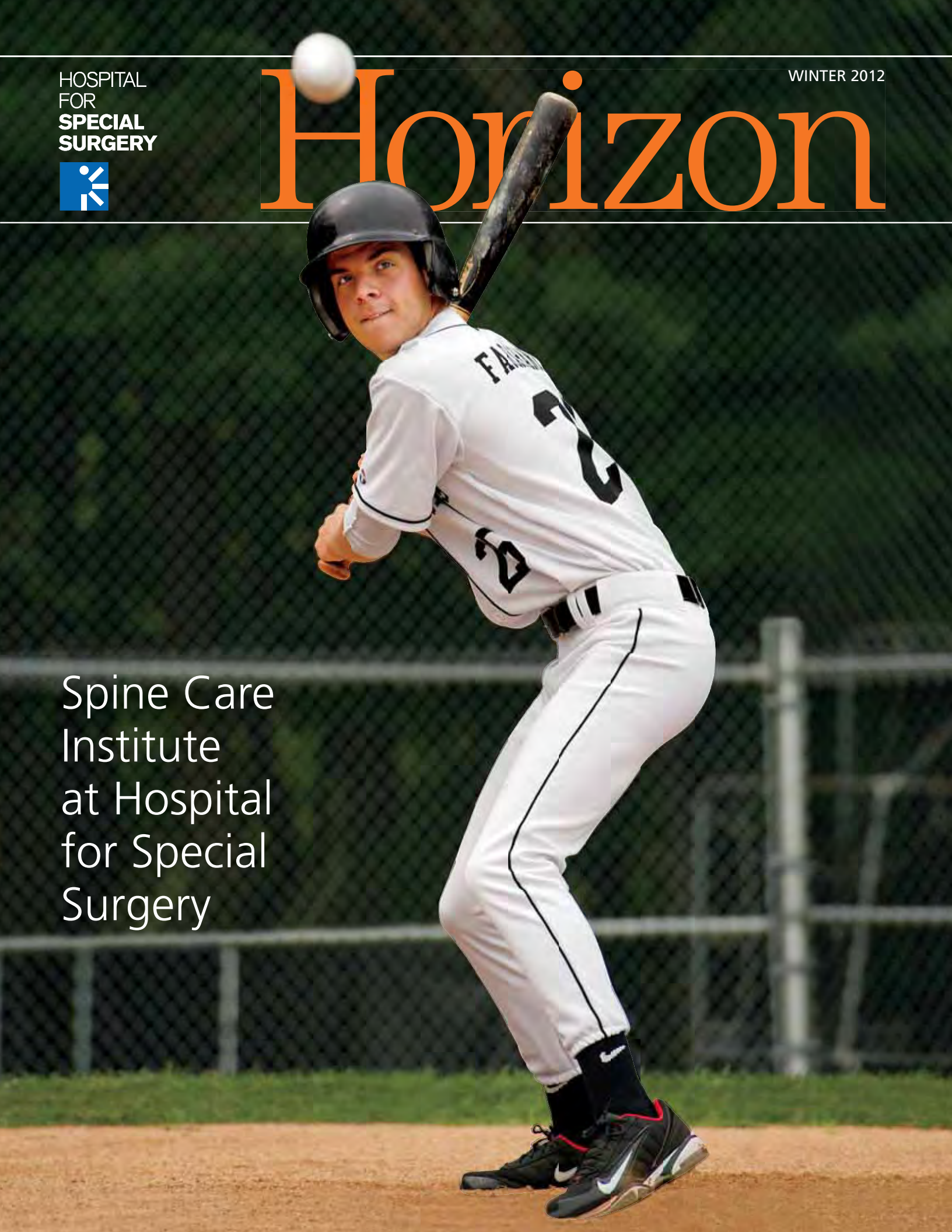


Spine Care Institute at Hospital for Special Surgery

The spine. This graceful, yet sturdy, structure is the central axis of our bodies – allowing us to stand tall and bend freely. When all of its vertebrae and accompanying network of muscles, bones, cartilage, and nerves are intact and working together, the spine is a remarkable example of mechanics in motion. However, if any one of these components is damaged or diseased, the spine can be the source of intense pain and chronic disability.

This issue of *Horizon* focuses on the incredible spine – its subtleties, strengths, and vulnerabilities – and the unique role it plays in the movement and function of our daily lives. From the Hospital's pioneering advances in spine fusion in the 1930s to the development of non-surgical interventions and approaches to relieve back pain today, the Spine Care Institute at Hospital for Special Surgery continues to set the pace for progress in the diagnosis and treatment of spine disease.

On the Cover:

Play Ball…Again
During the fall of his sophomore year at University of Tampa, Darius Farahani awoke in the middle of the night to excruciating pain. The pain turned out to be the result of a herniated disc in his lower back, which led to sciatica and numbness in his right leg. A family friend directed the Farahani family to HSS and Dr. Andrew Sama. Darius had the surgery on December 28, 2010 and was back in his dorm by January 19th. "HSS is just the best. We felt very, very comfortable there," Mrs. Farahani said. "Since the surgery, we have written Dr. Sama's phone number numerous times recommending him to family, friends, and friends of friends!"

Contents

Multiple Perspectives on Spine Care

Chances are if you mention back pain, a conversation is sure to follow. Spine problems are so prevalent in today's society – affecting 8 out of 10 people at some point during their lives – that virtually everyone knows someone who suffers from a temporary twinge to a chronic condition, with numerous manifestations in between. One of the most challenging decisions for an individual with back pain or a spinal disorder is determining where to start the process of care.

The Spine Care Institute at Hospital for Special Surgery is helping to make these decisions easier. How? By bringing together within a single program nearly 50 physicians, spine surgeons, and health professionals with expertise in diagnosing and treating all levels of spine disease.

Dr. Frank Cammisa, Chief of the Spine Service, and his medical and surgical colleagues have established a comprehensive program for patients with spinal disorders.

The inherent intricacy of the spine – with its multiple levels of bones, joints, discs, cartilage, and nerves running from the base of the skull to the tip of the tailbone – requires a number of disciplines to interact simultaneously to address associated symptoms and disorders.

"From the most current diagnostic procedures and non-operative management approaches to state-of-the-art surgical interventions, the Spine Care Institute calls on its multidisciplinary team of specialists to ensure that patients receive the right care at the right time," says Frank P. Cammisa, Jr., MD, Chief of the Spine Service at HSS.

"We need to be able to obtain comprehensive evaluations by anesthesiologists, pulmonologists, and other medical specialists in a coordinated fashion as is provided by HSS in order to best prepare patients for surgery," says Oheneba Boachie-Adjei, MD, Chief of the Hospital's Scoliosis Service, who sees children, adolescents, and adults with some of the most challenging spine deformities.

Roger F. Widmann, MD, Chief of the Hospital's Pediatric Orthopedic Service, and his team treat children with three major types of scoliosis in the pediatric population. Congenital scoliosis is a spinal deformity present at birth. Idiopathic scoliosis is a deformity that develops during childhood and adolescence. When scoliosis is associated with other conditions, such as cerebral palsy, it is referred to as neuromuscular scoliosis. "We approach each of these situations differently depending upon the child's age and stage of development," says Dr. Widmann. "In some situations non-surgical management is appropriate."

The Spinal Column
The spinal column is a pillar of support consisting of 33 vertebrae, including 7 in the neck, 12 in the middle region, 5 in the lower back, 5 fused at the base of the spine, and 4 fused to form the tailbone. Between these vertebrae are discs that serve as shock absorbers.

Spine surgeon Dr. Patrick O'Leary prepares for his next operation. He and other surgeons at HSS provide a wide range of expertise from treating herniated disks to correcting complex deformities.

