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Journal of the Spinal Research Foundation

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.

Welcome to the Spring edition of the Journal of the Spinal Research Foundation. As we begin our second year of publication, there is a sense of excitement based upon the progress that we have made. The inaugural issue of the Journal was published in the spring of 2006. It served as an introduction to the community for the non-profit Spinal Research Foundation and a forum for some of the most exciting research in the field of spinal healthcare. Our readership is growing exponentially.

The Spinal Research Foundation would be nothing were it not for two groups: our patients and our donors. Without our patients and their participation in the collaborative efforts of the research teams, there would be no progress. I would like to acknowledge the contribution of our patients to the data collection process. They fill out detailed computer data forms and return for office evaluations and x-rays long after their incisions have healed. I applaud both our corporate and private donors for their generosity in supporting this most worthy cause. Through donations, we have been able to add additional research personnel, expand the number of ongoing research projects and continue publishing the results of our work in both community-based forums as well as medical journals.

In 2007, the SRF finds itself in a predicament. There is quite simply too much to do in too little time. We have been involved in both the cervical (Prestige ™) and lumbar (Maverick ™) artificial disc trials. As the U.S. Food and Drug Administration approval is expected for both devices in 2007, we are focused on getting the crucial information to our readers in short order. Many patients will be considering the options available for both cervical and lumbar spinal disease. Our plan is to dedicate the Fall 2007 edition of the Journal to the Science and Practice of Spinal Arthroplasty.

We have also been busy in supporting spinal healthcare around the world. Dr. Mark McLaughlin, a renowned neurosurgeon and contributor to the JSRF has fostered a relationship with the neurosurgical community in Russia over the past decade. In conjunction with the Integra LifeSciences Corporation, the SRF has facilitated a donation of lifesaving medical supplies and materials specifically for the Institute of Neurotraumatology in St. Petersburg, Russia. Our mission of research and teaching in the United States continues to expand to touch the global community.

We have included in this issue an outstanding array of articles covering outcomes research, basic disease processes and treatment advances. One such article, written by a patient from the Virginia Spine Institute, gives unique insight in the world after spinal surgery. Another column, entitled "Spine Tale", is a before and after look at the life of one of our patients. If it feels like a reality show on television, there is a reason. The names are real, as is the story. It gives the reader a more tangible insight into what we see every day in our patients. Our research is performed to improve the lives of our patients. We believe that, by placing faces on the research effort, the effort seems that much more worthwhile.

Spine Tale

Mr. Frederick Stacey is our Spine Tale for this edition of the Journal. His problem began back in January of 2006. Both an avid skier and runner, Mr. Stacey had always been athletic. In fact, his choice of occupation in law enforcement essentially demands that he maintain fantastic physical condition. As a member of a Special Weapons and Tactics (SWAT) team, his physical strength, cardiovascular conditioning and focus had always been outstanding. Our patient told us at his initial office visit that "I had been skiing with my family in Vermont when I fell. I recall striking my head and left shoulder. My neck had bothered me some in the past and had been stiff for a couple of weeks, but it went away with some stretching and ibuprofen. This time it felt like a pulled muscle when I turned my head from left to right, but the pain between the shoulder blades and radiating down into the arms was different than before".

Fred Stacey

He tried the usual routine at first. He did his stretches and took an anti-inflammatory medication. He tried to put ice on his neck, until a friend recommended heat. He tried that next, but it made no difference. Mr. Stacey had difficulty even sitting or standing secondary to the pain. Running was simply out of the question and, as a result, his job-related activities had to be restricted. His family doctor recommended some physical therapy and an MRI scan of the neck. When the MRI report came back showing degenerative and possibly traumatic changes in his lower cervical spine (neck), Dr. Lessin suggested that he see Dr. Thomas C. Schuler at the Virginia Spine Institute. An orthopedic spine surgeon, Dr. Schuler founded the VSI and had made a career out of diagnosing and treating the most complicated neck and back problems in elite athletes.

Hearing that he may need to see a surgeon, he immediately thought the pain "was starting to go away. Then I remember distinctly waking up with this sharp pain in my neck, where the neck meets the shoulder."

The next morning the pain was incredible. No matter what position my neck was in, he "couldn't sit, couldn't lie down"

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Spine Tale

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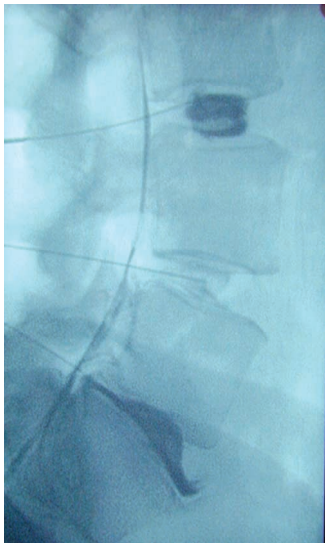
much less function. Previously, when the pain was bad, he would prop himself up on the couch at a 45 degree angle getting some relief. At this point, the couch would not even help. When he arrived at the Virginia Spine Institute, his neck pain was an 8 on a pain scale from 0 to 10. He had undergone knee surgery before, but this pain was completely different, "this was like walking around out of your mind".

At his initial evaluation, Dr. Schuler reviewed his MRI and performed a physical examination. Some degenerative (arthritic) changes in the lowest part of the neck (C5-C6) with a small disc herniation (rupture) at C5-C6. He had 90% neck pain when asked about his symptoms. Most surgeons believe that cervical disc herniations cause arm symptoms such as pain numbness and weakness. When the overwhelming complaint is neck pain, most spine specialists will avoid surgery and recommend additional therapy. Dr. Schuler saw something that the others might not have seen and recommended cervical discography. The discography, which consists of placing an extremely thin needle into the spinal discs in the neck before injecting a small amount of contrast dye, is performed by only a select few spinal surgeons in an attempt to explain the patient's pain. The test is designed to show the internal structure of the disc and to reproduce the patient's symptoms (neck pain) when the dye is injected. The discogram showed the disc herniation at C5-C6, but when that level was injected with dye, it did not reproduce Mr. Stacey's usual neck pain. The MRI had shown the next level, C6-C7, to be relatively normal. On discography, C6-C7 was anything but normal. The dye in the disc caused Fred to have pain in the usual place that had been bothering him for the past few months despite pain pills and therapy.

