Fall 2006

Journal of the Spinal Research Foundation

The Journal of the Spinal Research Foundation

A multidisciplinary journal for patients and spine specialists

From the Editor

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

Welcome to the fall edition of the Journal of the Spinal Research Foundation. Our first year has been one marked by growth and expansion, not to mention a few growing pains. 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 our ongoing research projects. Now we quite simply do not have enough room to print everything that needs to be printed.

I would like to take a moment to first thank the two groups who matter most in the cause: our patients and our donors. Without our patients and their participation in the collaborative efforts of the research teams, there would be no progress. Not only do they remain the primary reason for doing the work that we do, but they also contribute immensely to the data collection process by filling out endless outcomes forms and submitting to routing testing long after they have seemingly healed. Second, I would like to acknowledge our corporate sponsors and private donors. Based upon their continued generosity, our research budget is rapidly expanding to allow for additional project funding and hiring of additional research personnel.

The upcoming 2007 is just around the corner and it promises to be very exciting for the Spinal Research Foundation. We have expanded our dual mission of research and education to include teaching of underserved areas in the healthcare community. Rather than taking our message directly to the masses of people afflicted by spinal disorders, we have adopted a more top-down approach. By speaking to the healthcare providers and updating them as to the newest successes in both non-operative and surgical care, we hope to improve our efficiency in getting our message across. Generally in the form of lectures, case presentations and informal discussions, we are finding great success in transforming knowledgeable physicians into spinal care specialists. This method has worked for us in both hospital based forums and corporate health maintenance arenas.

We have included in this issue an outstanding array of articles covering outcomes research, basic disease processes and treatment advances. Based upon feedback from our donors, we have also a new column titled "Spine Tale". The piece, a permanent addition to our format, will tell the story of one of our patients who has undergone an intervention based upon the efforts of the Spinal Research Foundation team. The names are real, as are the stories. It gives the reader a more tangible insight into what we see every day in our patients. When you place a face on the research efforts, the effort seems that much more valuable.

Spine Tale

Eileen McDougall did not realize how much her life could change that February day in 2003. She was working as a second grade teacher in the Fairfax County Public School system. It should not have injured her back, but it did. Carrying too many things at once, as we all do, she bent forward at the waist and twisted to reach for a door handle. She had done the same thing a hundred times before. She knew it was different this time when she simultaneously heard and felt the pop in her low back. The sudden, sharp pain in her spine and the flood of warm aching into her legs made her both gasp and freeze where she stood. As she simply stood and breathed, she figured that it was a little muscle strain. Her back was sore but she was able to make it home. A nice warm shower and a little ibuprofen seemed to help. She would surely be better in the morning.

Inside Eileen's body, things were not nearly as calm. The popping sensation had been caused by a tear in the annulus of her

Eileen after surgery

lumbar L4-L5 disc. The basket-weave of collagen surrounding the disc had ripped apart, failing partly as a result of the bending, but also as a result of the years of progressive damage to the disc. The tissues in the area were swelling rapidly and the toxic inflammatory substances from her bloodstream were already starting to irritate the surrounding nerves destined both for her back and her legs. For the next three years, a battle between inflammation and repair would rage inside her spine until Eileen simply could not take the pain any longer.

None of the doctors seemed to realize how bad the pain was. "Here try this medication" they said. "Maybe a little more physical therapy will help" they hoped. Nothing seemed to work. The more she exercised, the worse the pain became. "I am afraid to give you the strong pain medications. Don't want you to get addicted" the doctors warned. She could not stand, she could not sit, and she could not even sleep. How could she possibly be expected to teach her students or be a wife or a mother?

At the time (her injury had occurred in 2003), there were doctors and scientists already hard at work developing a cure for her back pain called BMP or bone morphogenetic protein. When spinal discs are damaged beyond repair, this protein can be gently tucked into a protective cage, inserted

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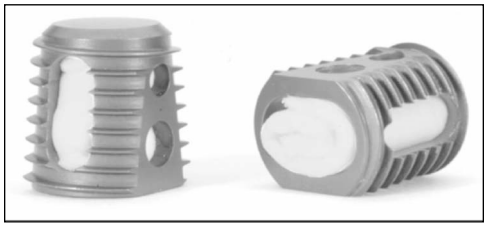
X-ray of Eileen's spine before surgery

Spine Story
continued from page 1

into the spinal disc space, and the bones will actually grow across the area of damage (fusion). In Eileen's case it was the L4-L5 lumbar disc. Her MRI and x-rays clearly showed the problem, while she suffered.