"As a premier institution for musculoskeletal disorders, Hospital for Special Surgery provides patients with access to physicians and health professionals who have unparalleled expertise in bone, soft tissue, and joint conditions," says Thomas P. Sculco, MD, Surgeon-in-Chief. "Our orthopedic surgeons perform over 25,000 surgical procedures a year – with approximately 10 percent of them for spine disorders."

Among these surgeons is Patrick F. O'Leary, MD. In the more than three decades that Dr. O'Leary has been performing spine surgery, he has diagnosed and treated most types of spine disorders and injuries. The experience of Dr. O'Leary, along with the outstanding expertise of each of the Hospital's orthopedic surgeons who specialize in spine surgery in children, adolescents, and adults, continues to set HSS apart in the world of spine care.

Coming Together for Spine Care

Spine disease impacts a patient's quality of life in varying degrees. HSS patients are professional athletes who injured their spine while pursuing their sport; those who suffer from degenerative disc disease or a herniated disc; others who have a major spinal deformity; and those who have an undiagnosed condition but are troubled by persistent pain and neurological symptoms. The Spine Care Institute harnesses the Hospital's collective knowledge and experience in spine care to provide each individual coming to HSS with a complete spine evaluation and the most appropriate plan for his or her particular situation. According to the Hospital's spine surgeons, the vast majority of people who have back pain do not have a surgical problem and never will. For these patients, the Spine Care Institute provides a non-surgical strategy that may include any number of conservative approaches, such as pain management techniques and physical therapy. For the patient who requires surgery, the Institute's spine surgeons have expertise in the full range of procedures.

An internist-rheumatologist at HSS for 25 years, C. Ronald MacKenzie, MD, will help manage the non-surgical approaches for the evaluation and treatment of patients suffering with spinal conditions. Also, in collaboration with other non-surgical specialists, and the spine surgeons as well, Dr. MacKenzie is currently developing and will oversee the medical and perioperative aspects of care at the Institute, which extends from the preoperative evaluation to post-surgical recovery. "The Spine Care Institute is establishing clinical protocols that encompass the entire spectrum of need for our patients, from initial diagnosis and treatment, right through the perioperative care of the patient who ultimately requires surgery," says Dr. MacKenzie.

Optimizing Patient Care
Dr. C. Ronald MacKenzie emphasizes the importance of the involvement of medical doctors in the care of the spine patient and the role they play in the continuity of care for patients during all phases of evaluation, treatment, and recovery.

"Through the Spine Care Institute, patients have access to a seamless continuum of care among the many disciplines and resources available to treat spinal disorders," says Dr. Sculco. "Patients appreciate and expect this from Hospital for Special Surgery." ■

Myth vs Fact

Myth: If you see a surgeon, surgery will always be recommended.
Fact: At the Spine Care Institute of Hospital for Special Surgery, a multidisciplinary team of spine specialists collaborate on the decision of whether surgery or a non-operative plan of treatment is the best course to take for an individual patient. With the right diagnosis and a clear understanding of spine anatomy, the physician can make an informed and appropriate plan of treatment.

Myth: Spine surgery should be avoided at all costs.
Fact: If there are non-operative modalities that will offer the same outcomes, those certainly should be recommended first. However, there are certain types of spine pain that are associated with either nerve compression or instability where studies have shown that surgical intervention is statistically the best option for the patient. Other types of back pain tend to have more success with non-operative, conservative care. Our role at the Spine Care Institute is to make sure that the patient is matched with the appropriate treatment, whether surgical or not.

Myth: Minimally invasive surgery is the preferred approach for spine surgery.
Fact: While there is an appropriate place for minimally invasive procedures in spine surgery, it is only one of many approaches used to address spine pathologies. In the Spine Care Institute, we prefer to use the term "less invasive." The common perception of "minimally invasive" is that if surgery can be done through a smaller incision, it is the better way to go. Most important, however, is using the least invasive surgical approach that will allow the spine problem to be corrected without causing damage to adjacent healthy structures. In selecting a procedure for a patient's spine disorder, HSS spine surgeons consider a number of factors, including diagnosis, location of the pathology, and complexity of the deformity.

Myth: Back pain will only get worse with age.
Fact: Many times, HSS spine surgeons will see patients in their 40s or 50s with moderate spine pain who want to have surgery because they fear the pain will worsen as they age. However, certain pathologies are self-limiting and resolve by themselves. That is important to know because it allows patients to make educated decisions on whether to delay surgery and see if they improve with conservative treatments, such as physical therapy and/or image-guided injections.

Myth: Spine surgeons do not collaborate with complementary care and alternative medicine practitioners.
Fact: At the Spine Care Institute, we believe that these modalities, when practiced as part of a multidisciplinary team, play a role in the care of the spine patient. The Hospital's Integrative Care Center contributes to the comprehensive care for spine patients. (Read more on page 8.)

Myth: Spine surgery carries a high risk of paralysis.
Fact: Like any surgical procedure, spine surgery does have certain risks, but the actual risk of neurologic complication is very low. To reduce anesthetic risks, new techniques have been developed by our spinal anesthesia specialists. At Hospital for Special Surgery, our neurologists are pioneers in spinal cord and nerve monitoring during surgery. All of these techniques have been developed to minimize risk.

Myth: Immediate postoperative recovery from spine surgery is very uncomfortable.
Fact: At Hospital for Special Surgery, we have greatly minimized postoperative pain and nausea – two common aftereffects of spine surgery. The Hospital's pain management specialists have refined the delivery of medications to manage pain after surgery, making it much more effective, with fewer side effects.

Diagnosing a Spine Disorder

Critical to the treatment of a spine disorder are the tests and procedures that enable the cause and consequences of the problem to be pinpointed. At HSS, the Department of Radiology and Imaging and the Department of Neurology provide highly focused diagnostic expertise for the evaluation of spine disorders, with radiologists and neurologists using their particular skills in a complementary manner to arrive at a precise diagnosis.

"As radiologists, our job is to detect any pathologic condition that may affect the spine and to provide this information in a clear and concise report to clinicians who are treating patients with spinal disorders," says Richard J. Herzog, MD, Director of Spinal Imaging. "Continuing advancements in MRI and CT technology have enhanced our capacity to improve our diagnostic capabilities."

Dr. Richard J. Herzog, Director of Spinal Imaging, calls on MRI, CT scans, and X-rays, as needed, to help guide the appropriate treatment for patients.

"But superior imaging is only one part of the equation," says Dr. Herzog. "Ongoing collaboration with spine specialists at the Spine Care Institute provides the optimal working condition to reach the correct diagnosis and treatment plan for our patients with spinal disorders."

Understanding Imaging Exams

Patients with back or leg pain and other spine disorders may benefit from a number of radiology tests; the selection of a test is based on the patient's symptoms and physical exam. Traditional X-rays may be the initial exam to assess spinal alignment and to detect evidence of degeneration or trauma. X-rays are usually obtained with the patient standing in order to determine how weight-bearing affects spinal alignment. "In some patients evidence of spinal instability may only be detected with the patient upright," adds Dr. Herzog.

If additional information is required to evaluate a patient with spinal symptoms, magnetic resonance imaging (MRI) is usually the next diagnostic test to elucidate the cause of a patient's pain or disability. Computed tomography (CT), myelography, and discography are additional exams that may be employed to evaluate the disc, vertebrae, and nerve roots.

