Chiropractic and Rehabilitative Management of a Patient With Progressive Lumbar Disk Injury, Spondylolisthesis, and Spondyloptosis

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Abstract

Objective: To describe the chiropractic treatment for a patient with low back pain accompanied by sensory and motor deficits of his left leg and magnetic resonance imaging–documented lumbar spinal cord and nerve root impingement.

Clinical Features: A 57-year-old man experienced low back pain that radiated into his left leg and subsequently produced both sensory and motor deficits of the left thigh and quadriceps followed by a similar weakness and accompanying paresthesia of the lower left leg. Onsets were sudden and occurred during sleep, after prolonged sitting or during long periods of driving. Diagnostic studies revealed a slight impingement at the L5-S1 level due to anterior displacement of the L5 vertebra and a mild protrusion of the L4 disk.

Intervention and Outcomes: Treatment consisted of chiropractic spinal manipulation, physical therapy modalities, and rehabilitative exercises. Outcome measurements in his case indicated that his rehabilitation was appropriate.

Conclusion: There is an abundance of published reports describing treatment of disk injury, low back pain, and spondylolisthesis with a variety of manipulative methods. However, this appears to be the first case reported in indexed literature of a progressive multilevel lumbar disk injury with concomitant spondylolisthesis and spondyloptosis.
(J Manipulative Physiol Ther 2006;29:66-71)

Key Indexing Terms: *Chiropractic; Lumbar Vertebrae; Spondylolisthesis; Intervertebral Disk Displacement*

The anterior displacement of a vertebral body in relation to the vertebrae below, which demonstrates a disruption of the posterior vertebral body line (George's line) on a lateral x-ray projection, is termed spondylolisthesis. This also may be referred to as an anterolisthesis. Spondylolistheses affect approximately 5% of the population and are a reasonably common finding in any chiropractic practice. There exist many different subtypes of spondylolistheses that are idiopathic or traumatic in nature. A spondylolysis is described as the interruption of the pars interarticularis, which can occur unilaterally or bilaterally. Disruption of the pars interarticularis allows either some anterior displacement of the vertebrae, which is termed a spondylotic spondylolisthesis, or merely disruption of the pars interarticularis with no anterior slippage (prespondylolisthesis). Spondylolistheses most commonly occur in the lumbar spine with a 67% prevalence rate at the L5 level.[1]

The findings observed on imaging of a spondylolytic spondylolisthesis are described as an anterior displacement with a break of the pars interarticularis on a lateral projection. In addition, Wiltse et al[2] developed the most commonly used classification system of spondylolisthesis, which consists of six types listed in Table 1.

The presence of a spondylolisthesis does not precipitate low back pain. In fact, only a small percentage of patients experience biomechanical instability and/or neurological deficits.[3] Early literature alleged that there was no correlation between pain and the presence of a spondylolisthesis.[2,4,5] However, Nachemson[6] and Ruge and Wiltse[7] identified spondylolisthesis to be a well-known cause of low back pain syndrome.

An intervertebral disk herniation is the protrusion of the nucleus pulposus through the annulus fibrosis and beyond any adjacent vertebral margins.[8] Discogenic pain is difficult to diagnose with certainty because medical examinations are limited when identifying lumbar discogenic pain.[9] However, testing for centralization or peripheralization of pain demonstrates a high correlation with discogenic pain.[10]

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Sources of support: No external funds were provided for this research.

