

## Case Report

# Diagnosis, Treatment, and Rehabilitation of a Lumbar Herniated Disk in a Cross-Country Skier: A Case Report

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**Abstract**

A 47-year old cross-country skier experienced continuous low back pain. It started after several years of skate skiing, an advanced technique used by cross-country skiers. It was determined that his form was less than ideal, which led to the lumbar pain. An MRI revealed a herniated disk between L3 and L4, and a bulging disk between L5 and S1. For 1 year his back was treated conservatively with core stability exercises, McKenzie extension exercises, thermal ultrasound, shortwave diathermy, TENS, massage, ice, heat, traction, epidural injections and opioid pain prescriptions. The most pain relief came from opioid medication and inversion table traction. After 1 year of using these treatments, his pain was still present. He and his physician decided to try surgery. A partial discectomy was performed to remove the herniated nucleus pulposus and take pressure off the sciatic nerve. The treatment was a success and the patient has been pain free for 12 years. He still has the bulging disk between L5 and S1, but it is asymptomatic.

**INTRODUCTION**

As we get older, degenerative changes occur in the spine. Our intervertebral disks become thinner and lose elasticity, while calcium deposits, called osteophytes, form on the vertebrae. These changes often put pressure on nerve endings, resulting in low back pain [1].

Approximately 80% of the population will experience lumbar pain at some time in their lives; of these, 90% will resolve in 2-4 weeks, but 60-80% will recur within 1 year [2]. In the workplace, low back pain is the leading cause of employee morbidity, disability, and lost productivity. Medical care is sought by 15-20% of those with low back pain, making it the second most common reason for physician visits [3].

This paper deals with my personal experience of developing a lumbar disk herniation from using improper form while cross-country skiing (skate style). The mechanism of injury, diagnosis, treatment and surgery are discussed.

**CASE REPORT**

When I was 45, I had episodes of low back pain. The pain started mid-season of the cross-country skiing season. The pain would last about 2 weeks then disappear, for 2-3 weeks, then reappear. After 13 months of dealing with the pain, an MRI

was performed (Figure 1). The MRI revealed a herniated disk between L3 and L4 and a bulging disk between L5 and S1. These irregularities explained the buttocks pain that radiated down my right leg. Since I was asymptomatic until skiing season, I determined that the cause of the injury was improper mechanics during cross-country skiing--nothing else led to this injury.

A course of exercises, therapeutic modalities, injections and pain medicine was followed for 1 year. The exercises mainly consisted of core stability and back extension exercises, which provided only minimal pain relief. I was also instructed in correct posture techniques. Pain was most severe when sitting. To counteract this, an office chair was replaced by a Swiss ball to sit on. This required core stability and provided only minimal relief.

The therapeutic modalities consisted of ice, heat, TENS, thermal ultrasound, thermal pulsed shortwave diathermy (PSWD), massage and traction. These provided minimal relief, except for traction which provided moderate relief. Also a regimen of 3 epidural injections; separated by one month was followed. These provided moderate pain relief, however, it was short lived (would only last about 24 hours). Pain medication (opioids) was used as needed for pain, which provided only moderate relief.

After 1 year of adhering to all these treatments, I returned to my physician. It was determined that a partial discectomy would



**Figure 1** This MRI revealed a herniated disk between L3 and L4 and a bulging disk between L5 and S1.

be performed. This invasive surgery involved removing the part of the disk (between L3 and L4), that was putting pressure on the sciatic nerve. Prior to the surgery, pain as an “8” on a numerical rating scale of “0” = no pain, and “10” being the worst imaginal pain. The procedure was remarkable, and resulted in complete loss of pain (a rating of “0”). I returned to full recreational activities consisting of running, biking and cross-country skiing.

## DISCUSSION

The lumbar spine consists of 5 vertebrae. These vertebrae are the major support of the low back and are the largest and thickest of the vertebrae, with large spinous and transverse processes. The superior articular processes face medially, while the inferior processes face laterally. The articular processes of the superior vertebrae articulate with the articular processes of the inferior vertebrae. Movement occurs in all the lumbar vertebrae; however there is much less extension than flexion [4].

Between each of our vertebrae is an intervertebral disk that functions to resist compressive forces provide flexibility and provide adequate space between the vertebrae. The outer layer of the disk is the annulus fibrosis, a series of interlacing cross-fibers that are attached to adjacent vertebral bodies. The inner layer is the nucleus pulposus, a protein gel between the cartilaginous end plates of the vertebrae and the annulus fibrosis [1]. The nucleus pulposus is watery, and as we age, it loses fluid (from 85-90% at birth to 70% by age 70) and its normal fullness. Another cause for a disk to lose its full size and normal shape is injury. The stretched or weakened annular fibers (annulus fibrosis) can protrude from the pressure of a bulging nucleus pulposus [1].

The physician and I were pleased with the outcome, but puzzled as to the cause of the herniation. Was it normal deterioration or a recreational injury? I determined that it was improper technique during skate style cross-country skiing that caused the injury.

Cross-country skiing uses 2 main techniques, classic and

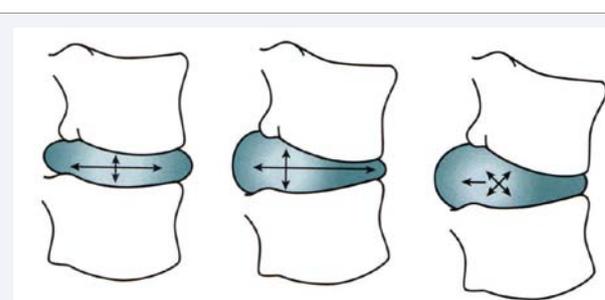
skating [5] (Figure 2). Most people are familiar with the classic technique that involves keeping the skis straight and pushing off the lead leg. This technique is like running, and the poles go in the ground as the arms move in unison with the legs. Classic skiing can be performed on a groomed or non-groomed trail. A groomed trail will have 2 grooves, about 6 inches apart that are the same width as the skis. This is the most common technique. Skate skiing involves turning the tips of the skis out and pushing off the lead leg. The skier leans to the right when pushing off the right leg, and to the left when pushing off the left leg. Typically, the skier uses both poles as he or she pushes off the involved leg. Skate skiing, can only be performed on a groomed trail. The skier does not put his skis in the grooves, but skates on the smooth trail that has been groomed. Those who use both techniques state that skate skiing is not only more fun, but a harder workout than classic skiing [5].