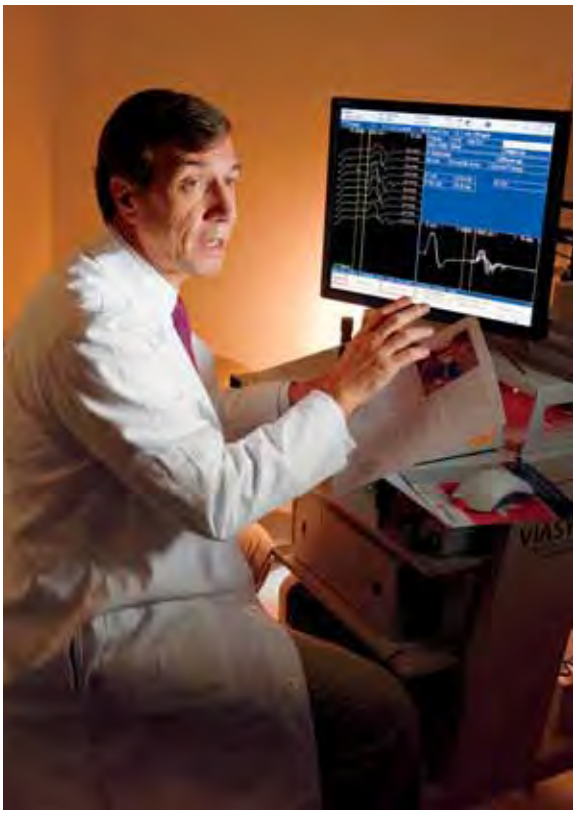
When performing an MRI exam, it is optimal to utilize a high-field strength magnet, i.e., 1.5 or 3.0 Tesla, to maximize the information provided by the exam. High-resolution MRI images facilitate the evaluation of all the components of the spine that may be the source of pain, including the disc, vertebrae, and the adjacent soft tissues and muscles. In order to maximize the value of MRI to evaluate patients with musculoskeletal disorders, the Hospital's MRI specialists have pioneered the development of specific protocols and technology for imaging a wide range of orthopedic conditions – a capability not generally available elsewhere.

A Look Inside
Maria Latapolski's MRI image demonstrates post-operative changes from a laminectomy, along with a fusion, as well as a compression deformity of two vertebral bodies in the lumbar spine suffered in a motor vehicle accident. See Ms. Latapolski's story at right.

Magnetic Resonance Imaging

A New Outlook

Maria Latopolski is no stranger to MRIs. The diagnostic imaging procedure, which she had in the Hospital's Musculoskeletal MRI Center, was critical to guiding her care. Mrs. Latopolski had suffered injuries to her spine in two separate automobile accidents – five years apart. Both times, she required surgery, which was performed by Dr. Frank Cammisa. Dr. Seth Waldman, in conjunction with spine surgeon Dr. Alexander Hughes, then implanted a permanent spinal cord stimulator, which delivers an electrical current to provide her with ongoing pain relief. Says her husband, Hospital for Special Surgery has "put the smile back in her eyes."



Dr. Dale Lange leads a team of highly trained neurologists who conduct nerve and muscle evaluations of patients with spine disease.

"With CT it is possible to create 3-dimensional images of the spine, which provide information not available with routine X-rays," explains Dr. Herzog. "CT is an excellent tool for evaluating complex boney anatomy and traumatic changes that may occur after injury."

To enhance the diagnostic value of MRI and CT imaging, the Hospital's radiologists can combine CT and MRI studies when studying spine pathology. "Combining CT and MRI information provides an additional means to assess complex spinal conditions," says Dr. Herzog.

The radiologist's interpretation is key to helping surgeons determine the appropriate treatment for the patient. "In other words," explains spine surgeon Alexander P. Hughes, MD, "you can have a patient with abnormal findings from an MRI point of view, but that doesn't mean that the problems seen on the MR image are the reason for their pain. The findings need to be interpreted within the context of the patient's history and symptoms while differentiating between natural, age-related changes and those associated with a particular condition."

Dr. Herzog and his team are exploring new techniques to evaluate the spine postoperatively when instrumentation has been used to correct the spine disorder. This includes the use of MRI protocols previously developed at HSS to image joint replacements and other hardware and new CT protocols for optimal imaging when there is metal instrumentation in the spine.

Employing Neurological Evaluations

At Hospital for Special Surgery, diagnostic evaluations are performed by neurologists and neuromuscular specialists to look at mobility issues and other symptoms that may relate to spine disease. "Neurological studies are used to identify deficits, such as muscle weakness and nerve involvement, associated with the patient's spine disorder," says Dale J. Lange, MD, Neurologist-in-Chief at HSS. "These studies also help to determine if, in addition to spine disease, there are other problems causing the patient's physical disability, if nerves and muscles are functioning properly, and if the findings correlate with the presenting clinical problem."

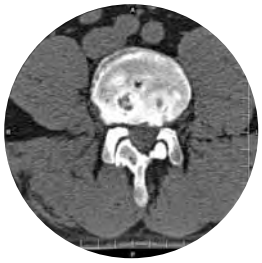
One of the diagnostic studies commonly performed by a neurologist is a somatosensory evoked potential study, which, combined with EMG and nerve conduction studies, provides a multi-dimensional analysis to assess the severity of the spinal cord disease, identify nerve deficits related to the spine disorder, and eliminate or confirm causes of these defects.

"With this test, we deliver electrical impulses to an arm or leg and follow the electrical response through the spinal cord and up into the head as it moves from the skin to brain, where sensation is appreciated," says Dr. Lange. "By measuring the time it takes for nerves to respond to the stimulation, we can determine if and where the impulse may be slowed or blocked, depending on the severity of a spine problem. These studies provide another approach for assessing severity of the spine disease." ■