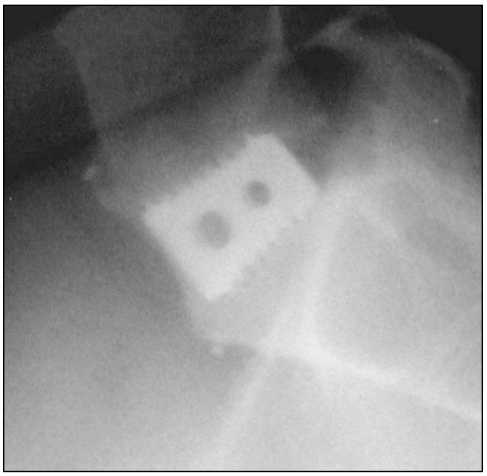
When Eileen met the specialists at the Virginia Spine Institute, her pain was so severe that she had to lie down with her knees bent to simply speak. Dr. Thomas Schuler and his colleagues had seen her problem hundreds of times before. Her disc would never heal on its own, even with time, rest and medications. Surgery would normally seem like a scary prospect, but she was actually more afraid of trying to live with this pain. The procedure, called an anterior lumbar interbody fusion (ALIF) would remove the rapidly deteriorating disc in her spine and replace it with two BMP-filled protective cages. It would immediately stop the grinding pain she felt and would actually heal the lumbar bones together as one in a period of months. The surgeons would previously have chiseled pieces of bone from the pelvis to place into the cages, but since BMP became available that was no longer necessary, she was relieved to hear.



The titanium implants with BMP placed in Eileen's spine

In just over an hour, her surgery was done. Eileen does not recall much about that day. Bright lights, faces with masks, far away voices, but most of all a great sense of relief that hopefully it was finally over.

She knew while lying in her hospital bed that things had changed. She felt different, her back stronger. No longer was she expecting the next breath to lead to paralyzing pain. Of course there would be physical therapy, medications and some discomfort, but for the first time in three years she had hope for the future.



X-ray of Eileen's spine after surgery

Six months later, Eileen McDougall returned to the Virginia Spine Institute a different woman. She still walks a little more cautiously than she did before her injury. She bends her knees carefully when she picks up things off the floor. She is no longer afraid of surgery, because she has seen first-hand what surgery and scientific research can do. She actually looks forward to each coming day. Thank goodness for the people who developed BMP and had the foresight to have it ready when she needed it. Eileen is glad to discuss your second grader's performance in her class or how her life was changed in February 2003 and given back to her in 2006.

Update on the Spine Patient Outcomes Research Trial (SPORT)

By Mark R. McLaughlin, M.D.

Initial results from the National Institutes of Health's (NIH) Spine Outcomes Research Trial (SPORT) were presented at the International Society for the Study of the Lumbar Spine 33rd Annual Meeting. The SPORT study compares the effect of surgery to conservative treatment for 3 conditions: lumbar herniated disc, spinal stenosis (narrowing of the spinal canal), and degenerative spondylolisthesis (forward slip of the vertebra). The SPORT study examines several outcomes: Bodily Pain, Physical Function, Disability Index, sciatica pain, satisfaction with symptoms, and self-rated improvement.

Results were presented for the treatment of lumbar herniated disc. A group of 501 patients were treated by 142 physicians at 13 sites in 11 states; this constitutes a nationally representative sample of patients diagnosed with disc herniation. After one year, the patients treated with surgery had improved more rapidly and achieved greater symptom relief and functional improvement than the patients treated non-operatively. Furthermore, 29% of the patients who were treated non-operatively opted to undergo surgery after 3 months of unsuccessful non-operative treatment.

These results are a clear indication that surgery is a very effective treatment of disc herniation. A herniated disc compresses nerve roots and creates pain, numbness, and weakness down the leg. When non-operative treatment fails to relieve pain, surgical removal of the herniation is a viable treatment option, now with multi-center validation.