X-ray of Fred Stacey's neck after the surgery

Fred Stacey underwent cervical fusion surgery on July 26, 2006. Since there was a clear disc herniation at C5-C6 and the discogram had identified C6-C7 as the primary cause of his pain, both levels were repaired. The discs were completely removed and replaced with a small wedge of donor bone before both spaces were covered by a titanium plate and anchoring screws. Mr. Stacey stayed overnight in the hospital and went home to his family the next day.



Example of discography. The injected dye in the superior disc shows the shape of a healthy disc. The inferior disc is unhealthy. The dye has not been injected yet in the middle disc.

Mr. Stacey visits the Virginia Spine Institute office every three months or so for a quick exam and an x-ray. He smiles and shakes hands. His pain is gone and he is back to his SWAT team without restrictions. When he does his daily neck exercises, he has a hard time recalling the indescribable pain that was there last year. He hopes he never remembers it. He did leave us a picture in full assault gear, so we don't forget him.

Frederick Stacey is one of the thousands of success stories that come from the Virginia Spine Institute. Our mission at the VSI is no different from the mission of a SWAT team. We both exist to save lives. We just choose to do it without body armor.

"To come up with last minute solutions to impossible problems created by other people" - Anonymous SWAT team member.

Fred Stacey back to work

Physical Therapy's First Objective in treating Spine Pain: The Modulation of Pain & Control of Inflammation

By E. Laurence Grine, MSPT, ATC and Richard A. Banton, DPT, ATC

In our last article [1], we described the complete spectrum of physical therapy treatments. We also explained that each treatment intervention should be designed to achieve one of the following four objectives:

Objective 1: Pain Modulation & Inflammation Control
Objective 2: Promotion of Active Movement
Objective 3: Enhancement of Neuromuscular Performance
Objective 4: Patient Education and Biomechanical Counseling

Identifying the appropriate objective for each patient determines how quickly a patient can achieve a full recovery from pain and injury. This article discusses in greater detail how a physical therapist can treat a patient to help modulate pain and control inflammation for musculoskeletal injuries to the spine.

Three primary factors determine the extent of an injury:
1. The amount of force applied to the body (trauma),
2. The duration or repetition of the force exposure to the body,
3. The force specifications of the bodily tissues involved.

Injury and inflammation occur when the forces applied to a joint or body part exceeds the force specifications of the involved joint or tissues. Every bodily tissue has a threshold called its exhaustive potential. When the forces placed on a structure exceeds its exhaustive potential, the involved structures can no longer handle the forces adequately and pain and tissue damage will result. Pain is the body's way of indicating an injury is present. The human body is a machine that is built to move and our bodies will break down if we exceed the limits of our musculoskeletal system and surprisingly enough, it will also break down and degenerate if we move too little. Every body part has an optimal loading that is required to maintain good health of its tissues. A bone is very strong and can withstand a tremendous amount of force, whereas the muscle and tendon of a joint is also very strong but will tear or become injured with much less force than the bone. The force specifications of all bodily tissues have a point at which it will fail and become injured. The duration of the force or number of repetitions of the force plays a major role in determining when and if the tissue fails, causing pain and inflammation. A one time large and violent force placed on the body, such as a motor vehicle accident, has the ability to cause major injury to tissues, such as fractures and soft tissue injury, in just one episode of force exposure. This would be an example of a high load ~ low repetition injury. However, individuals with repetitive strain injuries, such as many low back injuries and carpal tunnel syndromes, have repeated exposure to small forces that accumulate over time because the forces are poorly distributed throughout the body. This would be an example of a low load ~ high repetition injury (Figure 1). Many low back pain patients have an imbalance of anatomical structures that causes the body to overload structures and accelerates degenerative changes over time. Examples of these imbalances include a long leg, pelvic obliquity, scoliosis, and restricted joints. The repeated exposure to a poorly-distributed low-grade force accumulates over time to eventually exceed the force specifications of the tissue causing tissue breakdown and inflammation. The goal of the physical therapist is to identify the source of the pain generation, what structures are overloaded, and what structures are compensating for the asymmetrical loading of the body. Once the structures have been identified, the physical therapist develops a treatment plan to correct the loading of the injured structures in a way that will optimally load the structures and promote a healthy and good healing environment. Modalities are one way a physical therapist can reduce pain and inflammation to assist in bringing a patient from Area 3 back into Area 2 to allow for a progression of therapeutic exercises.

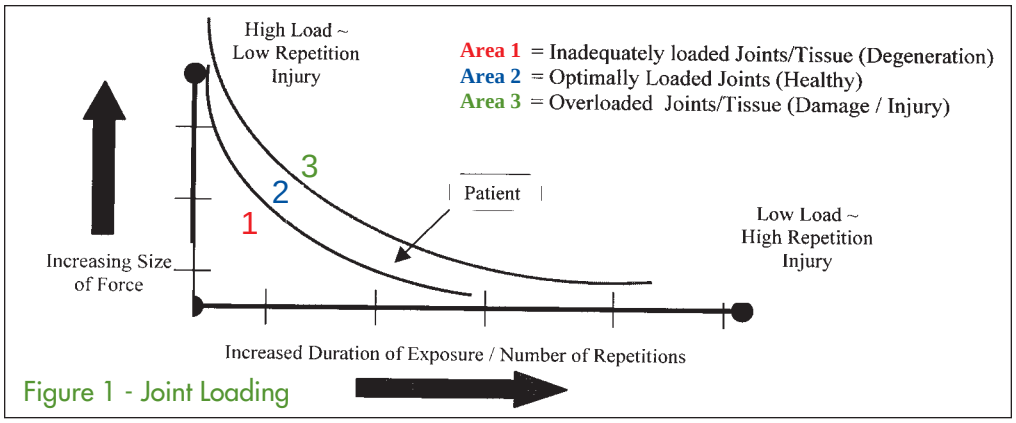


Figure 1 - Joint Loading

An inflammatory response is the body's response to an injury and can either be acute or chronic. Acute inflammation has a short onset and a short duration lasting hours to several days. Chronic inflammation has a long onset and a long duration lasting greater than six months. The International Association for the Study of Pain describes chronic pain as that which continues beyond the usual normal healing time. The cardinal signs of inflammation for a local reaction to an injury are *Redness, Swelling, Increase in Temperature, Pain, and Loss of Function.*

In order to modulate the patient's pain and control the inflammation, the physical therapist must have a keen understanding of what causes pain and precipitates the inflammatory response. Acute musculoskeletal injuries generally fall into three phases: the Acute phase, the Repair and Regeneration phase, and the Remodeling phase. The acute inflammation phase is the initial reaction of body tissue to an irritant or injury and is characteristic of the first three to four days after injury. The initial

inflammatory process imposes a number of vascular, cellular, and chemical responses that are necessary in order to prepare the injured body part for healing and repair. The second phase: the Repair and Regeneration Phase, which lasts anywhere from 48 hours post-injury up to 6 weeks, occurs when the area becomes clean through the removal of cellular debris and the beginning of tissue repair through scar formation. Remodeling of the traumatized area overlaps that of the repair and regeneration. The strength of the scar tissue continues to increase during the Remodeling Phase over a period of three months to two years after injury.