X-ray

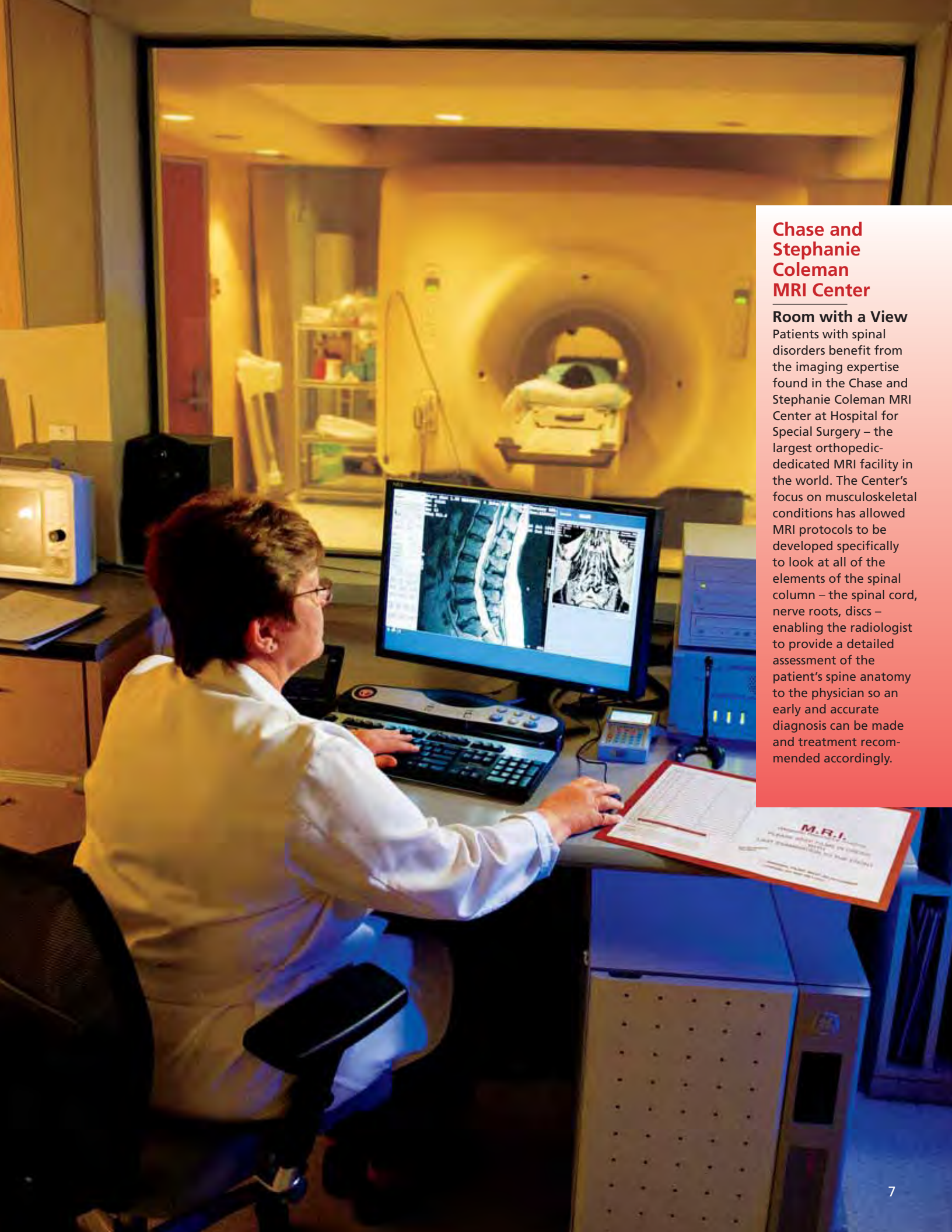
CT scan

Myelogram



Discogram

Multiple Perspectives
Hospital for Special Surgery's radiologists incorporate a number of sophisticated imaging exams, as needed, to pinpoint the cause and consequences of spinal disease. These include X-rays, computed tomography (CT), myelography, and discography shown above, as well as MRI shown on page 7.



Chase and Stephanie Coleman MRI Center

Room with a View

Patients with spinal disorders benefit from the imaging expertise found in the Chase and Stephanie Coleman MRI Center at Hospital for Special Surgery – the largest orthopedic-dedicated MRI facility in the world. The Center's focus on musculoskeletal conditions has allowed MRI protocols to be developed specifically to look at all of the elements of the spinal column – the spinal cord, nerve roots, discs – enabling the radiologist to provide a detailed assessment of the patient's spine anatomy to the physician so an early and accurate diagnosis can be made and treatment recommended accordingly.

Treating Spine Disorders Without Surgery

"Although this is Hospital for 'Special Surgery,' we are also dedicated to exploring all non-operative options available to spine patients," says physiatrist Peter J. Moley, MD. "Treatment plans are devised through a careful history, physical exam, and review of the pertinent radiographic studies. The patient is then treated with a combination of rehabilitation medicine and the appropriate use of interventional spinal injection techniques."

The Role of Rehabilitation Medicine

The Hospital's Department of Physiatry can be an invaluable first step for patients with a back problem. Physiatrists are physicians who specialize in the non-operative treatment of spine and other musculoskeletal disorders. "When patients come in with back pain, it is our job to figure out why they are having the pain and the underlying reason for symptoms," says physiatrist Jennifer L. Solomon, MD. "It is an important responsibility. Based on what we find, we then want to be as aggressive non-operatively as we can to get the patient better."

"Effectively managing a patient with a spinal disorder relies on a comprehensive evaluation," says Joseph H. Feinberg, MD, Director of the Department of Physiatry. "We see patients who have both acute and chronic back or spine-related issues. The spine is a complicated structure, and there are a number of potential generators that might be the source of pain and pathology. The physiatrist's evaluation process begins with compiling a complete history detailing the patient's medical issues, as well as work, recreational, and sports activities, since this information can help localize the problem. Electrodiagnostic testing may be recommended in our diagnostic process for certain neurological symptoms or abnormal findings. We can then determine if there is a nerve injury or disorder."

"Our team of physiatrists and physical therapists have a wealth of experience treating patients with non-operative spine disorders," says Christopher Lutz, MD. "This experience enables us to pinpoint which strategies will work best for a patient's particular situation and adjust them accordingly as the patient progresses. To accomplish this, we work together with the patient and the Hospital's skilled physical therapists to develop an individually tailored exercise program to help restore range of motion, strength, and endurance. Patients are also advised on how their daily activities can impact their spine, so their plan of care will include instruction on proper lifting, movement, and posture, which can help prevent future recurrences."

Physiatrist Gregory E. Lutz, MD, is at the forefront of research in regenerative medicine, which holds great promise in helping to heal structures, such as discs, that are difficult to restore. "We are currently conducting studies in which we take cells from the patient's blood and inject them into the disc to see if we can stimulate a repair response," says Dr. Lutz. "We are also involved in a study where we are injecting growth factor into the disc to try to turn on the disc's inherent ability to heal itself. These are some of the first studies that have been done in the world in this area."

Promoting Spine Health Through Integrative Care

Within an environment that promotes wellness and healing, the Hospital's Integrative Care Center (ICC) provides non-operative treatments for patients with spine issues.

A Healing Touch
The Integrative Care Center provides an array of complementary therapies for the spine patient that may include classes in Pilates, which focus on developing core strength, increasing flexibility, and improving posture; acupuncture, performed here by Dr. Jeffrey Ngeow; massage; as well as physical therapy and chiropractic services.

Exercise and Pain Management

The Art of Living

For almost 15 years, Jeanette Sisk had problems with her back. When her back pain would flare, she would have intermittent treatment for relief, but did not want to have any major intervention. In 2003, Ms. Sisk herniated a disc and decided to try an epidural steroid injection under the care of Dr. Vincenzo Castellano of the Hospital's Integrative Care Center. "I had immediate relief," says Ms. Sisk, an art historian. "It was like night and day. I was kicking myself for waiting so long." Today, with a combination of injections and exercises taught by her physical therapist, Ms. Sisk is looking forward to a pain-free future.

Aija Paegle, PT, MPT, CFMT, CPI, uses a combination of manual technique and therapeutic exercise to help relieve pain and restore function in patients with spine disease.

The ICC offers treatment options that include care by physiatrists and physical therapists, as well as medical acupuncture, chiropractic care, and massage therapy. "If we can diagnose individuals with spine problems early enough, then surgery can, at times, be prevented by implementing therapies that help them to lead more comfortable and healthier lives," says Vincenzo Castellano, MD, Medical Director of the ICC.

The Many Ways of Managing Pain

Pain management, once a subspecialty of anesthesia, is now becoming a specialty of its own. "Pain management is truly an art that we are always trying to refine," points out anesthesiologist Daniel I. Richman, MD, a specialist in pain management and acupuncture. "There is constant growth with new technology and new pharmacology. As a keener understanding is gained of the details of how the central nervous system works, horizons are opening for manipulating pain mechanisms for the benefit of patients."

At Hospital for Special Surgery, physicians in the Departments of Anesthesiology, Physiatry, and Radiology and Imaging are highly skilled in pain management techniques, treating more than 28,000 patients in 2010. Procedures included epidural steroid injections to reduce inflammation around the nerves in the spinal cord and image-guided injections of a short-acting anesthetic and anti-inflammatory steroid to provide immediate relief, especially in patients with an acute exacerbation of symptoms.

"A large percent of pain management involves outpatient injection therapy," says Seth A. Waldman, MD, Director of the Hospital's Division of Musculoskeletal and Interventional Pain Management since 1996. Board-certified in both anesthesiology and pain medicine, Dr. Waldman specializes in therapeutic and diagnostic spinal injections, and the management of neurologic pain. According to Dr. Waldman, the most common issues treated with injections include low back pain caused by acute sciatica from disc herniation and acute cervical pain. Injections can also be diagnostic, helping to pinpoint the source of the pain generator in order to determine the appropriate intervention.

A Hands-on Approach
In skilled hands, epidural injections bring relief to many patients with back pain.

"More aggressive pain management procedures, such as epidural infusions and radiofrequency ablations, are performed in the hopes of keeping patients from needing surgery," says Dr. Waldman. "At the other end of the spectrum are palliative approaches. These include implantable types of therapies such as a spinal cord stimulator, which is like a pacemaker for the spine, or an intrathecal pump that allows pain medicine to be delivered directly into the spinal fluid."