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Paper submitted November 23, 2004; in revised form July 10, 2005.
0161-4754/$32.00

doi:10.1016/j.jmpt.2005.11.010

Table 1. *Classifications of spondylolisthesis*

Type	Etiology	Comments
Type I	Dysplastic (congenital)	
Type II	Spondylolytic (isthmic)	Most Common at L5
Type III	Degenerative	Second most common at L4
Type IV	Traumatic	
Type V	Pathological	
Type VI	Postsurgical	

Fig 1. *Lateral standing radiograph demonstrating the anterior inferior position of L6 relative to S1 as well as the grade IV spondylolisthesis of L5.*

This centralization or peripheralization of pain coupled with an objective outcome measure such as the visualization of the herniation or protrusion on magnetic resonance imaging (MRI) has demonstrated a high degree of reproducibility and is therefore diagnostic.[11]

The purpose of this report is to discuss the management of a patient with progressive lumbar disk herniations complicated by a grade IV spondylolisthesis with chiropractic adjusting and physical rehabilitation.

Case Report

The 57-year-old male subject's history revealed three prior injuries, each with low back pain. In 1960, while playing football in junior high school, he and another player collided into each other head-on. The accident caused instantaneous low back pain. The second injury, in 1963, involved an awkward landing on a trampoline on his hands and knees simultaneously, which strained his low back. This patient had been previously diagnosed with a spondylolisthesis in 1968. At that time, the subject was in significant pain having trouble laying down, sitting, standing, and

Fig 2. *Lateral lumbopelvic radiograph demonstrating mild narrowing and marked disk space narrowing of the L3 and L5 disks, respectively.*

performing normal daily activities. The third injury occurred in 1999 when he fell backward from a retaining wall, falling on his right arm and side, resulting in fractures of the left radius and ulna. The patient had received occasional chiropractic care in the past.

The patient had excruciating low back pain at the initial consultation. The pain began suddenly during his sleep and radiated into the left thigh. Upon examination, Pheasant's sign and a seated straight leg raise test were both positive, reproducing the pain, which radiated into the hamstring and gluteal areas. The patient also presented with a motor strength grading of 2/5 of the left quadriceps muscles and paresthesia of the medial and anterior aspect of his left thigh.

Lateral and anterior to posterior lumbopelvic radiographs revealed six lumbar vertebrae and line analysis described by Meyerding method confirmed grade IV isthmic spondylolisthesis at L5 with complete anterior displacement and inferior displacement of L6 relative to the sacrum (Fig 1). Mild intervertebral disk space narrowing was observed at L3, but advanced degenerative disk disease was evident at L5-S1 (Fig 2).

The patient was treated with a chiropractic adjustment. A distractive Thompson Drop procedure, in the prone position, was used to address the sacroiliac and lumbosacral regions of the spine. These adjustments were performed using a Zenith Hi-Lo table. Thoracic adjustments were also performed on Zenith Hi-Lo table in the prone position using double transverse diversified technique. Cervical adjustments were performed using diversified procedures. The patient experienced an immediate and marked decrease of both low back pain and radiating pain into the left thigh after the first chiropractic adjustment.

Table 2. *Dorsiflexion and calf measurements*

Wk	Left foot dorsiflexion	Right foot dorsiflexion	Left midcalf measurement	Right midcalf measurement
1	0	10	16.25	17
12	1.8			
16	2.9			
20	4.0		16.75	17
21	5.0	10		
22	5.8			
24	7.6		17	17
32	78.0			
40	9.0	10		

Three weeks later, the patient returned for a second visit with no low back pain. However, weakness of the left leg was still present as well as a difference in both muscular tone and size of the left thigh. An examination revealed circumference measurements of his thighs bilaterally, at 8 in proximal to the knees with the left measuring 1 in smaller than the right. Atrophy was observed with a marked loss in tone and definition in the left quadriceps muscle as compared with the right. His gait appeared to be unimpaired, although the patient expressed that his knee periodically felt unstable, and on occasion, it would give out when climbing down stairs or walking down slopes. Sensory testing revealed medial thigh paresthesia following the L3 dermatome; strength tests demonstrated mild medial quadriceps weakness, and the patient exhibited a patellar deep tendon reflex of +1, whereas all others measured +2. Lumbar range of motion was mildly reduced by 5° in both flexion and extension. Clinical impression of a significant L3 discopathy was made.