Physical Therapy Management of the Nonsurgical Patient

By Richard A. Banton, DPT, ATC, and
E. Laurence Grine, MSPT, ATC
Virginia Therapy & Fitness Center, PLC

When the complete spectrum of physical therapy treatments for spine disorders is carefully analyzed, each intervention is designed to achieve one or more of the following objectives:

Objective 1: Modulate pain and control inflammation

Objective 2: Promote active movement by the patient as quickly and safely as possible with manual therapy techniques or controlled exercises

Objective 3: Enhance neuromuscular performance

Objective 4*:* Educate patient in the form of biomechanical counseling

Identifying the appropriate objective for each patient determines how quickly a patient can achieve a full recovery. Most poor outcomes in physical therapy are directly related to the therapist incorrectly diagnosing the patient, choosing the wrong objective to begin the plan of care, and therefore choosing the incorrect intervention for the patient's condition. Let's define each objective to form a better understanding of physical therapy interventions.

Objective 1: Modulate pain and control inflammation.

(Examples of interventions: ice, ultrasound, electric stimulation). Patients typically enter physical therapy because they are in pain and seek relief. The challenge, however, is determining whether pain modulation and inflammation control is the treatment goal itself or simply a strategy to move the patient quickly and efficiently to another objective. The first step towards selecting the appropriate intervention is identifying whether the patient's condition is acute or chronic. Acute conditions would benefit from Objective 1 interventions while chronic conditions respond best to Objective 2 or 3 interventions.

Objective 2: Promote active movement by the patient as quickly and safely as possible with manual therapy techniques or controlled exercises.

(Examples of interventions: massage, manual traction, mobilization, manipulation, active exercise). The effect of applying manual therapy, massage, or exercises to the musculoskeletal system achieves the following results:

1. *Reduce swelling and inflammation*- swelling and edema are some of the ways in which fluid accumulation results in mechanical distortion of tissues and creates chemical irritation to an injured area.
2. *Alter pain perception*– pain perception is amplified by muscle tension. Manual therapy decreases pain by relieving muscle tension.
3. *Modifying connective tissue*- muscles and fascia can restrict joint mobility and quality of movement. The experienced manual therapist must identify limitations of these tissues and use appropriate techniques to restore them to their normal state.

Objective 3: Enhance neuromuscular performance.

(Examples of interventions: strengthening exercise, stabilization programs, aerobic conditioning**).** Scientific evidence supports the belief that aerobic exercise and strengthening activities are beneficial for patients with spine disorders. The adaptations can be seen as change in muscle size, increase in muscle power and endurance, or improved balance, speed, and coordination. When chosen inappropriately interventions associated with this objective often reinjure patients creating more tissue damage and chemical irritation to the injured area.

Objective 4: Educate patient in the form of biomechanical counseling.

(Examples of interventions: patient education, videos). It is important that the therapist begin to teach the patient to take an active role in managing their spine disorder. An understanding of the pathomechanics of injury is important for the clinician to understand and then share with the patient, using common, understandable terminology, in an educational process that takes the form of biomechanical counseling.

Successful Outcome Using the Physical Therapy Objectives

A 37 year old female patient was evaluated in physical therapy for low back pain and a diagnosis of lumbar herniated disc. This patient had been injured in a yoga class four months ago while performing an exercise. The patient had attended physical therapy at another facility for four weeks without success. In fact, she stated that her pain had increased since beginning physical therapy. Her physical therapy at that time consisted of mechanical traction, ultrasound, and performing spine range of motion exercises.

Upon completion of our evaluation, we concluded that this patient had normal strength, sensation, and neural mobility. These findings were inconsistent with a pain emanating from a lumbar herniated disc. We also determined that she had poor mobility of the sacroiliac joint (SI) and at the left facet joint of one level (L4-L5) of her lumbar spine. These findings were very consistent with the lower back symptoms she was reporting.

When selecting the appropriate physical therapy objective, we needed to consider if the patient's condition was acute or chronic. The original injury occurred four months ago, but had the patient re-injured her spine during her previous physical therapy sessions? The patient's previous physical therapy had been relatively ineffective, consisting of mechanical traction, modali-