"You have to have a very keen understanding of the way the pain signaling system – from the spinal cord to the brain – is altered in somebody who is in chronic pain and somebody who is taking high doses of pain medication," says Dr. Richman. "Our goal is for our spine patients to have a less painful experience, whether they need surgery or not." ■

Epidural Injections

Targeting the Pain Source

Dr. Seth Waldman has more than 15 years of experience in the field of interventional and medical pain management, specializing in therapeutic and diagnostic spinal injections. Epidural steroid injection is one of many techniques used to control pain in a patient's lower back. The physician injects a corticosteroid medication around the affected nerve to relieve pressure and inflammation. At times, the procedure may be performed with a fluoroscope, a special X-ray machine that allows the physician to visualize the patient's anatomy for precise needle placement, delivering medication directly to a specific nerve root.

The Spine Care Institute Team

The Spine Care Institute at Hospital for Special Surgery has assembled a multidisciplinary team of experts in the care of back pain and spine disorders. Through the Institute, patient services are comprehensive and coordinated, providing all related resources – from radiology and neurology for diagnosis, to physiatry, rehabilitation, and pain management therapies, to surgical interventions – under one umbrella of care. As a Center of Excellence, the Spine Care Institute complements its clinical efforts with a major

1 Harvinder S. Sandhu, MD 2 Stavros G. Memtsoudis, MD, PhD 3 Joseph M. Lane, MD 4 Charles B. Goodwin, MD 5 Alexander P. Hughes, MD
6 JeMe Cioppa-Mosca, PT, MBA 7 Christopher Lutz, MD 8 Patrick F. O'Leary, MD 9 Matthew E. Cunningham, MD, PhD
10 C. Ronald MacKenzie, MD 11 Russel C. Huang, MD 12 Richard J. Herzog, MD 13 Allan M. Lans, DO 14 James C. Farmer, MD

research agenda and a comprehensive education program for patients, fellows, and other medical professionals, as well as the general public. Having clinicians from each specialty within the Spine Care Institute collaborate on the discussion of cases is key to rendering the right diagnosis, and subsequently, the appropriate treatment. According to members of the Spine Care Institute, the more experts you have, the more their information will be used in an optimal manner to help patients with spinal disease and disorders.

15 Celeste Abjornson, PhD 16 Joseph H. Feinberg, MD 17 Jennifer Johnson 18 Roger F. Widmann, MD 19 Oheneba Boachie-Adjei, MD
20 Bernard A. Rawlins, MD 21 Federico P. Girardi, MD 22 Seth A. Waldman, MD 23 Frank P. Cammisa, Jr., MD 24 Darren R. Lebl, MD
25 Daniel W. Green, MD 26 Andrew A. Sama, MD 27 John S. Blanco, MD 28 Linda A. Russell, MD

A Guide to Spine Surgery

The Hospital's spine surgeons address the full range of cervical, thoracic, and lumbar spine disorders, with specialized expertise in complex deformities, traumatic injuries, and revision surgery. "When it comes to spine surgery, the most critical factor is that it is done correctly the first time," says Dr. Frank Cammisa, Chief of the Spine Service. "At HSS, we make sure that the surgical approach we recommend is the best option for that particular patient."

Mrs. Ann Gips, who has had lifelong difficulty with spinal curvature and movement in her extremities, was helped by a complex surgery performed by Dr. Federico Girardi.

Indications for Spine Surgery

"Some spine conditions will resolve with time," says Federico P. Girardi, MD. "But how long is the patient willing to live with the limitations of the spine disorder? Every person has a different threshold for pain and personal factors that weigh into their decision to have surgery. We advise patients of their options, the pros and cons of surgery, and what can be expected in terms of recovery and outcomes."

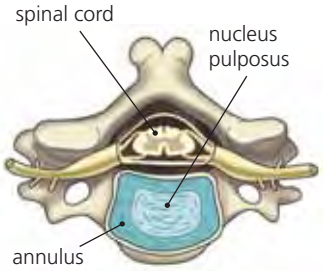
"Before considering spine surgery, it is important to understand the neurologic implications of their problem," adds Andrew A. Sama, MD. "Are weakness and numbness present? Does the patient have pressure on the spinal cord? A few absolutes drive us to recommend surgery. A progressive neurologic deficit usually needs to be addressed quickly by surgery, as does instability of the spine, such as a fracture that could pose a risk for neurologic injury."

As patients age, the decision whether to have surgery tends to relate more to quality of life rather than a neurologically threatening condition. "If a back problem interferes with a person's ability to enjoy retirement, for example, that may be an important reason for that patient's decision to have surgery," notes Dr. Sama. "In such cases, we will consider what treatment the patient has undergone already to mitigate symptoms, the likelihood of achieving relief with a surgical intervention, and the potential risks involved. Once you have all of this data you can customize a recommendation for that patient."

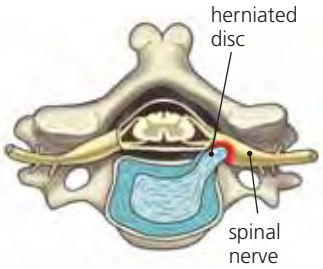
Surgery for Scoliosis and Other Spine Deformities

The Scoliosis Service has a long history of achieving excellent results for patients with complex spinal deformities. A careful preoperative evaluation and the support of subspecialty services, including pulmonary, neurology, internal medicine, and anesthesiology, are vital since many of these procedures involve major reconstruction of the spine – a surgery that can take many hours to perform in order to restore a patient's ability to function.

"Adults may develop scoliosis resulting from a curve that existed when they were younger that has progressed, or as the result of osteoporosis or degenerative changes in the spine," explains Dr. Oheneba Boachie-Adjei, Chief of the Scoliosis Service, who works with a team of orthopedic surgeons highly specialized in the treatment of scoliosis.



Healthy Disc



Herniated Disc
With a herniated disc, a tear occurs in the outer annulus allowing the gelatinous center to leak out. This not only causes the disc to be painful, it could exert pressure on the surrounding nerves and require a surgical repair.

Cervical Disc Decompression and Fusion

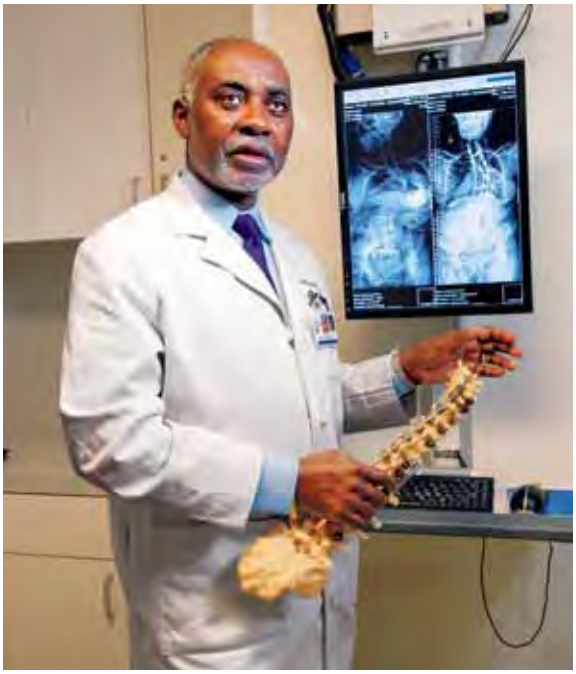
An Envoy at Ease

One week after spinal surgery at HSS, U.S. Ambassador to South Africa Donald H. Gips was back to work. First, in Washington, D.C. for a series of meetings with fellow ambassadors and President Barack Obama, and two weeks later, on a plane to South Africa, where he resides with his family. "Mine was an amazingly quick recovery," said Ambassador Gips of the surgery, which relieved the pain and weakness in his right upper extremity. He knew he wanted his procedure done by Dr. Federico Girardi because he had operated on his mother, Ann Gips, in 2005. "I was so pleased with how that went that when I had a problem he was the first person I called."