Patients typically enter physical therapy because they are in pain. Pain is one of the major indicators of the presence of an injury. Many complex factors are inherent to pain, including anatomical structures, physiological reactions, and psychological factors. Pain receptors are free nerve endings which are sensitive to extreme mechanical, thermal, and chemical energy. Pain sources can be cutaneous (skin), deep somatic (bones/joints/tendons), visceral (internal organs), and psychogenic (emotions/mind). Muscle spasms often accompany pain and create a "pain→spasm, →pain" cycle. Modalities are useful tools used by the physical therapists to minimize the deleterious effects of the inflammatory response. The nervous system is powered electrochemically. Endorphins and serotonin are two types of chemical neurotransmitters that mediate pain; both are generated by noxious stimuli.

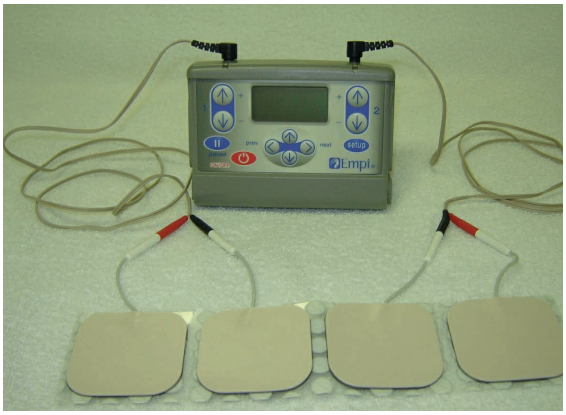
Several modalities are commonly used in the physical therapy clinic to modulate pain and control the inflammatory response; those modalities include: ice, moist heat, electrical stimulation, and ultrasound. Selection of the appropriate modality is based on a complete and accurate evaluation of the injury and a decision about which modality would most effectively reach the desired target tissue to achieve specific results. If used appropriately, modalities can be an integral part of a rehabilitation program to manage pain and inflammation in order to progress the patient from Objective 1 to Objective 2 as quickly and safely as possible. If used inappropriately, modalities can perpetuate and prolong the inflammatory response.

Ice and cold therapies are very effective treatments for acute injuries or chronic injuries that have become re-aggravated. The most commonly used cold therapy is an ice pack or gel-based cold pack. Many cold packs are specifically made for particular anatomical structures like the neck region or low back. Cold therapy is beneficial by reducing pain, swelling, removing heat, and relieving muscle spasms. When a cold object is applied to a warmer object, heat is abstracted usually through conduction. The extent to which tissue is cooled depends on the cold medium being applied, the length of cold exposure, and the conductivity of the area being cooled. In most cases, the longer an area is cooled the deeper cooling. Much of the damage done to cells after injury occurs as a result of compromised circulation due to swelling. Local swelling then decreases the amount of oxygen being delivered to the healthy cells in the area of the injury. When cold is applied to the skin for fifteen minutes or less at a temperature of 50° F (10°C) or less, vasoconstriction of the blood vessels occur. If cold is continuously applied for fifteen to thirty minutes, an intermittent period of vasodilation of the blood vessels occurs for four to six minutes. The phenomenon of vasodilation is known as the hunting response, which is a reflexive reaction against tissue damage from too much cold exposure. The immediate use of ice after injury decreases the extent of oxygen deprivation to those cells on the periphery of the primary injury by decreasing the local cellular metabolism and vasoconstriction. When applying an ice or cold pack you should also use a protective layer between skin contact and the cold pack to prevent frostbite and should be applied for up to 15 minutes.

The application of heat has been used for centuries to treat disease and traumatic injuries. More recently, its use with acute injuries has been replaced with applications of cold therapies. There are still many unanswered questions about the how heat produces a therapeutic effect. Like a cold pack, superficial heating modalities transfer heat through conduction by increasing the subcutaneous temperature and indirectly spreading to deeper tissues. When applied at the same temperature, moist heat causes a greater indirect increase in deep-tissue temperature than dry forms of heat. For a physiological response to occur, heat must be absorbed into the targeted tissue, causing an increase in molecular activity. The desired therapeutic effects of heat include increasing extensibility of collagenous tissues, decreasing pain perception, decreasing joint stiffness, reducing pain, relieving muscle spasms, and increasing blood flow. Heat has been most beneficial in relieving pain for those patients that have pain and muscle spasms caused by joint stiffness and inelastic muscles. Muscle spasms caused by ischemia, a lack of local blood flow, can be relieved by heat, which increases the blood flow to the area of injury. Moist heat is a commonly used form of heat therapy in the physical therapy clinic. Commercial moist heat packs, sometimes called hydroculator packs, contain silicate gel in a cotton pad. The packs are immersed in thermostatically controlled hot water at a temperature of 160°F (71°C). Each pad retains water and a constant heat level for twenty to thirty

Picture 1: Ice Packs

Picture 2: Moist Heat Pack



Picture 3: Electrical Stimulation

Picture 4: Therapeutic Ultrasound

minutes. The primary value of the moist heat pack is helps with general relaxation and reduction of the pain-spasm-ischemia-hypoxia-pain cycle. The limitations of the moist heat pack and other forms of superficial heating modalities is that the deeper tissues, including muscles, are usually not significantly heated because the heat transfer from the skin into the deeper tissues is inhibited by subcutaneous fat.

