

Rehabilitation of a patient with a rare multi-level isthmic spondylolisthesis: a case report

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A rare multi-level isthmic spondylolisthesis was discovered in a young male patient following an acute onset of low back pain. The prevalence of spondylolisthesis in the adult population is low and it is believed that the prevalence of multiple level spondylolisthesis is even rarer. A combination of onset of ambulation, hereditary factors, and sports involving hyper-extension of the spine are predisposing factors. Conservative treatment such as chiropractic manipulation and rehabilitation of the spine are first treatment options before surgical intervention is considered. The clinical presentations, radiographic features, treatment options including rehabilitation methods are discussed.

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KEY WORDS: chiropractic, spondylolysis, multiple spondylolisthesis, rehabilitation.

Introduction

Spondylolysis is from the Greek root word spondylos, which means vertebra. The root word lysis means break or defect. Spondylolisthesis is from the Greek roots spondylos and listhesis, meaning movement or slipping. Therefore, the term spondylolisthesis refers to the slipping forward of one vertebra on the adjacent inferior vertebra.

There are five different classifications of spondy-

On a découvert une forme rare de spondylolisthésis multiple par lyse isthmique chez un jeune patient, à la suite de l'apparition de douleurs lombaires. Le taux de prévalence de la spondylolisthésis est faible dans la population adulte et l'on croit que celui de la spondylolisthésis multiple est encore plus faible. Une combinaison de facteurs prédisposant tels que l'ambulation, l'hérédité et la pratique de sports exigeant une hyper-extension de la colonne vertébrale peuvent entrer en cause. Les traitements conservateurs tels que la manipulation chiropratique et la réadaptation de la colonne vertébrale sont les premières options à considérer avant d'envisager une intervention chirurgicale. Les profils cliniques, les examens radiographiques et les options de traitements, y compris les méthodes de réadaptation, sont discutés dans l'article suivant.

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MOTS CLÉS : chiropratique, spondylolyse, spondylolisthésis multiple, réadaptation.

lolisthesis¹ (Table 1). Of the different types of spondylolisthesis, the isthmic variety (Type II) is the most common.¹ Isthmic spondylolisthesis occurs secondary to a defect of the pars interarticularis. The defect can be a result of fatigue fracture or elongation of an intact pars.¹

In the adult population 4-8% have a spondylolisthesis in their spine.² L5 is the most common level of pars defect at 90%.² The majority of the defects at L5 are bilateral.² As a consequence, the slippage occurs most

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Table 1
Categories of Spondylolisthesis

Type I:	Dysplastic or Congenital Spondylolisthesis
Type II:	Isthmic Spondylolisthesis
Type III:	Degenerative Spondylolisthesis
Type IV:	Traumatic Spondylolisthesis
Type V:	Pathologic Spondylolisthesis

commonly at this level with L5 slipping anteriorly on the sacrum. Pars defects can occur at L4 and above, but these are much less common.^{3,4,5}

Reports of multiple level spondylolisthesis and/or spondylolysis in the lumbar spine are rarely encountered.⁶⁻¹⁴ There are no studies that estimate the prevalence of multiple level spondylolysis and it is believed to be rare.

Reported cases of multiple level spondylolisthesis, were almost all surgically treated.^{6-8,10,11,14} Some patients responded with limited success. A conservative method of treatment should be implemented before considering surgical intervention.¹² Conservative treatment could reduce risks associated with surgery. Surgical intervention should only be considered in cases of progressive neurological deficits or cauda equina symptoms.¹⁵

Case report

A 26-year-old male massage therapist presented with symptoms of acute low back pain isolated to the lumbo-sacral region. Interview revealed a long standing history of low back pain which began at 14 years of age. Twelve years prior to presentation, while playing rugby, the patient received a tackle from behind causing hyper-extension of his back. He felt severe and immediate pain that disabled him for a few moments. After several days of continued back pain he consulted his family physician. X-rays were taken and the patient was told he sustained a hairline fracture of his spine. He was also informed that he had mechanical low back pain and that the fracture would heal with time. Although the patient's recollection was vague, he was told by a medical specialist that he had spondylolysis of the spine and that he would experience more problems later in life. He was advised to avoid playing sports and to consider choosing a career in a non-

labor or sedentary type of job. Since then his low back pain had reoccurred sporadically.