"The most common type of surgery to correct a curve that develops in adults is a posterior spinal fusion with instrumentation," says Dr. Boachie-Adjei. In this procedure, the spine surgeon makes an incision in the back and essentially joins the vertebrae together using bone taken from elsewhere in the body or from a bone bank. Rods, screws, or other implants may be used to hold the spine in alignment during the healing process, which could take a year or longer. Once the fusion is complete, the instrumentation no longer serves a function but is left in place to avoid the need for additional surgery.

"To correct spinal deformities, we may use a minimal access procedure called transsacral interbody fusion to stabilize the base of the spine without going through the abdomen," notes Dr. Boachie-Adjei. "The front part of the lumbar spine is fused from below, which is less disruptive to the patient's anatomy, thereby improving outcomes of the surgery and reducing recovery time."

"If a younger child develops early onset scoliosis requiring surgery, we make every effort to use expandable spinal instrumentation that allows for ongoing growth of the spine," says Roger F. Widmann, MD, Chief of Pediatric Orthopedics. "We also consider the patient's potential future athletic activities, and we try to preserve as many motion segments of the spine as possible."



Dr. Oheneba Boachie-Adjei is highly respected for his expertise in scoliosis surgery, which he performs at HSS as well as in third world countries to help underserved populations.

Scoliosis most frequently presents in the adolescent population. When spinal curves demonstrate significant progression, spinal fusion may be indicated in order to correct and prevent further deformity. The level of the spinal fusion makes a big difference in a young person's ability to return to sports.

"In fact, fusion limited to the thoracic spine rarely limits the patient's ability to return to sports," says Daniel W. Green, MD, MS, a pediatric orthopedic surgeon who specializes in sports injuries and spine disorders.

"This information helps us convey realistic expectations to patients and families," adds Bernard A. Rawlins, MD, a specialist in adult and pediatric scoliosis.

As Co-Director of the Kathryn O. and Alan C. Greenberg Center for Skeletal Dysplasias, pediatric orthopedic surgeon Cathleen L. Raggio, MD, treats children who have scoliosis associated with this genetic condition.

A Focus on Spinal Fusion

"Spinal fusion is used to join two or more vertebrae into a single, solid boney structure to eliminate motion between the vertebrae, reduce the accompanying pain, and stabilize the spine," says Dr. Patrick O'Leary. "The procedure is appropriate for conditions that include severe deformity, tumors, vertebral fractures, spondylolisthesis, and some spinal disc herniation."

Cervical and lumbar disc disease can be addressed with discectomy and a fusion of the adjacent vertebrae. "The vertebrae are fused together using bone graft material," says Dr. O'Leary. "At HSS, we use different types of material and bone growth factors to facilitate the body's natural bone healing processes and achieve successful spine fusion. While the iliac crest remains the primary natural source for bone graft material, in more complex cases, biologics, such as bone morphogenetic proteins, have increased the rate of successful fusion."

On the Straight and Narrow
Before and after X-rays of a patient following scoliosis surgery show the dramatic improvement in the curve achieved by a dual-rod instrumentation technique.

Scoliosis Surgery

On the Road Again

When Roni Cimone Willis was a freshman in high school, her parents noticed that a slight curvature of her spine seen in her pre-teen years had progressed and was becoming quite visible. "I saw her back one day and was in shock about how much more her spine had curved – so much so that her shoulder blades were pushed out through her shirt," says Ms. Willis. The family was referred to HSS and Dr. Matthew Cunningham. Roni underwent surgery to fuse the upper part of her spine using instrumentation to prevent a continued progression of the curve. "She can now wear all the clothes she couldn't before the surgery. She went in with a major deformity and came out beautifully. She is so happy."

Physician-scientist Matthew E. Cunningham, MD, PhD, is looking at alternate methods to achieve fusion without surgery. "Rather than having the patient undergo surgery, we are investigating ways to deliver an injection of a specific gene to the disc that causes the disc tissue to turn into bone in the same space that would otherwise be the target for the surgery," says Dr. Cunningham. "In other words, you still achieve the spine fusion, but you don't have to subject the patient to surgery."

Dr. Ronald Emerson (left), closely monitors patients' neurological functioning during spine surgery procedures.

With a patient's bone health critical to the success of a spine fusion, the Spine Care Institute has initiated a clinical protocol for patients to evaluate their bone health prior to surgery using bone density and laboratory tests. Based on the results, a treatment plan is developed with the goal of maximizing bone quality to ensure the best surgical outcomes. "If people have very soft bone, we believe the fusion will not heal well," says rheumatologist Linda A. Russell, MD, Director of the Hospital's Perioperative Medicine Division. "We are seeking evidence to determine if patients with better bone quality have better surgical results." As one example, says Dr. Russell, "We know that tobacco is toxic to the cell that makes bone. So we recommend that patients stop smoking before undergoing spine surgery. We also suspect Vitamin D levels play an important role in surgical outcomes and are therefore checking patient levels and increasing their Vitamin D intake as needed.

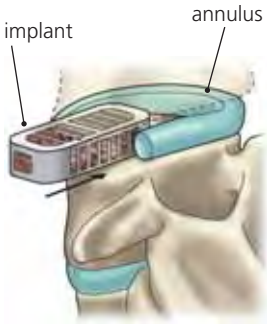
"Additionally, data suggest that bisphosphonates seem to slow spine fusion healing, while another bone-building agent, teriparatide, appears to promote spine fusion, so we make recommendations about taking these drugs accordingly," continues Dr. Russell. "Surgeons will also call on us postoperatively if a patient's bone quality is poor so that we can manage his or her bone health going forward."

Pursuing Surgical Innovations

Spine surgery techniques have improved tremendously over the last few years and continue to evolve toward less invasive techniques and smaller incision surgeries. Spinal surgeons can now remove damaged discs and replace them with mechanical artificial disc implants and stabilize spinal segments as an alternative to spinal fusion, which uses a system of screws and flexible rods.

Many of these innovations have been developed and refined by the Hospital's spine surgeons. "The basic goals of spine surgery have stayed the same over the years: If the spine is unstable, you have to stabilize it. If the nerve roots or the spinal cord are compressed, you have to decompress them," says Russel C. Huang, MD. "At Special Surgery we're focused on finding less invasive and less disruptive ways of achieving those time-tested goals."

Patients undergoing spine surgery also benefit from the presence of members of the Neurology Department in the operating room. HSS is one of the few hospitals in the country with a neurologist solely dedicated to neurophysiologic monitoring during spine surgery. "We use intraoperative monitoring to ensure that the spinal cord and the nerve roots that come from it are not impacted by the surgery," explains the program's Director, Ronald G. Emerson, MD, an attending neurologist at HSS. "It involves looking at how the spinal cord and roots are working in real time during surgery."



Enhancing Bone Healing
An implant with bone morphogenetic protein is placed into the space left after the disc is removed to promote bone growth and a successful fusion.

Strengthening Bone
Dr. Linda Russell is collaborating with spine surgeons on a study to determine if improving bone quality prior to surgery leads to better surgical results.

Spinal Fusion

Tackling the Issue

After sustaining a serious neck injury during a September 2011 NFL game, three-time Pro Bowl safety Nick Collins of the Green Bay Packers underwent successful spine surgery at HSS with Dr. Frank Cammisa. Dr. Cammisa was able to decompress the spinal cord and stabilize the neck with the use of special implants. "The team at HSS understood my goal of returning to play professional football," said Mr. Collins. "When I was faced with the possibility of a career-ending injury, Dr. Cammisa was committed to getting me back in game shape in the safest possible way." Today Mr. Collins divides his time between Wisconsin and his home in Florida, running and lifting weights to get back in shape, and playing with his kids to stay in good humor during the offseason.