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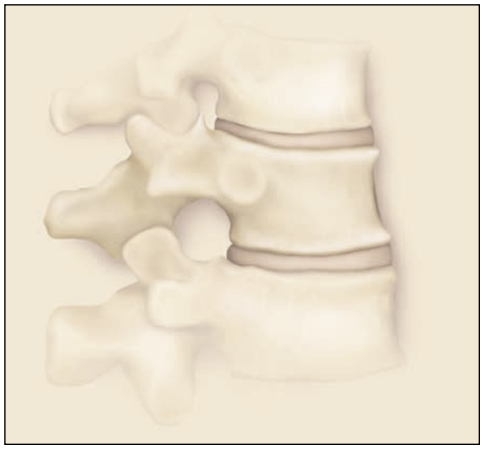
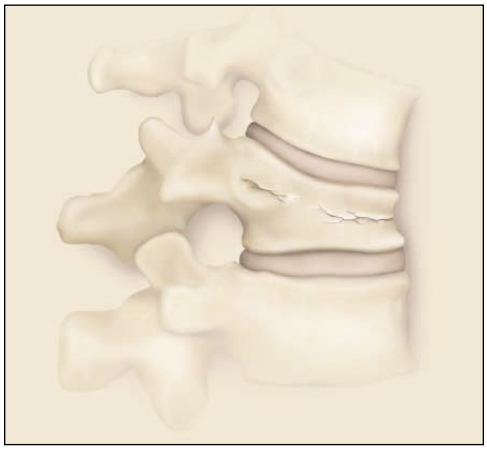
Research Note: The Relative Advantages of Vertebroplasty and Kyphoplasty for the Treatment of Vertebral Compression Fractures: The KAVIAR Study

Vertebral compression fractures (VCF) occur in 26% of women 50 years old and older. Osteoporosis is the most common cause of VCF, but VCF can also result from trauma and tumors. Only one third of VCF are painful and do not respond to medical management such as immobilization and pain-killers. Furthermore, a fracture in one vertebra increases the risk of fracture in adjacent vertebrae. The compressed vertebra causes loss of height in the spine. VCF in multiple vertebrae leads to the typical hunched posture (kyphosis), loss of height, and potential pulmonary complications.

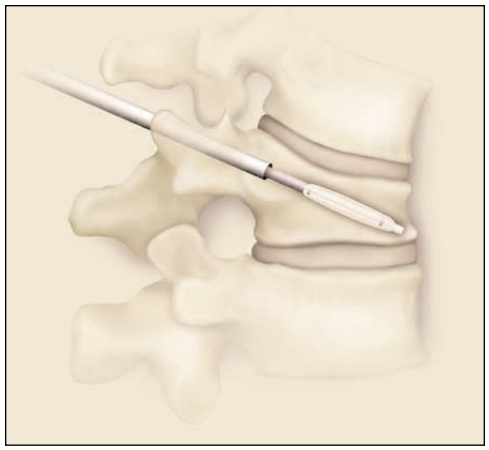
Vertebroplasty, which started in 1984 (1995 in the US), consists of filling the fractured vertebra with acrylic cement. It has been reported that vertebroplasty successfully relieves pain in 85% to 90% of patients. The acrylic cement fuses the pieces of the fractured vertebra, preventing painful motion of the bone fragments. The cement also strengthens the osteoporotic bone and decreases the chance of repeat fractures. Vertebroplasty is not indicated in cases of bone infections or in situations