The same adjusting procedures were used, with two to three adjustments per week for 6 weeks. Russian muscle stimulation was administered to the quadriceps daily. From week 6 to 12, adjusting frequency decreased to one or two adjustments weekly. Russian muscle stimulation continued to be used on a daily basis and was performed on the quadriceps bilaterally to take advantage of any crossover effect that may occur. The electrical muscle stimulation aided in reduction of pain and nerve inflammation but was used to minimize any further atrophy of the left quadriceps. The Russian electrical stimulation was set at a mode of 10/30, reciprocating with a ramp of 1.0 MHz, and was performed on both quadriceps for 10 minutes, at an intensity within the patient's tolerance.

The patient was given a battery of exercises to expedite improvement of motor function. The exercises followed a gradation process, which commenced with seated straight leg raises against gravity, then progressed to gravity in addition to hand resistance. The next stage had the patient moving from isometric type exercises to isotonic resistance which involved the subject laying supine, elevating the leg into the air and drawing out shapes such as circles, squares, and triangles in a clockwise and counterclockwise direction. Elastic tubing exercises were also given for home exercise. Each step was performed in sets of 5, 10, and 20 as strength improved. Once resisted, strength tests revealed a 3/5 grading; the patient's exercise protocol involved a component of walking 2 to 3 miles daily performing hill walking with emphasis on walking down hills to increase eccentric contractions of the quadriceps. Cycling three times weekly at a moderate intensity for approximately 40 miles each session was also recommended; this was encouraged because this subject was cycling approximately 150 miles a week before this occurrence. In addition, a regular routine of hamstring and quadriceps stretches was integrated into his exercise program because muscle contractures of both the hamstrings and quadriceps were noted.

Fig 3. *Sagittal T1-weighted MRI of the lumbar spine. Note the bridging of bone between L6 and S1.*

After 6 weeks of treatment, the definition and muscle tone of the left quadriceps were showing marked improvement. The patient reported an improvement in left leg stability. At week 12, there was a complete resolution of muscle atrophy; the patient stated that there was no longer any feeling of instability; muscle strength was +5, and patellar deep tendon reflexes of the left leg had returned to normal (+2).

Five months after the onset of the L3 discopathy, the patient presented with a sudden onset of foot drop of the left extremity. He was unable to dorsiflex the left foot, reported paresthesia of the lateral lower left leg, and had no sensation of the great toe on the left foot, indicative of an L5 dermatomal distribution. There was noticeable atrophy of the left tibialis anterior muscle with midcalf measurements of 17 and 16.25 in for the right and left legs, respectively.

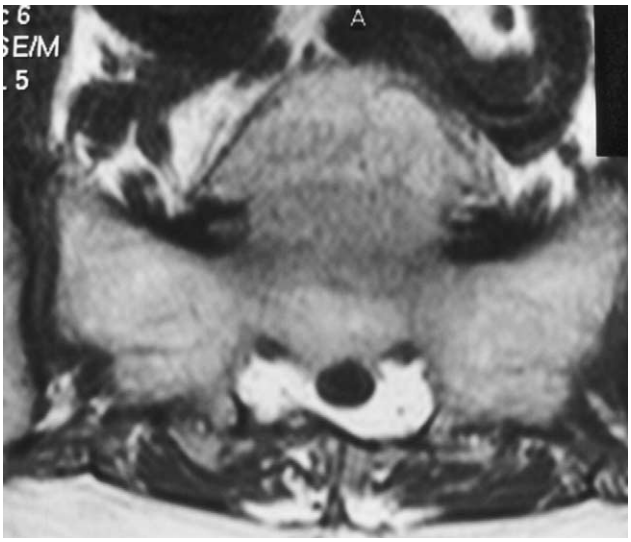

Fig 4. *Axial T1-weighted MRI of lower lumbar region demonstrating bone bridge formation between L6 and S1.*