When skate skiing, it takes a lot of skill to alternately push off the right side and then push off the left side repeatedly. I had trouble pushing off the left side, so I only skied by pushing off the right side. I was warned that if I continued to do this, back injury might result. In fact, several times, after I finished skiing, moderate low back pain would occur (about a 5-6 on the numerical rating scale). I rarely skied using the classic technique, but would use the skate technique most of the time when skiing (5-6 times per week, for 45-60 minutes each time).

It was determined that skate skiing caused the injury due to fluid-dynamic principles [1,4]. For example, if the disk is damaged, and you move in a weight-bearing position, the nucleus pulposus



**Figure 2** Cross-country skiing uses 2 main techniques, classic (left) and skate (right).



**Figure 3** Representation of a herniated disk and how it moves according to the weight-bearing forces placed upon it.

will shift. If tears develop in the annular fibers, the nucleus will tend to take the path of least resistance and move in this direction (Figure 3). This squeezing of the vertebrae on the disk caused it to protrude and put pressure on the sciatic nerve.

Because the disks receive no blood supply, they must rely on changes in pressure and body position to produce a pumping action that brings in nutrients and flushes out metabolic waste products with an influx and out flux of fluid. Because maintaining a fixed body position curtails this pumping action, sitting in one position for an extended period of time can negatively affect disk health [6]. This might be why some pain relief occurred when the office chair was replaced with a Swiss ball. The round shape of the ball required moving of the hips and feet to remain on the ball. This movement may also have moved the disk slightly enough that the disk did not press on the sciatic nerve, leading to some mild pain relief.

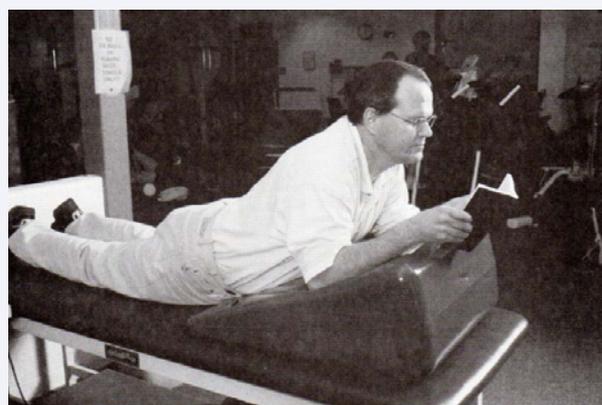
Forces acting on the spine include body weight, tension in the spinal ligaments and paraspinal muscles, intra-abdominal pressure, and any applied external loads. When the body is upright, the major form of loading on the spine is axial, and the lumbar spine supports the weight of the body segments above it. Although most of the axial compression load on the spine is borne by the vertebral bodies and disks, the facet joints, when the spine is in hyperextension, may be as much as 30% of the load. Under significant compressive loading, such as during a heavy lifting task, (or pulling yourself up a hill while skate skiing) increases in intra-abdominal pressure that may help to stiffen the trunk to prevent the spine from buckling [7]. When the paraspinal muscles are fatigued, there are increased levels of co-contraction, which also helps to stiffen the spine and increase spinal stability.

Strengthening of the back muscles is imperative to stabilize the spinal column. Exercises to strengthen the low back area should involve back extension, lateral flexion, and rotation. In addition, it is important to strengthen the abdominal muscles to maintain appropriate postural alignment. Normal range of motion (ROM) also is essential in stabilizing the spine and preventing injury. If warranted, stretching exercises should be used to promote and maintain normal ROM. In particular, it is advantageous to ensure maximal motion in lateral flexion, forward flexion, and rotation [8]. All of these exercises were performed with only mild pain relief.

Other than pain medicine, the thing that provided the most pain relief was inversion traction (Figure 4). Inversion table traction is an inexpensive (\$150-\$250) effective way to gain the benefits of traction. The patient is suspended upside down or at various angles by the ankles or thighs. This position allows the weight of the upper body to act as a traction force. Because it causes significant increases in blood pressure, this technique is contraindicated by someone with hypertension. Also it increases pressure on the eyes, so patients with glaucoma should not use inversion traction. Guvenol et al, [9]. Reported no difference between inversion traction and mechanical traction in alleviating symptoms of herniated lumbar disk patients. I, however; found inversion traction to be far superior to mechanical traction. This was probably due to extending the back while prone, by laying on a wedge immediately after the inversion traction regimen (Figure 5).



**Figure 4** The patient found that the inversion table traction device was an inexpensive (\$150-\$200), effective way to moderately relieve pain.



**Figure 5** As soon as the inversion table traction therapy session ended, the patient would lay prone on a wedge. It was thought that this position helped to relieve pressure off the sciatic nerve.

## CONCLUSION

Though not that common, lumbar pain can occur during cross-country skiing, especially when the skier uses an improper technique. In my case exercise, pain medication, injections and modalities provided only minimal or moderate pain relief. Surgery, involved removing the affected part of the disk that was pressing on the sciatic nerve. This resulted in complete eradication of pain. There is still a bulging disk between L5 and S1, but it is asymptomatic.

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