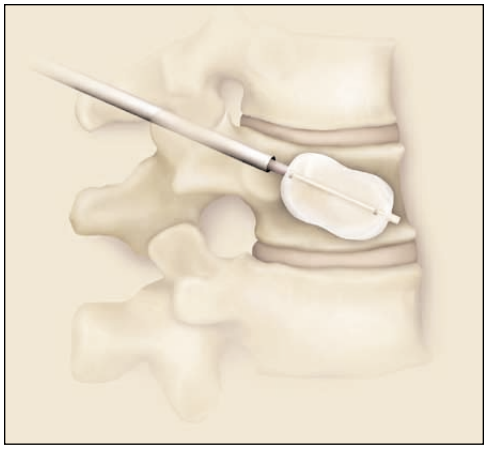
Normal vertebra



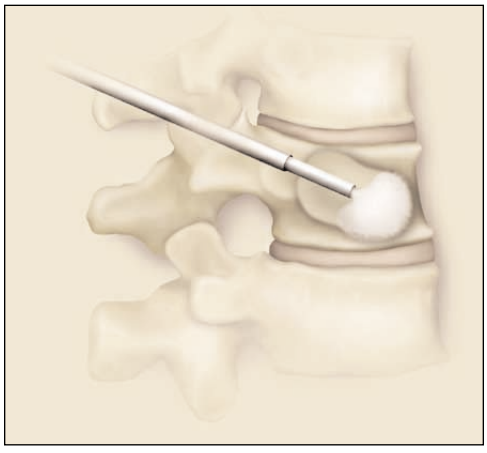
Compression fracture



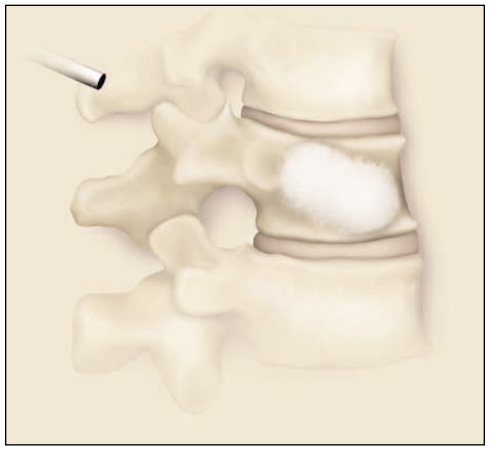
Balloon is inserted



Balloon is inflated then removed



Cavity is filled with cement



Cement hardens and supports the bone

Kyphoplasty was developed in 1998 as a refinement of vertebroplasty: the height of the compressed vertebra is regained by inserting and inflating a balloon in the vertebra before filling it with cement.

where the acrylic cement could leak into the spinal canal, such as burst fractures.

Kyphoplasty was developed in 1998 as a refinement of vertebroplasty: the height of the compressed vertebra is regained by inserting and inflating a balloon in the vertebra before filling it with cement. The added advantages of kyphoplasty are the prevention of kyphosis and loss of height. Kyphoplasty could also decrease the risk of fractures to adjacent vertebrae.

A study comparing the effects of vertebroplasty and kyphoplasty began in the summer 2006. The study is named KAVIAR (Kyphoplasty And Vertebroplasty In the Augmentation and Restoration of vertebral body compression fractures) and will follow more than a thousand patients at 75 sites across the US and Canada. Patients will be followed for 2 years and the following results will be studied: rate of subsequent vertebral fractures, change in back pain and back function, physical function and quality of life, change in vertebral body height and angulation, change in sagittal vertical axis, serious adverse event, VCF-related health care utilization.

Physical Therapy Management, *continued from page 3*

ties, and spine range of motion exercise. Most of these interventions were directed towards *Objective 1* **(Modulate pain and control inflammation).** If a more comprehensive evaluation had been completed by the first physical therapists, they would have realized that the patient's pain was due to lost mobility in the SI and lumbar facet joints. Instead the therapists only treated the patient's pain and inflammation from lost mobility, but not the true source of her dysfunction. A common mistake made in physical therapy clinics is failure to recognize when interventions are not effective. After two weeks using Objective 1 interventions, the therapists should have reevaluated the patient. Instead, they continued with the same plan of care without success.

Our choice for beginning this patient's plan of care was ***Objective 2*** **(Promote active movement by the patient as quickly and safely as possible with manual therapy techniques or controlled exercises).** Although the patient was performing active spine range of motion exercise, the exercises were not specific for the joints that had lost mobility. This patient required manual therapy techniques to the SI joint and to the lumbar facets to help restore their normal mobility. Manual therapy techniques are often excluded in physical therapy because they are either too time consuming or the therapist lacks the expertise to perform them. It is important that your physical therapist has an understanding of these techniques, but more importantly that they know when to perform them.

After three sessions of manual therapy, massage, and active range of motion it was time for the patient to begin ***Objective 3*** **(Enhance neuromuscular performance).**

As stated above, this objective is often chosen at the wrong time. Normal joint mobility must be present for the body to respond to interventions for objective 3. Since the patient was demonstrating normal SI and lumbar mobility with a decrease in pain it was appropriate to enhance neuromuscular performance. A stabilization program was chosen for this patient based upon her poor abdominal control. She performed these exercises for three additional sessions and continued to perform them as part of her home exercise program.

After completion of 6 visits this patient was 90% pain free. She had received no relief prior to her evaluation a*t Virginia Therapy and Fitness Center* because her treatment was focused upon the wrong objective. Each patient is different, and therefore interventions need to be individualized to meet the patient's desired outcome. The objectives of physical therapy management need to be considered and organized accordingly when evaluating a patient.