Despite being told not to play sports the patient continued to be active especially with hockey, golf, martial arts, roller blading, and horse back riding. Before participating in these activities he often wore a back brace around his torso. At 21 years of age the patient began massage therapy school. The patient recalled that whenever other students massaged his back deeply he would suffer more pain for several weeks after.

On the day of presentation the patient explained that he was lying prone in bed when he coughed violently at which time he felt sudden, pain in his low back. For some time he could not move from his bed. Later in the day, his girlfriend and neighbor had carried him to his vehicle so that he could come to the office. The patient had to be helped from his vehicle by using a wheeled office chair because he could not stand nor walk on his own.

During the examination the patient appeared distraught and in considerable discomfort. The pain was localized in the lumbo-sacral junction bilaterally without radiation. No bowel or bladder problems were reported. He could barely move his lower limbs because of the pain. He was helped onto the treatment table so that an examination could be done. Deep tendon reflexes of the patella and achilles tendon were +1 bilaterally, and zero for the medial hamstrings bilaterally. Light touch sensory testing of the lower limbs was normal. Orthopedic tests were not performed because the patient was in too much pain. Palpation of the spine revealed inflammation about the L4 to S1 segments with palpable spasm of the erector spinae, quadratus lumborum, and lumbar intrinsic muscles. Digital pressure over the L4 to S1 facet joints was extremely sensitive. Vertebral joint restrictions were palpated about the thoraco-lumbar junction, lumbo-sacral area, and sacro-iliac joints bilaterally.

A working diagnosis of acute lumbar sprain/strain was made and treatment was given. The treatment involved soft tissue massage, mobilization of the restricted joints and cryotherapy. Following the treatment the patient reported some relief but was still unable to ambulate by himself. He was given icing instructions, to rest at home for a few days, and to consult his medical physician for analgesics and anti-inflammatory medications.

The patient returned 3 days later. The patient had bed rest and anti-inflammatory medication which helped

enough so he could walk. Examination revealed limited active range of motion in all directions to approximately 10 degrees with considerable pain. Neurological examination of his lower limbs was still unremarkable. Orthopedic assessment revealed a positive Kemps test bilaterally at the L4–S1 levels. Straight leg raise was limited to 20 degrees bilaterally with pain at the lumbo-sacral junction without radicular pain. Digital pressure over the L4–S1 facet joints was still very sensitive. All other orthopedic tests were negative. Vertebral joint fixations were noted at the sacro-iliac joints, thoraco-lumbar junction, and lumbo-sacral area bilaterally. Palpation of the muscles revealed tight erector spinae, quadratus lumborum, piriformis, gluteus medius, gluteus minimus, and intrinsic muscles at the L4–S1 levels.

The patient underwent treatment daily for 4 days consisting of soft tissue massage, trigger point therapy, spinal mobilization techniques to the restricted areas, and cryotherapy. Home recommendations included ice, range of motion exercises, to keep mobile and to sleep supine with a pillow under his knees. He was also instructed to avoid sitting for long periods of time, lifting and bending at the waist. Following this, the patient was treated 3 times a week for 3 more weeks. During this time the patient was able to tolerate positioning and spinal manipulation at the sacro-iliac joints and thoraco-lumbar junction. Muscle energy techniques and Active Release Techniques were used on the muscles that were tight.^{16–18} As the patient's condition improved treatment frequency dropped to twice a week for another 4 weeks.