Electrical Stimulation (ES) in physical therapy takes many forms; however, Transcutaneous Electrical Stimulation (TENS), and Interferential Electrical Stimulation are the two most commonly used electrical modalities for pain modulation and inflammation control. Therapeutic ES utilizes a electrical signal generator that sends an electrical current to pairs of electrodes that are placed in proximity to the injured tissue. An electrical current applied to nerve tissue at a sufficient intensity and duration to reach that tissue's excitability threshold will result in a firing of that nerve. There are three major types of nerves: sensory, motor, and pain. As current intensity of the ES device increases the excitability threshold will be reached first for sensory nerves, then for motor nerves, and then for pain mechanism nerves. Electrotherapeutic devices can generate three different types of electrical current, which, when introduced into biological tissue, are capable of producing specific physiological changes. These three types of current are alternating current, direct current, and pulsed current. Current parameters can be further modified by waveform, modulation, intensity, duration, frequency, polarity, and electrode setup. Electrotherapeutic modalities accomplish pain control by the stimulation of sensory nerves in the involved area to "override" the painful response to the brain by stimulating sensory nerves without stimulating pain generating receptors and nerves. We override painful responses instinctively when we rub our finger after it has been injured (smashed with a hammer). ES can be very beneficial in the early stages of inflammation to reduce pain and spasm.

Therapeutic ultrasound is a widely used modality in the physical therapy setting. Ultrasound is defined as inaudible, acoustic vibrations of high frequency that may produce thermal or non-thermal physiological effects. The primary piece of equipment used is a high-frequency generator, which provides an electrical current to a transducer contained in the applicator wand. In the transducer are synthetic crystals that possess piezoelectrical properties that causing expansion and contraction of the crystals when electrical current passes through them. The expansion and contraction generates an ultrasonic sound wave. Used as a thermal modality it will help improve the extensibility of tight and restricted joint capsules and muscle tendons. Thermal ultrasound treatments can penetrate the surface of the body by up to 5 centimeters, deeper than a superficial heating modality such as the moist heat pack. As a non-thermal modality it can be used to promote healing and tissue repair in the early stages of an injury. Ultrasound treatments typically are performed between 5-10 minutes per area treated. Tissue penetration depends on the acoustical properties of the tissue which are proportional to tissue density.

Each of the modalities described are applied directly to the injured area in order to modulate pain and control inflammation. Modalities chosen appropriately are a beneficial and integral part of a rehabilitation program. Moist heat is often provided to patients in the acute stage of their injury, because it feels better than ice. The application of heat in the acute stage will perpetuate the inflammatory process and prolong their recovery and transition from Objective 1 to Objective 2. They are not to be over-utilized and should not be the patient's primary treatment program once the patient' pain and inflammation are under control. Modalities should be used early in a patient's rehabilitation program and they should be used only as means to progress to Objective 2: The Promotion of Active Movement as quickly and safely as possible.

[1].Banton RA, Grine EL. Physical Therapy Management of the Nonsurgical Patient. *Journal of the Spinal Research Foundation;* Fall 2006:3,5.

A word of advice from our patient:

The Medical Device Identification Card (MDIC): Why You Should Carry It during Travel

By B.J. Mitchell

Modern spine surgery frequently entails the stabilization of painful or degenerating segment by a process known as spinal fusion. In most cases, titanium spacers or screws are used. Such implants may be as small as the tip of your finger or, in the case of scoliosis surgery, more than a foot long. One advantage of titanium implants is that they do not have as high a magnetic profile as surgical steel. However, if you have enough metal in you, you can still set off search magnetometers (metal detectors). Given the increased security post 9/11, security checkpoints can be found not just in airports, but also in government buildings, museums and even stadiums. Setting off a walk-through magnetometer will alert security to a possible problem with a concealed metal object. Typically, the secondary search is done with a small wand magnetometer. If the wand search is positive, further body searches are conducted. The searches can be "benign" or "aggressive," ranging from pat-downs to body cavity searches.

Patients who have undergone spinal surgery involving metallic implants often receive a medical device identification card (MDIC, Figure 1) to help with passing through metal detection checkpoints. Having the MDIC provides proof of a legitimate reason for positive magnetometer results, can help diffuse the situation, and speed your passage through the checkpoint.

A few months ago, I had to travel to Las Vegas. It was my first trip since I had several ounces of titanium implanted at the base of my spine. I had my MDIC in hand but, still, it was with some trepidation that I approached the magnetometer at BWI. And five minutes later... Left foot, right foot. Left arm, right arm. Turn around slowly while people stare... It's the Magnetometer Hokey Pokey. And I was dancing it to the

Figure 1. Front and back sides of a medical device identification card.

accompaniment of a buzzing magnetometer wand hovering at the base of my spine. I had every piece of metal taken off of me that I could possibly remove. My belt was gone. I was down to the button and zipper on my black cargo pants and the top of the pants was rolled down with the snap undone. The guard looked over the implanted medical device card and noted that the wand was not going off where he thought my implants should have been. He told me with a stern and accusing look the wand should have been going off higher on my spine. I gave some serious thought to turning around and asking him, "So you're a world famous spinal surgeon moonlighting as a TSA guard...why?" At this point he had me turning the top of my pants inside out; I was nervously looking for someone putting on rubber gloves. So, I decided to not make fun of someone who had both a gun and a pair of latex gloves at the ready. However, I did request that the guard took me to a private room if he was going to have me take off any more of my clothes in public. To this day, I do not know what persuaded the security guard. He decided to pat me down, just to make sure, and to let me through. Clearly, a valid medical device card doesn't guarantee smooth sailing through security screening; it just improves the odds.

I have found that a MDIC is also useful in crossing international borders while carrying pain medication, especially narcotic-based ones. Many countries have harsh penalties for drug runners and dealers. For example, drug smugglers are subject to the death penalty in places such as Singapore. The types and quantities of pain medication that may be needed after complex spinal surgery may be out of the ordinary. You do not want that kind of negative attention.

At least some countries (e.g. Australia) specifically ask on entry cards if the incoming visitor is carrying narcotics or other controlled substances. There is no exception for prescribed medication. Travel guides typically suggest carrying the medication in its original bottle as well as carrying a copy of the prescription. Even if you carry legally prescribed pain medications in original bottles, I have found that border authorities will sometimes question the need for the types and quantities of medication carried. In some cases, they may legally confiscate the medication or deny you entry to the country. As much of a hassle as it may sound to carry all the proof, it is well worth it. If you do not reveal that you are carrying legal pain medication, you run the risk of detection and potentially huge legal problems. These problems can include

Medical Device ID Card

continued from page 3

criminal prosecution. Your medical device identification card is critical in such situations since it acts as further proof that the medication is necessary. It also corroborates the validity of the prescription data on the original medication bottles.