The neurologist monitors two components, each of which can provide valuable information about function as the procedure unfolds. "The sensory system is monitored by electrically stimulating sensory nerves in the arms and legs and recording the signals that the brain makes when it receives this impulse," says Dr. Emerson. "Separately, the brain is stimulated to produce electrical signals in the muscles of the arms and legs to make sure that they are responding. The surgeon is informed of the patient's neurological status throughout the procedure."

An Array of Surgical Approaches

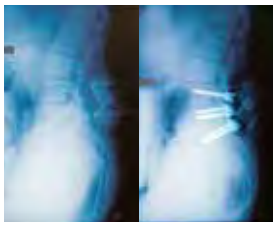
Spine surgery has evolved to include procedures that can be done with smaller incisions, allowing the surgeon to clearly visualize and correct the pathology while minimizing harm to the muscles, nerves, and bone. "The patient's anatomy should be minimally affected by our approach to the problem," says Dr. Alexander Hughes. "At HSS, we can use minimal access techniques to treat straightforward conditions, but we are also using these same innovative approaches to tackle very complex spine pathologies that in years past were not amenable to surgery."

For example, rather than performing spine fusion surgery through the back or abdomen, which involves disruption of major muscles and soft tissues, spine surgeons can now reach the spine from the patient's side in a procedure called Extreme Lateral Interbody Fusion (XLIF). The approach reduces blood loss during surgery and enables the surgery to be accomplished avoiding the major muscles of the back or abdomen. This results in less postoperative discomfort for the patient and a shortened recovery from several months required for traditional fusion techniques to just a few weeks. "The procedure is indicated for patients who require fusion to treat degenerative disc disease, spinal deformity, or lumbar and thoracic disc herniation," says Dr. Huang. "With the XLIF technique, you can perform a multi-level fusion through a 1" incision in the patient's side instead of a 6" to 12" incision and achieve a very good result."

Microsurgical laminoplasty is an advanced spine surgery technique for treating compressed nerves in the lumbar spine. Available at only a few institutions, this procedure is performed through small incisions with the use of an operating microscope to improve visualization of the spinal nerves. The surgeon removes a minimal amount of bone and retains all of the essential supporting ligaments while taking pressure off the nerves. In cases of spondylolisthesis or scoliosis, microsurgical laminoplasty may obviate the need for fusion.

"The most common spine surgery to relieve symptoms of nerve root compression and spinal instability is fusion, which means removing the disc and fusing the two vertebrae above and below it with a bone graft," notes Dr. Huang. Fusion is a very effective and useful technique for treating many painful spine conditions, but a newer treatment option is now available to replace the herniated disc with an artificial disc that is used in place of a bone fusion to preserve spinal motion and flexibility. The disc replacement has a small ball and socket joint with materials comparable to other joint replacements. The artificial disc retains motion in the area of the surgery. "The hope is that by retaining motion, the adjacent discs will not age at an accelerated rate," explains Dr. Huang. Lumbar and cervical disc replacement are generally recommended for patients who have chronic pain with only one disc involved and who have not been helped by other types of treatment.

The cervical spine is subject to the same disc problems as the lumbar and thoracic spine. The goal of surgery is to maintain normal neck movement while addressing the pathology.



Picking Up the Pace

Top: Before her surgery four years ago, a stroll on the beach would have been unheard of for Nancy Dailey. At that time, Mrs. Dailey was diagnosed with a cyst on her spine that was impinging a nerve at the fourth and fifth lumbar vertebrae and causing her great pain.

Bottom: Radiology images of Mrs. Dailey's spine before surgery (left) and after (right) show where a new lumbar instrumentation system was used to fuse her lower spine. See Mrs. Dailey's story at right.

Spine Stabilization

A Perfect Fit

In 2007, Dr. Andrew Sama and Dr. Federico Girardi performed a complex, six-hour surgery to stabilize Nancy Dailey's spine using a comprehensive spinal fusion system that the Hospital's team of engineers and surgeons had developed. "Mrs. Dailey had instability in one level of her spine and severe degeneration of the discs at the bottom two levels," says Dr. Sama. "We needed to take the pressure off the nerves and then stabilize the spine to allow the bones to heal." The new instrumentation, made of titanium alloy and pure titanium – a material that makes it easy to contour to a particular shape – proved ideal for Mrs. Dailey's condition. "I'm doing fine now," says Mrs. Dailey.

"With cervical spine surgery, a patient debilitated by a condition that affects the neck, upper extremity, and hand function can obtain significant improvement in quality of life," says Dr. Federico Girardi. "Using either a fusion or a total disc replacement, we can take pressure away from the spinal nerves and reconstruct the stability and integrity of the spine."

Optimizing Spine Surgery Outcomes

With the Spine Care Institute's model of collaboration, HSS has established a continuum of care for patients undergoing spine surgery, which is further enhanced through constant communication among spine surgeons, internal medicine physicians, physiatrists, radiologists, anesthesiologists, and neurologists. These individuals work together as a team to ensure the best possible surgical outcome for patients.

"We have established clinical pathways for our spine surgery patients, which include pre-established post-op order sets," adds Susan Flics, RN, MA, MBA, Assistant Vice President of Operations. "Members of the spine surgery team follow these protocols so that patient care is standardized and optimized according to the particular surgery. This includes making sure there is an appropriate discharge plan in place. We have also found that developing discharge plans two to three weeks prior to patients' hospitalization reduces their anxiety about surgery and helps to facilitate their recovery."

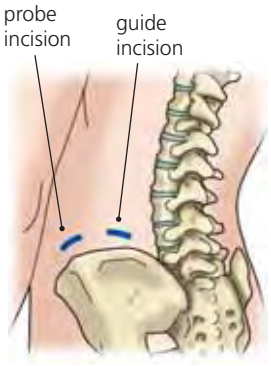
Regina Cannon-Drake, MA, RN, ONC, explains the anatomy of the spine during a preoperative education class for patients scheduled for spine surgery. In addition to explaining what they should expect, patients have the opportunity to ask questions to help ease any anxiety.

"The clinical protocol begins with a preoperative medical evaluation of the patient by one of the Hospital's internal medicine physicians," says Dr. C. Ronald MacKenzie. "The preoperative evaluation is critical to help us determine any medical issues that need to be addressed prior to surgery and to minimize surgical risks."

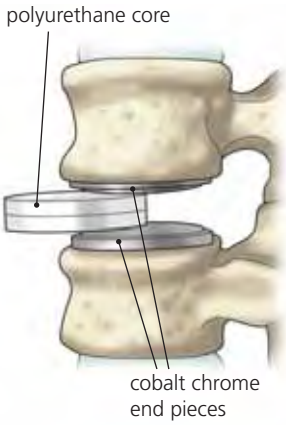
Anesthesiologists at HSS, who are part of the spine team, may become involved well in advance of the patient's surgical date. "We often work with the surgeons and the medical doctors to help determine which subspecialty consults might be needed to help ensure the best perioperative outcomes," says James D. Beckman, MD. "Our goal is always, as part of the team, to ensure the safest possible experience for patients."

A major component of the patient's preoperative preparation is a patient education class that is offered to all spine surgery patients. "We encourage patients to attend this class prior to surgery," says Jack Davis, MSN, RN, ONC, Manager of Patient Education Programs. "The class helps them prepare for surgery and explains what they can expect on the day of surgery and during the initial recovery period."