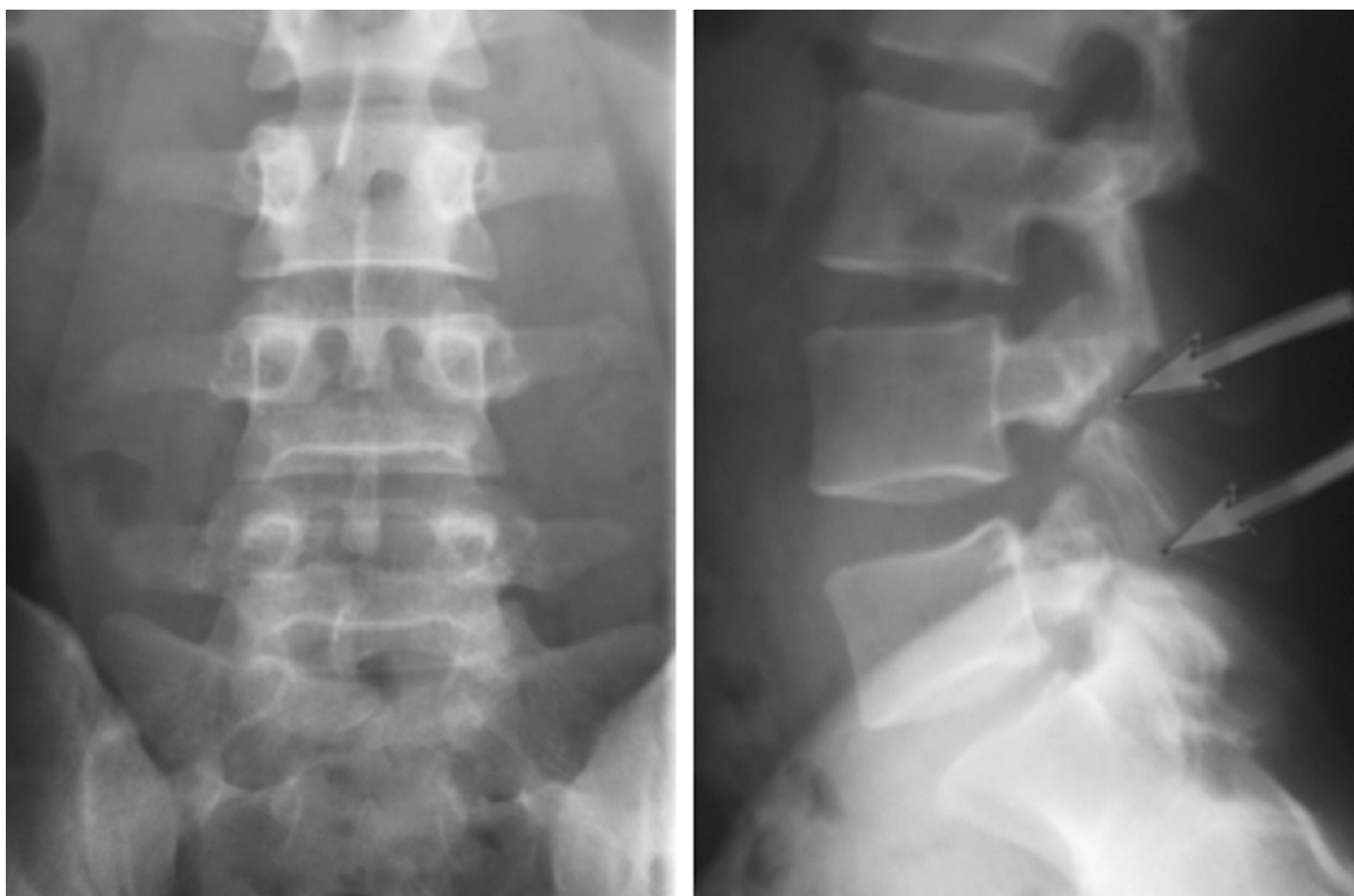


Figure 1 Lumbar spine radiographs taken four years prior to presentation. Observe the non-union of the S1 spinous process. Note the radio-lucent defects at the L4 and L5 pars (arrows).