The Art and Science of Back Pain Diagnosis

By Anne G. Copay, Ph.D.

Blood pressure is easily measured and high (or low) blood pressure is rapidly identified. Similarly, diabetes may be detected with a simple blood test. On the other hand, identifying the source of back pain is not such a straightforward process. It is difficult to pinpoint the source of back pain due to the fact that the many structures that can cause pain are in close anatomical proximity. Furthermore, the results of the tests used to identify back pain are equivocal. For instance, no abnormalities may be found on the x-rays and magnetic resonance images (MRI) of patients who are in pain, while abnormalities are often seen in patients without pain

MRI is used to detect abnormalities of the soft tissues such as intervertebral discs. The following figures illustrate the spinal abnormalities that can be identified with MRI.

Researchers selected 148 outpatients at the Veterans Affairs (VA) hospital in Seattle, Washington. Those patients never had back surgery and had not suffered from back or leg pain (sciatica) over the past 4 months. Their age range was 36 to 71 years old and the majority of them were white males. Forty seven percent of the patients had never experienced any back pain in their lifetime, 39% had experienced back pain up to five times in their lifetime, and 15% had over 5 episodes of back pain in their lifetime. MRIs were performed on all the patients. Some abnormalities are visible on the MRI pictures of the great majority of the patients and are more frequent in the older population.

Disc degeneration was present in 98% of the patients (The researchers defined disc degeneration as the combination of one or more observations: dessication, height loss, and bulging). Disc dessication (loss of water) was the most common disc abnormality, found in 91% of all patients while disc bulge and loss of disc height were found in more than half the patients. The occurrence of most of the disc abnormalities

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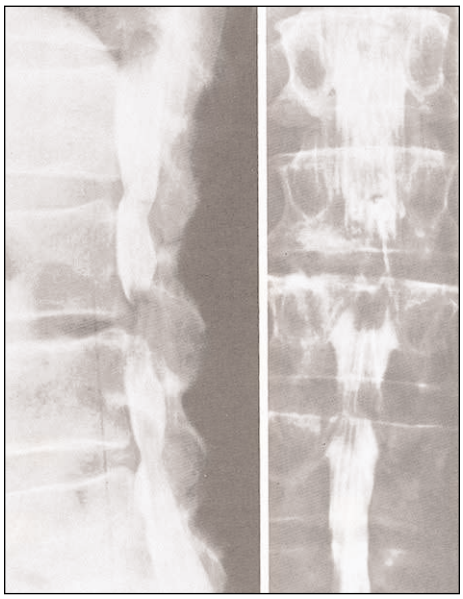
MRI findings by age groups

MRI findings	All 148 patients	< 45 yr 31 patients	45-55 yr 53 patients	55-65 yr 35 patients	65 yr 29 patients
Disc degeneration	134 98%	24 77%	49 93%	32 91%	29 100%
Disc dessication	123 91%	20 65%	42 79%	32 91%	29 100%
Bulge	95 69%	14 45%	34 64%	23 66%	24 83%
Loss of disc height	83 60%	13 42%	27 51%	23 66%	20 69%
Annular Tear	56 45%	12 39%	19 36%	13 37%	12 41%
Protrusion	48 37%	9 29%	18 34%	11 31%	10 35%
Endplate changes	39 24%	1 3%	9 17%	15 43%	14 48%
Facet Degeneration	27 19%	0 0%	4 8%	12 34%	11 38%
Spondylolisthesis	26 18%	2 6%	5 9%	9 26%	10 35%
Stenosis	15 7%	2 7%	3 6%	4 11%	6 21%
Extrusion	9 5%	0 0%	6 11%	2 6%	1 3%
Nerve Compression	5 3%	0 0%	2 4%	1 3%	2 7%

Incidence increases with age.



Stenosis. The white column is the spinal cord. Interrupted parts represent areas of spinal cord compression

Disc Hernia. One disc protrudes in the back of the vertebra.