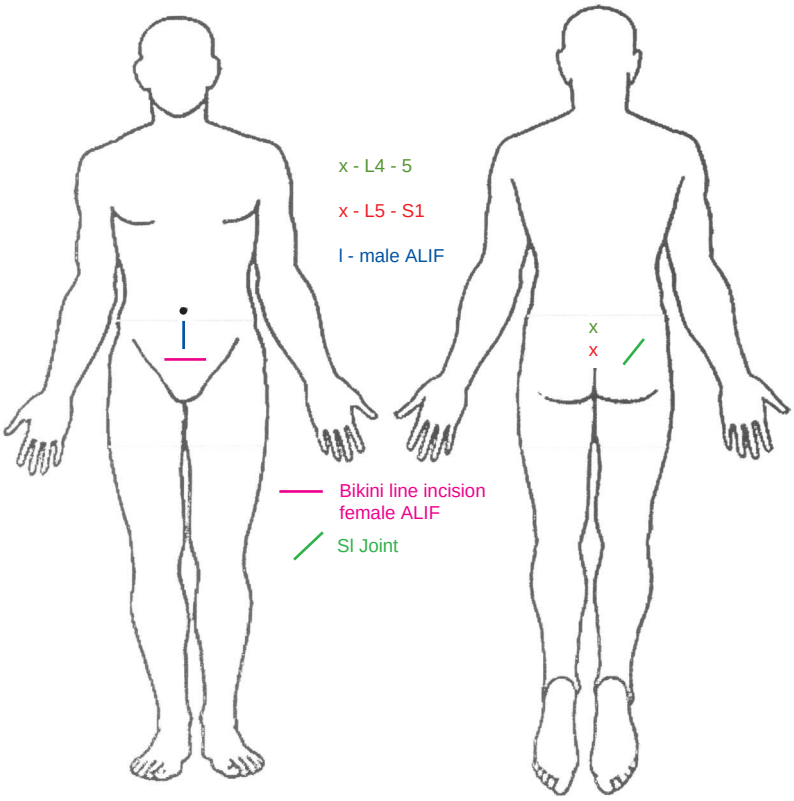
I was traveling from the United States to Australia. Like all other passengers, I had to fill out a landing card in order to pass through Immigration and Customs. One question on the card asked whether or not I was in possession of controlled substances (which include prescription pain medications). Since I was under treatment for severe back pain and taking narcotic-based pain medication, I checked the box "Yes." When going through Customs, the officer on duty took the landing card and noted the acknowledgement of possession of a controlled substance. He then asked about the nature of the controlled substance. I told him that my carry-on luggage contained both Oxycodone and MS Contin. At that point, I presented my MDIC and told the officer I had undergone L5-S1 fusion surgery and was still being treated for pain. The customs officer examined the MDIC, asked a couple of questions about the nature of the back injury, and then allowed me to pass through Customs with no further delays. It was clear to me that the MDIC made a major difference in easing my entry into the country. The MDIC provides additional documentation that you suffer from a serious medical condition and require a controlled substance to treat severe pain. It also contains a means to confirm the condition independently – the copy of the x-ray. The position of the implant on the MDIC can be correlated with a positive magnetometer result to prove the existence of a medical condition.

In conclusion, I have found the MCID to be invaluable in describing my medical condition, as would someone with a pacemaker implanted in his body. I am no longer in pain, thanks to the doctors at the Virginia Spine Institute. I can travel a little easier, thanks to my medical device identification card.

Would a security guard know where to expect the scars from spine surgery?

Scars from spine surgery may not be where a security guard might expect them. (Figure 2)

Figure 2
Locations of scars from different spine surgeries



The National Low Back Pain Study[1, 2]

By Anne G. Copay, Ph.D.

Persistent low back pain

Most individuals will have an episode of back pain at some time during their adult life. The duration of back pain episodes may be classified in 4 possible ways: transient, acute, persistent, or chronic.

Transient low back pain is a very brief pain (either discomfort or sharp pain) that tends to subside within a few days. Transient back pain does not seem to be caused by an identifiable injury and people usually do not consult a physician. Transient back pain is the most common type of back pain.

Acute low back pain is pain that resolves within 2 months. It can be one or multiple episodes of disabling back pain, with or without leg pain. Acute low back pain is often treated by primary doctors with pain medication, mobilization, and aerobic exercise.

Persistent low back pain is pain that does not subside and is not relieved by treatment. People with persistent back pain require consultation with orthopedists and neurosurgeons who are skilled in the diagnosis and treatment of low back pain. Surgical interventions are common for those patients. Persistent low back pain sufferers do not experience the behavioral, emotional and physical co-morbidities of the chronic back pain sufferers.

Chronic low back pain is pain that persists long after the diagnosed pathology has been corrected. Patients who suffer from chronic pain often become depressed, anxious, and angry. They are limited in their work, activities of daily living, and a few are even bedridden. They are often referred as "failed back syndrome" patients. Chronic low back pain sufferers require the services of various specialists.

Patients in the National Low Back Pain Study

In order to study patients with persistent low back pain, the Department of Neurosurgery at the Johns Hopkins School of Medicine conducted the National Low Back Pain Study in coordination with seven university-affiliated medical centers. The patients in the study had suffered intermittent back pain for an average of 10 years and their current pain episode for an average of 2.5 years. They had had multiple ineffective conservative treatments but no more than one prior surgical or intradiscal treatment (having more than one surgical treatment would be considered chronic instead of persistent pain). Those patients were now seeking help from specialists from orthopedics and neurosurgery. A total of 2,374 patients took part in the study. When the patients met the doctors at the study centers, it was clear that they had unremitting severe pain and neurological symptoms (Table 1).

Table 1. Proportion of patients experiencing the following symptoms

Symptoms	% of Patients
Pain in the back only	6.8%
Pain in the back and in one leg	32 .5%
Pain in the back and in both legs	27.1%
Diffuse pain throughout the lower part of the body	33.6%
Weakness in lower extremities	61.1%
Numbness in lower extremities	63.5%
Bowel and bladder dysfunction	28.0%

Treatments prior to the study

In the 12 months preceding the study, 87% of the patients visited a doctor's office because of back pain, with 13% averaging one or more visits per month. Prior to the study, the patients had already consulted a variety of specialists (Table 2). About 96% of the patients consulted at least one specialist while about 49% of them consulted four or more different types of specialists.