Figure 2 Lateral view of the lumbar spine exhibits progression of the anterior slippage of the L4 and L5 vertebrae.

A request was made for the patient's radiographic films (Figure 1) that were taken 4 and 9 years prior. The radiographs taken when he was originally injured at 14 years of age were no longer available. The radiographic films obtained came accompanied with radiology reports. Each of the reports indicated defects in the pars interarticularis at L5. One report indicated a Grade 1 spondylolisthesis whereas the other did not mention spondylolisthesis.

After inspecting both sets of radiographs, it was evident that there were L5 pars defects in both earlier studies. However, both radiologists failed to mention a defect at the L4 level. Also, spina bifida occulta was present at the S1 level.

Repeat radiographs were taken to determine the possibility of progression of the spondylolisthesis. Radio-

graphs were taken weight-bearing with anterior-posterior, lateral and oblique views. The lateral view of the lumbar spine demonstrated pars defects at the L4 and L5 levels as seen in the previous films (Figure 2). There appeared to be 3 mm of progression of the Grade 1 spondylolisthesis at the L5 level. The L4 vertebra had also progressed anteriorly by 3 mm.

Dynamic films were taken in flexion and extension (Figure 3). This was done once the patient had full ROM of the lumbar spine. The dynamic films demonstrated flaring of the spinous processes of L4 to S1 levels. Of note was that the pars defect exhibited an increase in space by about 3 mm from the extended position to the flexed position. Also, the L5 vertebra exhibited a displacement of about 1.5mm and the L4 vertebra showed 3 mm displacement from extension to flexion.

After interpreting the results of the radiographic studies, functional capacity evaluation results, and with the patient's residual symptoms a rehabilitation program was undertaken. The purpose of the rehabilitation program was to improve the patient's strength, flexibility, cardiovascular condition and proprioception. Because of the displacement observed on the radiographic studies, additional goals were to improve spinal stability and function with the hope of preventing reoccurrence.

A low-tech rehabilitation program was implemented about 6 weeks post injury. The rehabilitation program involved the use of floor exercise at the onset and later progress to gym ball and tubing exercises along with proprioceptive training on labile surfaces such as rocker and wobble boards. As for cardiovascular training the stationary bicycle was used.

Progress evaluations were performed using Outcome Assessment forms, functional and movement pattern assessments, and physical examination at 2 week intervals. Both numeric pain scale¹⁹ and Oswestry Low Back Disability Questionnaire (OLBDQ)²⁰ methods were used. The results of the patient's Outcome Assessment scores are tabulated below (Table 2).

A follow up consultation two month post discharge revealed that the patient had returned to his usual activities. Along with his home exercises he was working out at the gym, playing golf, rock climbing, and playing hockey. Although his lower back occasionally gave him some low grade discomfort he found that this pain was relieved with stretching exercises



Figure 3 Lumbar spine extension (left) and flexion (right) views demonstrate excessive displacement at the L4 and L5 vertebral bodies. Note the gapping of the pars defects upon flexion (arrows).

Prevalence

The prevalence of spondylolisthesis in the adult population with low back pain is 4–8%.² The variation in prevalence is dependant on the race, age and sex of the population sample.^{2,5} The prevalence of spondylolysis is higher than that of spondylolisthesis.^{2,21} About 20–70% of pars defects give rise to anterior slippages.^{2,21} There are two peaks in the temporal presentation of isthmic spondylolisthesis. One peak occurs between the ages of 5 and 7 years and a second peak in the teenage years.^{22,23}

Spondylolisthesis is reportedly found only in humans and never recognized in other species except for one case in a gorilla.^{5,22} The upright posture and being ambulatory may contribute because there are no known cases in non-ambulatory patients.²³ With the exception of that found by Borkow and Kleiger,²⁵ no cases of defect of the pars has been found at birth.^{5,23,24,26} Earliest cases were discovered at 6 weeks to 10 months of age.^{23,25} The prevalence by 6 years of age is 5% which is close to that seen in the adult general population. Pars defects are 2–3 times