"When patients are in the surgeon's office, there's often so much information being given that it is hard to absorb all the material at once," says Regina Cannon-Drake, MA, RN, ONC, a patient educator. "In the class, we help them understand the information and also answer any of their questions." In a classroom equipped with a bed, patients are familiarized with items they may need related to their care and recovery when they are in the Hospital. Participants also learn how their postoperative pain will be managed. Web-based materials are an integral component of the program. "We're trying to encourage multiple resources and strategies so the patients and their families can access material early and often," she adds.



XLIF: Minimal Access, Maximum Success
A less invasive surgical technique for achieving spine fusion, XLIF is performed through two small incisions on the patient's side to access the lumbar discs while avoiding major muscles.



Out with the Old, In with the New
Replacing a diseased or damaged disc with an implant composed of metal and polyethylene can relieve pressure on the nerves and eliminate the accompanying pain.

Disc Replacement

Managing Some Heavy Lifting

When Richard Anderson suffered an acute attack of pain in his neck accompanied by pain down his right arm, it turned out to be a herniated disc. With little relief after months of physical therapy and anti-inflammatory medications, he saw Dr. Russel Huang, who had performed spine surgery on Mr. Anderson's father. Dr. Huang recommended a cervical disc replacement to remove the ruptured disc and substitute it with a metal and plastic implant. "I felt like a new person after the surgery," says Mr. Anderson. The procedure preserved the flexibility in his neck enabling him to return to his job as a police officer and member of the dive rescue team for the police department, to bowling, and to working on his family's farm.

Advancing Spine Surgery with Science

Developing tomorrow's innovative surgical solutions and life-changing medical devices for spinal surgery begins with collaboration between the Hospital's spine surgeons and affiliated physicians and research professionals.

Combining his surgical skill with scientific expertise, Dr. Matthew Cunningham investigates biological approaches to improve the success of spine fusion.

Dr. Matthew Cunningham and his scientific colleagues are investigating a non-invasive technique for spine fusion that may reduce the need for surgery in many cases, promote faster healing for degenerative disc disease, and serve as an early intervention for progressive scoliosis. The method involves the use of new bone morphogenetic proteins (BMPs) and other treatments that, when injected into the disc, promote new bone growth, resulting in spine fusion.

Through the Spine Care Institute's Integrated Spine Research Program, the Hospital's spine surgeons have been involved in numerous multicenter clinical trials, including the Spine Patient Outcome Research Trial (SPORT) funded by the National Institutes of Health. This five-year study at 13 sites across the country compared surgical and non-surgical treatments in 2,500 patients with three of the most common back conditions: intervertebral disc herniation, spinal stenosis, and degenerative spondylolisthesis (when one vertebrae has slipped over another). The results found that patients who had surgery showed greater improvement and maintained their improvement over time in comparison to those who had non-operative care. The results of the study were published in the *Journal of the American Medical Association* and the *New England Journal of Medicine*. HSS has also been a leading center in six multicenter clinical trials of total disc replacements for the neck and lower back to determine their safety and efficacy for the treatment of degenerative disc disease prior to their U.S. approval.

Spine surgeons and Celeste Abjornson, PhD, Director of the Integrated Spine Research Program, are collaborating with the Department of Biomechanics on a registry of retrieved total disc replacements from around the world to better understand performance and wear mechanics to improve future designs. By studying these implants and the clinical experience of the patients, they are able to fully understand how a device is working in different types of patients.

"The main question is, how do you define success of surgical outcomes?" says James C. Farmer, MD. "Is it by MRI? Is it the amount of pain medication needed? Is it being able to work? There are many points of view and there has been a lot of effort throughout the years to try to answer this question. At the end of the day, what's important is that we're changing the patient's life for the better."

The Hospital's expertise in spine surgery is world renowned, attracting physicians from across the globe who come here to train. "Among the many countries represented at HSS are six spine surgeons from my native Ireland, who returned home to successful careers in spine surgery," says Dr. Patrick O'Leary. "We feel it is imperative to share our knowledge in the field of spine care with our colleagues around the world and with the next generation of spine surgeons." ■

A Wealth of Information on the Web

At www.hss.edu/spine you will find over 80 articles, videos, and animations on spine and neck conditions and treatments.

Continuing Education

Top: Training physicians from here and abroad is a key component of the Spine Care Institute. Shown here is Dr. Alexander Hughes (seated), Paul Kiely, MD, a research fellow from Ireland (foreground), and spine fellow David Essig, MD.

Bottom: Grand Rounds draws a multidisciplinary audience to Special Surgery to learn the latest advances in spine care.

Cervical Discectomy

Back on Track

Almeshia Medley had already been coping with a herniated disk when a car accident in May 2010 greatly aggravated her condition to the point where she was having persistent neck pain and significant symptoms in her right arm. An MRI showed several disc herniations in her cervical spine with spinal cord compression. On August 19, 2011, Dr. James Farmer performed a four-level cervical discectomy to remove the problem discs and a fusion to stabilize her cervical spine. Within a few weeks, Ms. Medley showed great improvement and, by early October, was able to resume walking for exercise and enjoyment.

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A Vision to Behold:

Chase and Stephanie Coleman MRI Center

As a member of the Board of Trustees at Hospital for Special Surgery since 2006, Charles (Chase) P. Coleman III has long been aware of the expertise behind the Hospital's stellar reputation. But an accident he suffered in the summer of 2009 gave him a more personal perspective on HSS's extraordinary capabilities. After being seen in a local emergency department on Long Island, Mr. Coleman went to Special Surgery for a second opinion.

At HSS, an MRI reviewed by Hollis G. Potter, MD, Chief of the Division of Magnetic Resonance Imaging and Director of Research for the Department of Radiology and Imaging, revealed an injury that threatened Mr. Coleman's spinal cord if not treated quickly. Surgery by HSS spine surgeon Patrick J. O'Leary, MD, followed, and today, Mr. Coleman – an avid athlete – is fully recuperated and playing golf, ice hockey, and skiing with the same intensity as before.

As an HSS trustee for the past five years, and Co-Chair of its Investment Committee for the past four years, Mr. Coleman and his wife Stephanie wanted to find a way to further support the Hospital, and helping with its MRI clinical services and research efforts made perfect sense. The Colemans conferred with Dr. Potter to prioritize her Division's needs, ultimately providing an important gift to establish a chair in Dr. Potter's honor that would help fund research scientists, as well as the addition of a new MRI.

"The establishment of the Chase and Stephanie Coleman Chair in MRI Research will add an enduring legacy of innovation and research, with the ability to recruit additional clinician-scientists, bioengineers, and physicists," says Dr. Potter, who is renowned for her work in cartilage and joint arthroplasty imaging, and for her research in meniscal structural integrity. She has received many awards for her accomplishments, including the American Orthopaedic Association research award and the Cabaud research award from the American Orthopaedic Society for Sports Medicine. She has also been elected as a fellow in the International Society for Magnetic Resonance in Medicine.

Under Dr. Potter's leadership, HSS has established the largest academic MRI facility dedicated to orthopedics in the world. The additional MRI made possible by the Colemans brings to 10 the Hospital's number of MRI units of different field strengths. The MRI Division's robust research program provides tangible answers to clinical questions, including why joint replacements fail, reasons for cartilage damage, and complex modeling of growth abnormalities in children. More than 100 orthopedic MR scans are performed each day at HSS. The MRI Division complements the Hospital's other patient offerings, including highly specialized imaging technology and extraordinary radiologists with expertise in spine disorders.

With their endowment of a chair honoring Dr. Hollis Potter (seated), Stephanie and Chase Coleman have provided vital funding for research that will continue to expand the role of MR imaging in musculoskeletal care.

Says Dr. Potter, "The Colemans' generous gift will allow for substantial growth of our 'bench-to-bedside' approach of improving the detection of disease that many times goes undiagnosed by conventional imaging and routine clinical examination." ■