Patients also received a variety of treatments (Table 3) which were ineffective in alleviating their pain. Most patients with persistent back pain had incorrectly received treatment recommended for acute low back pain and a few patients had received more aggressive treatment such as surgery and narcotic drugs.

Table 2. Percentage of patients who consulted these specialists

Specialist	% of Patients
Family physician	65.5
Orthopedist	55.9
Physical therapist	50.5
Chiropractor	46.7
Neurosurgeon	39.4
Neurologist	30.7
Internist	22.4
General surgeon	17.9
Osteopath	11.2
Acupuncturist	10.2
Rheumatologist	8.6
Psychiatrist	6.1
Psychologist	5.7
Faith healer	2.0
Hypnotist	1.6

Table 3. Percentage of patients who received the following treatments

Treatment	% of Patients
Heat or cold treatment	67.9
Exercise	63.4
Massage	43.2
Chiropractic manipulation	41.3
Ultrasound	41.6
Back brace	37.7
Electrical nerve stimulation	31.8
Traction	29.0
Relaxation	21.5
Whirlpool	19.2
Surgery	17.9
Nerve blocks	16.7
Acupuncture	9.3
Back school	9.1
Nutritional therapy	8.2
Psychotherapy	6.6
Pain treatment center	6.0
Biofeedback	4.7
Body cast	2.2
Intradiscal therapy	2.2
Hypnosis	1.8

Patients' level of pain

For the majority of the patients, the average pain level is rated as discomforting to distressing and increases at the end of an active day (Figure right). At its most severe, their pain can be horrible to excruciating. They experience significant functional impairment at work, at play, and at home. They are no longer able to do as many of their usual activities and their pain is aggravated by normal activities such as walking, standing, lifting and riding in a car. They also experience sleep disruptions: they have difficulties with both falling asleep and staying asleep.

Final diagnosis

Physical examination of the patients, by itself, did not provide clear evidence identifying the causes of the persistent low back pain. For instance, less than 1% of the patients had the classic signs of disc herniation. Study physicians issued a final diagnosis after examining the patients, reviewing the patients history and diagnostic studies (X-rays, MRI, etc.), and the patients initial response to treatment. The majority of patients were given a single diagnosis but 27.9% were given two or more diagnoses. The most common diagnosis was herniated disc (36.7%), followed by myofascial syndrome (pain in muscle and connective tissue) (19.6%). About three in five patients had a diagnosis of root compression, one in five had a diagnosis of myofascial syndrome and one in five had a diagnosis of instability. Very few patients had a diagnosis of post surgical complications, but one in 10 patients who had surgery prior to the study had a diagnosis of post surgical complications.

Treatments

Study physicians prescribed one of the following treatments: no treatment, conservative care, or surgery. Three hundred twenty-two patients (13.7%) were prescribed no treatment. One thousand four hundred forty one patients (61.4%) were prescribed conservative care which consisted of physical therapy, medications, or non-surgical invasive therapies such as epidural injections or nerve blocks. Other patients had surgery which consisted of a discectomy, a laminotomy, a foraminotomy, or a fusion.

Figure 1.
Reported pain severity at study enrollment

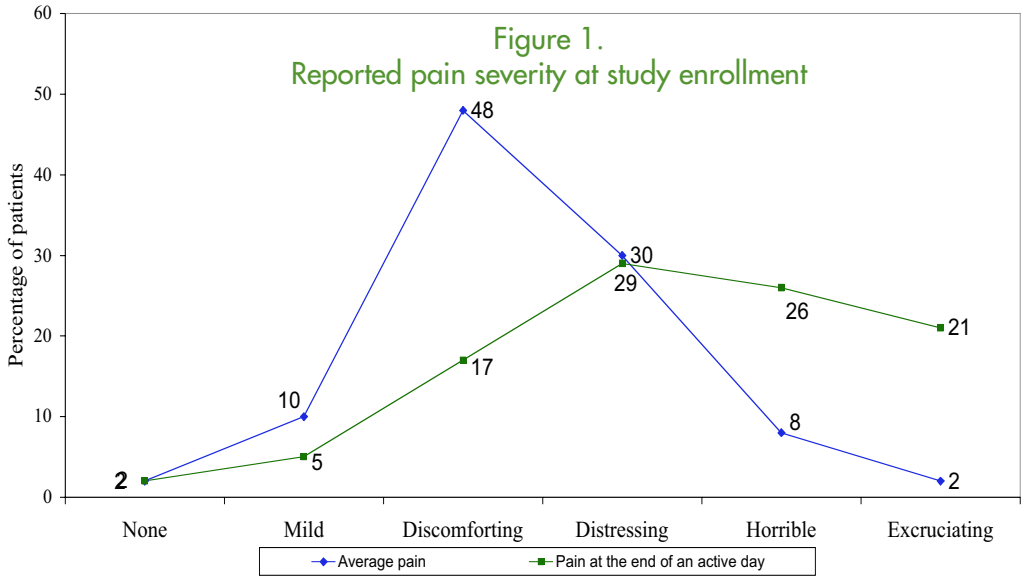


Table 4. Final Diagnosis

Diagnosis	Percentage
Root compression	**62.0**
•Herniated disc	36.7
•Spinal stenosis	14.0
•Lumbar Spondylosis	12.2
•Osteoarthritic root compression	8.7
•Nonherniated degenerated disc	6.1
Myofascial syndrome	**19.6**
Instability	**18.7**
•Spondylolisthesis	7.3
•Facet joint arthritis	4.8
•Lumbar instability	3.6
•Spondylolysis	3.1
•Compression fracture	1.9
•Spina bifida	0.5
Post surgical complications	**2.1**
•Epidural fibrosis	1.3
•Epineural fibrosis	0.8
•Arachnoiditis	0.6
Other Diagnoses	**19.1**
•Pain with undetermined etiology	8.5
•Scoliosis	3.1
•Pain with psychiatric component	2.2
•Other diagnoses	5.1

The surgery patients (331 patients or 14.1%) underwent surgery within 3 months. The outside surgery patients (128 patients or 5.5%) were not considered surgical candidates by the study physicians and were prescribed conservative care or no treatment. Those patients were advised not to have surgery by the study physicians, but were later evaluated and treated surgically by physicians outside the study.