MRI findings by the occurrence of pain in lifetime

MRI findings	All 148 patients	Pain never 69 patients	Pain 1-5 times 57 patients	Pain >5 times 77 patients
Disc degeneration	134 98%	60 87%	53 93%	21 96%
Disc dessication	123 91%	55 80%	47 83%	21 96%
Bulge	95 69%	42 61%	37 65%	16 73%
Loss of disc height	83 60%	34 49%	35 61%	14 64%
Annular Tear	56 45%	26 38%	21 37%	9 41%
Protrusion	48 37%	18 26%	22 39%	8 36%
Endplate changes	39 24%	17 25%	28 16%	6 27%
Facet Degeneration	27 19%	12 17%	11 19%	4 18%
Spondylolisthesis	26 18%	13 19%	10 18%	3 14%
Stenosis	15 7%	5 7%	5 9%	5 23%
Extrusion	9 5%	1 1%	1 2%	7 32%
Nerve Compression	5 3%	1 1%	2 4%	2 9%

Clear association with pain, Some association with pain

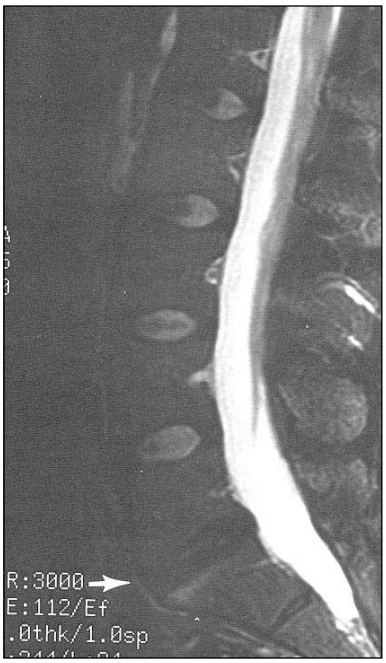
Spondylosthesis: The vertebra marked by the arrow has slipped forward.

increased with age, so that disc degeneration was present in all patients older than 65 years.

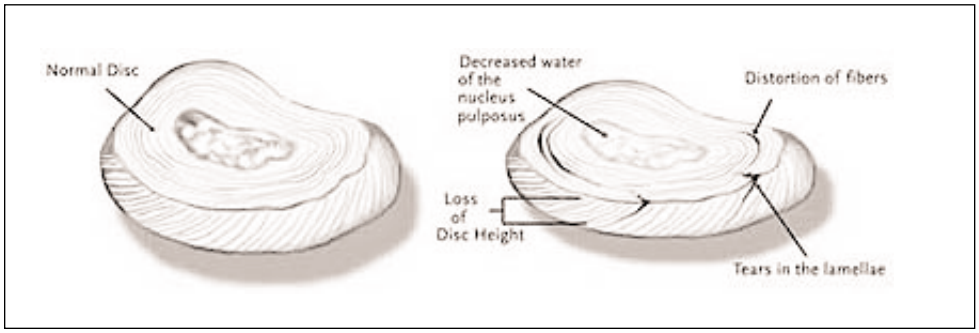
The presence of abnormalities on the MRI does not necessarily imply pain for the patient. For instance, 87% of the patients who never had back pain still had signs of disc degeneration. Three discs abnormalities were clearly related to back pain: disc extrusion, nerve root compromise, and stenosis: a greater proportion of patients with these disc problems reported more than 5 episodes of back pain in their lifetime. Also, compared to patients who never had back pain, a greater proportion of patients reported back pain when they had the following discs problems: degeneration, dessication, loss of height, and protrusion.

Of the 148 patients, 131 were contacted again after 3 years and 123 returned for repeat MRI. Sixty seven percent (88 of 131) had some episode of back pain over the course of the 3 years. None of the abnormalities on the initial MRI clearly predicted the incidence of new back pain. Nerve root compression or spinal stenosis on the initial MRI was somewhat related to new back pain. Few new abnormalities were found on the repeat MRI: 5 new disc extrusions, 4 new nerve root compression, and 2 new central stenosis. However, all the patients with new abnormalities experienced pain.

Spinal abnormalities detected on MRI are thus not necessarily the cause of back pain nor do they predict future back pain. This lack of certainty about the causes of back pain means that the skill, knowledge and experience of the healthcare giver are important factors in the determination of appropriate care.