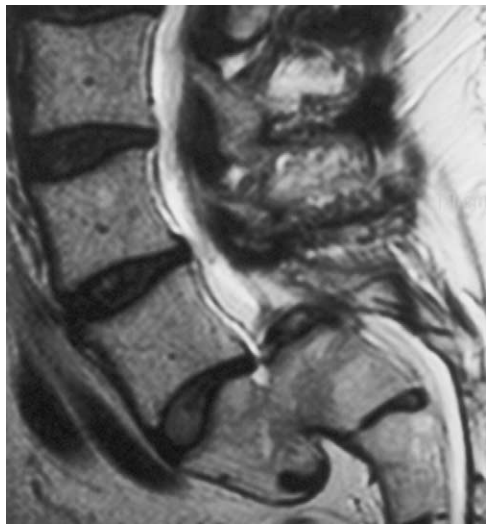

Fig 5. *Sagittal T1-weighted MRI of the lumbar spine demonstrating L5 nerve root impingement and the anterior displacement of L5 vertebrae relative to S1.*

Values for dorsiflexion and circumferential mensuration are presented in Table 2. These symptoms occurred after a long driving trip. Lumbopelvic radiographs demonstrated a grade IV isthmic spondylolisthesis at L5 with almost complete anterior displacement from the sacrum as well as advanced degenerative disk disease evident at L5-S1, supportive of the diagnosis of progression of an L5-S1 disk protrusion. Interbody fusion was also noted between the posterior aspect of L6 and the anterior aspect of S1. Although complete fusion was not present, there were large portions of bony bridging between the two structures (Figs 3 and 4). MRI indicated impingement of the L5-S1 nerve root because of marked anterior displacement of the fifth lumbar vertebrae and a narrowed disk space at that same level (Fig 5). Minimal protrusion of the L4-L5 disk was noted but described as nonsignificant.

The same adjusting protocols were used for cervical, lumbar, and sacral regions, but the thoracic vertebrae were adjusted supine. Russian stimulation was performed on the tibialis anterior, peroneal, and gastrocnemius muscles bilaterally. The Russian electrical stimulation was set at a mode of 10/30, reciprocating with a ramp of 1.0 MHz, and was performed on both quadriceps for 10 minutes at an intensity to patient's tolerance.

The patient's exercise protocol involved walking 2 miles, daily hill walking, resisted dorsiflexion and plantarflexion exercises, and elastic tubing exercises at home. Cycling was performed on a cyclergometer three times weekly at a moderate intensity for approximately 40 miles each session. The patient's regular routine of hamstring and quadriceps stretches was continued. Progress was slow and steady with two short periods in which the patient experienced a plateau in improvement. On two separate occasions early on in the management plan, the subject tripped and fell because of the foot drop. By week 24, the patient had completely regained all muscle girth in his left lower leg, specifically in the tibialis anterior muscle. The subject recovered 90% of his left foot dorsiflexion, although he had still not regained all of the strength. A neuromuscular grading of 4/5 was measured.

Discussion

The facet joints, pars interarticularis, and the annulus fibrosus, including anterior and posterior longitudinal ligament attachments, are the structures responsible in limiting anterior vertebral displacement. Despite these ligamentous structures, 5% of the population exhibits some type of spondylolisthesis.[12,13] Cox et al[14] performed an overview of the outcomes of 1000 cases that included 57 spondylolisthesis cases and 199 lumbar disk protrusions. The review of Cox et al, as well as that of many others, has generated a significant amount of literature pertaining to the management of spondylolistheses and disk herniations as separate entities. However, there is minimal information available about disk herniations with concomitant spondylolytic spondylolisthesis.[15,16] Furthermore, there appears to be no literature to date discussing disk herniations at multiple levels with concomitant spondylolisthesis within the same study. It has been suggested that even the relationship between disk degeneration and spondylolisthesis still has a limited understanding.[17,18]

Szypryt et al[17] and Dai[18] assessed the prevalence of disk degeneration in the disks both above and below a spondylolisthesis defect using MRI. These studies indicated that there was a significant increase in the prevalence of disk

degeneration of the disk inferior to the spondylolisthesis but not of the disk superior. Szypryt et al[17] concluded that patients younger than 25 years, in most cases, had relatively normal disks both above as well as below the spondylolisthesis, whereas patients older than 25 years, in most cases, had increased disk degeneration of the disk inferior to the spondylolisthesis.