The prescribed treatment was clearly associated with the diagnosis: 91% of the patients with myofascial syndrome were prescribed conservative care and less than 1% were prescribed surgery; half the patients with root compression were prescribed conservative care and about a third were prescribed surgery; 71% of the patients with instability were prescribed conservative care and 15% were prescribed surgery (Table 5 next page). The majority of patients who were prescribed surgery had root compression.

Results

The patients following a conservative care or no treatment plan (the majority of the patients in the study) saw only a minor improvement over the next two years. The patients who were deemed surgical candidates and underwent surgery (a small group of patients) saw their pain level reduced by half and their disability by a third soon after the surgery. The outside surgery patients remained at higher pain and disability, both before and after surgery, than

The National Low Back Pain Study

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all other patients.

Currently, there is no successful treatment for the majority of persistent low back pain sufferers. Persistent low back pain does not spontaneously remit and is minimally improved by conservative care. Surgery is a highly successful option only for a minority of patients: those who were prescribed and treated by experts. The results of surgery in patients who were not considered surgical candidates by these experts were deplorable.

1.Long DM, BenDebba M, Torgerson WS, et al. Persistent Back Pain and Sciatica in the United States: Patient Characteristics. *Journal of Spinal Disorders and Techniques.* 1996;9(1):40-58.

2.BenDebba M, Torgerson WS, Boyd RJ, et al. Persistent Low Back Pain and Sciatica in the United States: Treatment Outcomes. *Journal of Spinal Disorders and Techniques.* 2002;15(1):2-15.

Table 5.
Percent of patients in diagnosis category receiving one of three treatment types.

	Conservative care	Surgery	No treatment
Root compression	54.4	30.4	13.3
Instability	70.6	15.3	14.1
Myofascial syndrome	90.6	0.6	8.8

Figure 2. Pain severity by treatment

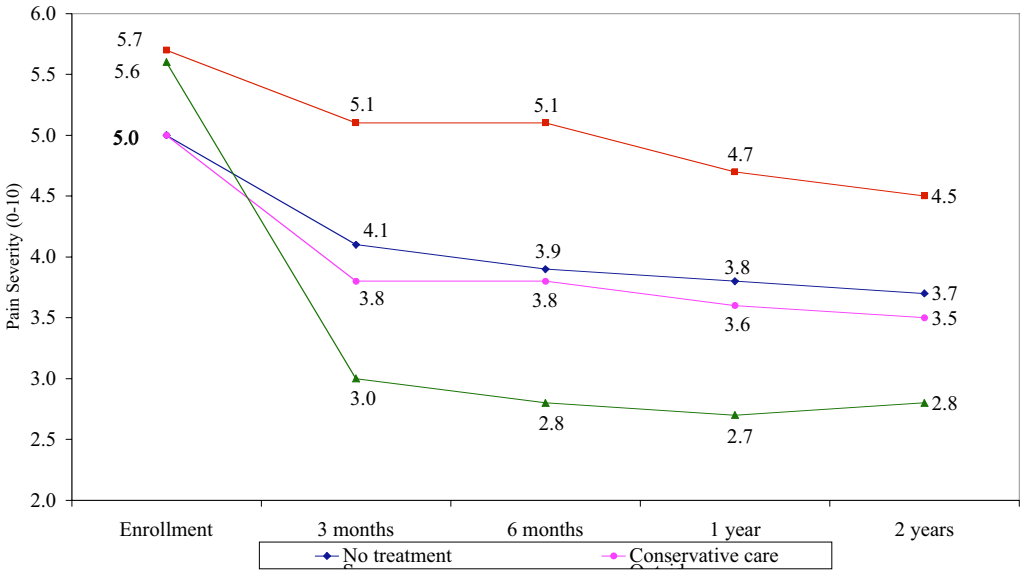
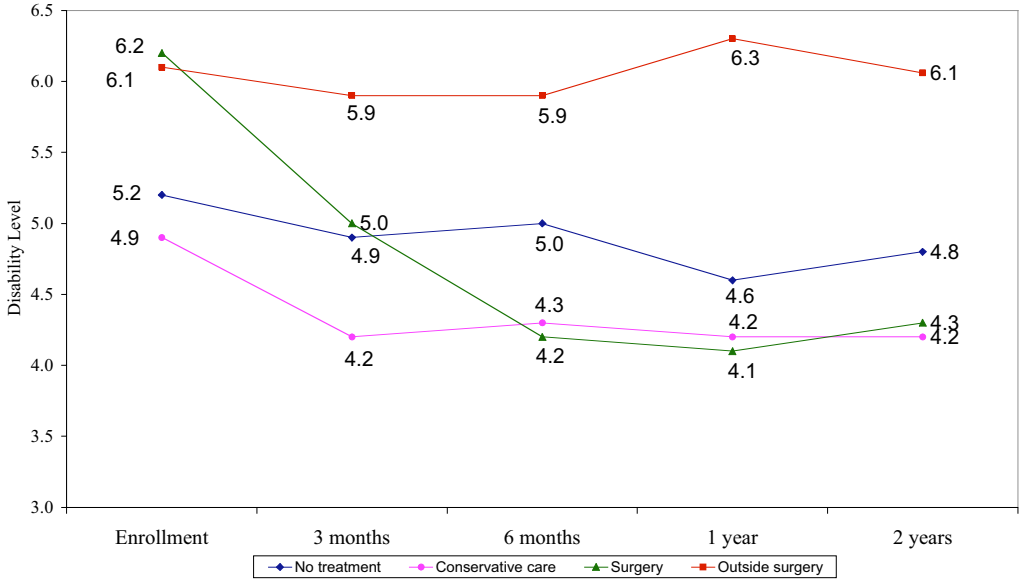


Figure 3. Functional disability by treatment



Can video games make you a better surgeon?

By Anne G. Copay, Ph.D.