Disc Degeneration. The disc at the arrow appears darker that the healthy discs on the MRI



Loss of water in the center and tear in the outer ring of disc

Back Pain in the Early Stages of Occupational Life

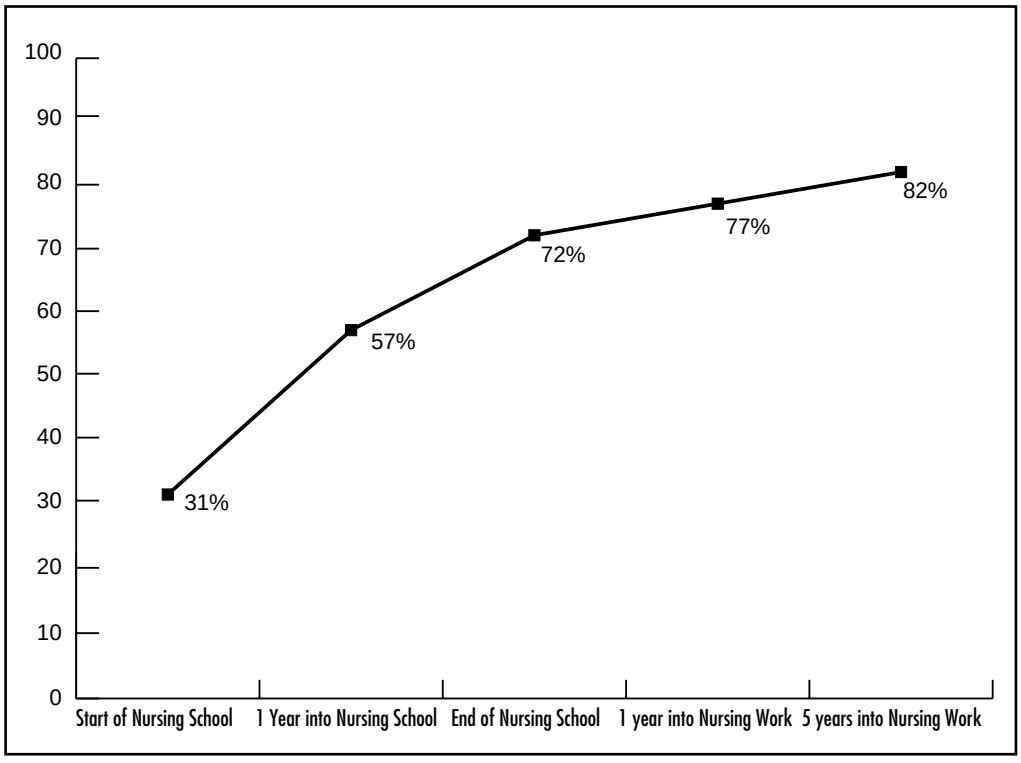
By Anne G. Copay, PhD

Very little is known about the development of back pain between adolescence and early professional life. Back pain prevalence seems to double in this relatively short time period.

Many factors are considered a source of back pain, such as, occupational heavy lifting, sedentary work, working in twisted and bend postures, whole-body vibration, poor fitness, smoking, obesity, low body weight, and number of children. Some of those factors are contradictory (sedentary versus physically demanding jobs), some are linked to growing old, and still others depends on our occupation. A study[1] followed a group of adolescents through an important life phase: the end of schooling and the beginning of a working life. Specifically, the study followed 4 classes of nursing students from their start at a nursing school in Helsinki, Finland. The students entered the nursing school, generally right out of high school. They stayed for 2.5 years at the nursing school then entered the workforce. The study followed the students throughout nursing school then sent the students questionnaires at 1 year and 5 years after the end of nursing school.

One surprising finding from the study was the fact that many students had already experienced back pain before nursing school. The incidence of back pain increased dramatically as the years went by. The lifetime cumulative prevalence of back pain increased from 31% before starting nursing school to 57% during the first year of nursing school. At the end of the nursing school, the lifetime prevalence of back pain reached 72%. After 1 year in the nursing profession, the lifetime prevalence was 77% and after 5 years 82%! About one fourth of the nurses reported back pain at each time period and could be considered as chronic back pain sufferers. About one eighth of the nurses did not report any back pain at any point in time and would be consistently free of back pain. All other nurses reported episodes of back pain at some time in their life.

Very few factors were able to predict who would get back pain. Having had back pain even before entering the workforce made it more likely for the nurses to experience back pain during their professional life. Also, working in twisted/bent positions was more likely to result in sciatica (pain radiating down the leg).



Percent of nurses who suffered from back pain

[1] Videman T. Ojajarvi A., Riihimaki H., Troup JDG. Low Back Pain AMong Nurses. A follow-up Beginning at Entry to the Nursing School. Spine. 2005; 30(20):2334-2341

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