In this case study, the patient presented with discogenic symptoms, for both the second and third episodes, during his fifth decade of life, thus supporting the position of Szypryt et al. Furthermore, our patient's third episode of low back pain and radiculopathy involved the vertebral disk inferior to the spondylolisthesis. However, the second episode involved one of the disks above the level of the spondylolisthesis, specifically L3, which occurred superior to the spondylolisthesis. Whereas this case study appears to support the conclusion of Szypryt et al of significant disk degeneration of the disks inferior to the spondylolisthesis, marked degeneration of another disk superior to the spondylolisthesis does not.

This was a unique case study in that many variables were involved. The patient, before experiencing the onset of disk injury or any neurological deficits, had lost 70 lb of body mass in the previous 14 months. Moreover, the patient routinely cycled 150 miles per week and was in the flexed position, leading to changes in the direction and magnitude of any forces on the L5-S1 disk during this activity. As a result of the angle of inclination of S1, there is a shear force that acts upon the L5-S1 disk.[13] In this case study, the L5-S1 has an intervening sixth lumbar vertebra which may have been a previous spondylolisthesis/spondyloptosis that fused to the anterior aspect of the first sacral body and thus created an even greater shear force causing the L5 spondylolisthesis to occur. Although there was no quantitative measure of the changes in the biomechanics of our subject before and after the loss of weight, it must not be overlooked as a contributing factor in the onset of the disk injury. Furthermore, our patient maintained extended periods of seated posture because of his occupation, recreational cycling, and long driving trips. Studies have demonstrated an increase in disk herniation and/or annular tearing with prolonged periods of loading from sitting postures.[19,20]

The patient in this case exhibited classic clinical findings for disk herniation, such as the presence of pain with radicular symptoms and impaired functionality of the spine, on all three presentations. Although all clinical indications would dictate an L5 disk lesion as well as an L3 disk lesion, we must not assume this conclusively. We are left to question a new condition or a more extensive exacerbation of the prior lesion that had not been diagnosed because it was previously asymptomatic. The lack of certainty may be due to this patient's congenital anomaly. This anomaly may be, in part, the cause or could have led to formation of variations or slowed maturation of his neurology at one or multiple levels. Furthermore, significant disk lesions do not necessarily present on MRI or plain film radiography, regardless of being symptomatic.

There exist many different subtypes of spondylolistheses that are idiopathic or traumatic in nature. The typical medical protocol for spondylolisthesis and most spinal conditions had been analgesics and/or bed rest,[21] and in symptomatic cases not responding to conservative treatment, fusion surgery.[16] Fusion surgery unfortunately leads to an even earlier degeneration of the surrounding joint structures, which results in further hypomobility of subjacent structures in an area where reduced motion will compound the problem further.[22-24]

Conclusion

This case was different from other spondylolisthesis cases presented in the literature, as it included an anomaly of an L6 vertebrae fused to the anterior aspect of S1, a grade IV spondylolytic spondylolisthesis at L5, and progressive episodes of disk injury at multiple levels. This case demonstrates that conservative chiropractic spinal manipulation, the application of therapeutic modalities, and physical rehabilitation may be effective in the management of difficult and challenging spondylolistheses coupled with progressive disk lesions at multiple levels.

Acknowledgments

The authors thank John Stites for his contributions in the development of this manuscript.