Games have been a favorite past time for generations of Americans. Over the past decade, video games have been blamed for lower grades in school, aggressiveness, and lack of positive social behaviors. On the other hand, video games seem to improve eye-hand coordination, reaction time, and spatial visualization. There is now some indication that video gaming may also help surgeons in the performance of certain surgical procedures. Laparoscopic surgery allows a surgeon to use small incisions instead of a large cut as in open surgery. Patients typically recover faster after laparoscopic surgery. However, it takes specific skills to perform surgery

Surgeons performing laparoscopic surgery

laparoscopically. A miniature camera and surgical tools are inserted inside a patient. The surgeon looks at the pictures transmitted by the camera on a video screen while remotely operating the surgical instruments. In many ways, the surgeon is playing a video game of the human body (Figure 1)

The potential advantage of video gaming was tested on a simulator reproducing some of the tasks of laparoscopic surgery.[1] Surgeons had to perform a variety of tasks on the simulator. They were asked how much they played video games both in their past and currently. Their scores were then recorded while playing three video games for 25 minutes each: *Super Monkey Ball 2, Stars Wars Racer Revenge*, and *Silent Scope.*

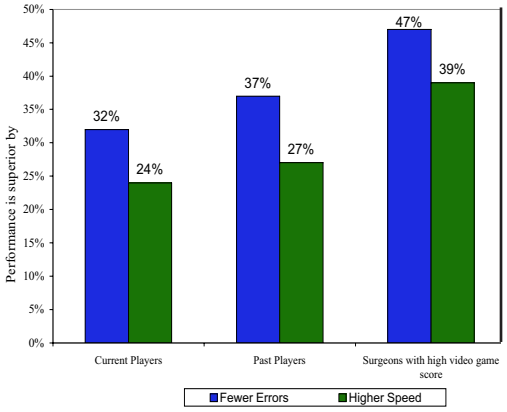
Surgeons who currently played video games made 32% fewer errors and performed 24% faster than their non-video game-playing colleagues. Surgeons who played video games in the past for more than 3 hours per week made 37% fewer errors and were 27% faster than surgeons who had never played video games. Surgeons earning the top third of scores in the video games made 47% fewer errors and performed 39% faster than the surgeons with the bottom third scores. Interestingly, the surgeons' scores on the different video games also predicted their performance on the simulator: *Super Monkey Ball 2* was the best predictor, followed by *Silent Scope,* and finally *Stars Wars Racer Revenge.*

Video gaming clearly can be used as a training tool. The U.S. Army has recognized the benefits of video games for teaching certain skills, especially the skills that may be expensive or dangerous to teach. For example, the Army uses the video game series *Rainbow Six* to teach its special operations forces the steps necessary to plan and conduct special operations missions.

In this study, over-the-counter video gaming has improved some laparoscopic skills. In the future, game controllers could be designed to resemble laparoscopic instruments and other medical devices. The content and mechanics of games could be created with the purpose of developing medically related fine motor skills, eye-hand coordination, visual attention, depth perception, and computer competency. It is not as hard as it may seem. Someday our children may be asking for a copy of the new virtual gallbladder or spine surgery.

It is remarkable that the improvement of the simulator performance was noted for surgeons who played 3 hours or more per

Figure 1.
Superiority of the performance on the simulator



week in their past. This is far less than the average of 9 hours per week for today's adolescents. School performance of adolescents and college students deteriorate with video gaming. Hence, excessive video gaming is not justified in any ways.

SImulator used to test skills of spine surgery

The Young Neurosurgeons Committee of the American Association of Neurological Surgeons have used a simulator (Medtronic Stealth Station) to test the skills of surgeons in training. These young surgeons had to insert screws on the sides of three vertebrae. This is a common procedure in spine surgery (Figure 2).

The computer software in the simulator measured how far the young surgeons diverged from an ideal trajectory. Results showed that most surgeons were a few millimeters away from the ideal trajectory. The Stealth Station (Figure 3) should also be used as a training tool to help surgeons master the ideal trajectory before ever coming near a patient.

1. Rosser JC, Lynch PJ, Cuddihy L, Gentile DA, Klonsky J, Merrell R. The Impact of Video Games on Training Surgeons in the 21st Century. *Archives of Surgery*. 2007;142:181-186.

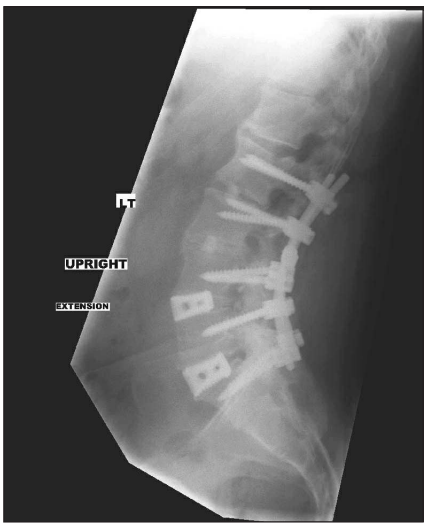


Figure 2. Back and side views of screws inserted in vertebrae.

Simulator used to test skills of spine surgery

Life-saving Devices Donation to Russian Hospital

The Spinal Research Foundation, the Princeton Brain and Spine Care, and Integra LifeSciences Corporation have joined forces to donate life-saving medical devices to doctors in Russia. A donation of needed instruments was made in March 2007, at the University Medical Center on the Princeton campus. Dr. Mark McLaughlin, the medical director at Princeton Brain and Spine care, made the donation to Victor Rudenko, MD, PhD, chief of the Department of neurotraumatology at St. Petersburg Institute for Trauma in Russia. The spine and brain shunts alleviate fluid pressure build-up on the brain and spine, a condition that is fatal or severely debilitating if left untreated. The shunts, prohibitively expensive in Russia, will enable surgeons to treat people who would otherwise not have access to the critical device.

Dr. McLaughlin first visited Russia in 1997. He discovered a healthcare system with antiquated technology and physicians who were under-appreciated and struggling to save lives. Since this time, a lasting bond of friendship and collaboration between the Russian doctors and the supporting groups in the USA has forever changed the way neurosurgery is performed in Russia.

"We are thrilled to be able to facilitate this donation of Integra medical devices as a way to further forge our bond with Dr. Rudenko and his Russian colleagues", said Dr. Brian Subach, Director of Research for the Spinal Research Foundation. "We fully intend to continue our support for many more years to come." The Spinal Research Foundation is a non-profit national organization dedicated to the improvement of spinal health care through research and education.

"Through generous support from the Spinal Research Foundation and Integra, Dr. Rudenko and I can continue to build our Neurosurgical Bridge between the United States and Russia. The shunts will save lives and make people whole again. Our project is a wonderful example of how great things can be achieved through selfless collaboration and generosity to pursue a common goal of improving neurosurgical and spine care in the world."

From left to right: Dr. Victor Rudenko (St. Petersburg Institute), Dr. Mark McLaughlin (Princeton), Stuart Essig (CEO Integra Life Sciences)

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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 the medical profession and the general public to improve the overall quality and understanding of optimal spinal health care.

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