References

1. Resnick D. Diagnosis of bone and joint disorders. 3rd ed. Philadelphia: WB Saunders; 1995. p. 1372-462.
2. Wiltse LL, Newman P, Macnab I. Classification of spondylolysis and spondylolisthesis. Clin Orthop Relat Res 1976; 117:23-9.
3. Yochum T, Rowe L. Essentials of skeletal radiology. Baltimore: Williams and Wilkins; 1987. p. 243-72.
4. Fredrickson B, Baker D, McHollick W, Yuan HA, Lubicky JP. The natural history of spondylolysis and spondylolisthesis. J Bone Joint Surg Am 1984;66:699.
5. Schmorl G, Junghans H. The human spine in health and disease. 2nd ed. New York: Grune and Stratton; 1971. p. 158-72.
6. Nachemson A. The lumbar spine: an orthopaedic challenge. Spine 1976;1:59-71.
7. Ruge D, Wiltse L. Spinal disorders: diagnosis and treatment. Philadelphia: Lea and Febiger; 1977. p. 219-97.
8. Marchiori D. Clinical imaging with skeletal, chest and abdominal pattern differentials. St Louis: Mosby Inc, 1999. p. 486-502.
9. Schwarzer A, Aprill C, Derby R, Bogduk N, Kine G. The prevalence and clinical features of internal disc disruption in patients with chronic low back pain. Spine 1995;20:1878-83.
10. Donelson R, Aprill C, Medcalf R, Grant W. A prospective study of centralization of lumbar and referred pain: a predictor

of symptomatic discs and anular competence. Spine 1997;22: 1115-22.
11. Videman T, Battie MC, Gill K, Manninen H, Gibbons LE, Fisher LD. Magnetic resonance imaging findings and their relationships in the thoracic and lumbar spine. Insights into the etiopathogenesis of spinal degeneration. Spine 1995;20:928-35.
12. Troup JDG. Mechanical factors in spondylolisthesis and spondylolysis. Clin Orthop Relat Res 1976;117:59-67.
13. Farfan HF, Osteria V, Lamy C. The mechanical etiology of spondylolysis and spondylolisthesis. Clin Orthop Relat Res 1976;117:40-55.
14. Cox JM, Feller J, Cox-Cid J. Distraction chiropractic adjusting: clinical application and outcomes of 1000 cases. Top Clin Chiropr 1996;3:45-59.
15. Poussa M, Tallroth K. Disc herniation in lumbar spondylolisthesis: report of three symptomatic cases. Acta Orthop Scand 1993;64:17-21.
16. Seitsalo S, Schlenzka D, Poussa M, Osterman K. Disc degeneration in young patients with isthmic spondylolisthesis treated operatively or conservatively: a long term follow up. Eur Spine J 1997;6:393-7.
17. Szypryt EP, Twinning P, Mulholland RC, Worthington BS. The prevalence of disc degeneration associated with neural arch defects of the lumbar spine assessed by magnetic resonance imaging. Spine 1989;14:977-81.
18. Dai LY. Disc degeneration in patients with lumbar spondylolisthesis. J Spinal Disord 2000;13:478-86.
19. Videman T, Nurminen M, Troup JD. Lumbar spinal pathology in cadaveric material in relation to history of back pain, occupation and physical loading. Spine 1990;15: 728-40.
20. Wilder DG, Pope MH, Frymoyer JW. The biomechanics of lumbar disc herniation and the effect of overload and instability. J Spinal Disord 1988;1:16-32.
21. Rouse J. Spondylolisthesis: response to chiropractic rehabilitative care. J Sports Chiropr Rehabil 1996;10:41-3.
22. Anderson CE. Spondyloschisis following spine fusion. J Bone Joint Surg Am 1956;38:1142-8.
23. Harris RI, Wiley JJ. Acquired spondylolysis as a sequel to spinal fusion. J Bone Joint Surg Am 1963;45:1159-67.
24. Unander-Scharin L. Spinal fusion in low back pain. Acta Orthop Scand 1951;20:335-41.