Table 2 Outcome Assessment Scores

Days Post Onset	Numeric Pain Scale	Oswestry Low Back Disability Score
3	8	78%
17	6	56%
33	6	36%
47	3	14%
61	3	10%
2 months post discharge	3	4%

more common in boys than girls. However high-grade slippages are four times more common in girls.^{26,27} The highest incidence (28–45%) is found in Northern Eskimos.^{5,28} Yochum and Rowe suggested that the Eskimos, who carry their infants in a papoose, place undue amount of premature stress on the pars and this explains the high prevalence in their population.⁵ There is also an association with familial incidence.^{22,24,29} It has been found that there is a 13-fold increase in the prevalence of spina bifida occulta among those with pars defects.⁵ There is a lower prevalence in African Americans (2.4% prevalence) than in whites.⁵

Etiology of isthmic spondylolisthesis

The hereditary basis of isthmic spondylolisthesis is unknown. However, there is an inference of a link because of the higher incidence in near relatives of those with isthmic spondylolisthesis. The reported incidence in near relatives is about 25–30%.^{2,6}

Hormonal factors may play a role because progression of the anterior slippage has been noted during adolescence. It is, however, uncertain whether that this observation is one due to hormonal changes or simply due to growth potential in the development of the spondylolisthesis.²

Both gravitational and postural forces place stress on the pars and subsequently making it susceptible to injury. Repetitive loading of the spine in flexion, hyper-extension, and rotation seems to be a contributing factor. Also, activities such as gymnastics, diving, weight lifting, and wrestling are associated with higher incidences of spondylolysis.^{5,22,30,31} Repetitive trauma can lead to micro-fractures of the pars which may either heal, or form a fibrous union consisting of fibro-cartilaginous tissue. The fibrous tissue being weaker than the osseous structure can be further stressed and lengthens the pars.²

The cause of isthmic spondylolisthesis is likely multifactorial. A defect in the pars may develop because of a genetic weakness in the pars. This inherited predisposition coupled with repetitive trauma (as seen with active children and adolescents) could result in a pars defect.

Clinical presentation

Even though spondylolysis is known to have its onset in childhood, most of these individuals do not seek treatment until later in life. In about half of those that do have

pain there is a history of a precipitating event.^{2,22} The typical presentation includes pain with weight bearing or lifting. The pain can be described as a deep ache localized to the lumbar area with possible radiation of pain into the buttocks or posterior thighs. Spasm in lumbo-sacral musculature may present with the acute exacerbations. In a case of instability of a segment, the patient may note a “giving way” or “catch” in the back upon rising from a forward flexed position.^{21,32}

Most radicular pain is usually in the distribution of the L5 nerve root. The radicular symptom can occur bilaterally or unilaterally. In higher grades of slippage there can be traction of the cauda equina resulting in symptoms of cauda equina syndrome.² Cauda equina syndrome is a constellation of symptoms including low back pain, bilateral leg pain and weakness, saddle anesthesia, loss of sensation in the genital and perineal region, overflow incontinence or retention, difficulty initiating a stream of urine, loss of ejaculatory ability, loss of rectal sphincter tone, and sometimes fecal incontinence.^{33,34}

On physical examination a step defect on the spinous processes may be palpable in higher grades of spondylolisthesis. The palpable step defect is usually located between the spinous process of L4 and L5.²¹ In cases of Grade 3 or higher there can be an angular displacement of the vertebra resulting in a lumbo-sacral kyphosis. Patients with more severe grades may compensate in two ways. They attempt to hyper-extend the lumbar spine and rotate the pelvis into flexion so that the sacrum is more vertical. They may also flex the knees and hips to assist in maintaining balance. This may present with tightness in the hamstrings,^{2,35} hyperlordosis of the lumbar spine, and flattened buttocks.

Radiographic imaging

Plain radiographic evaluation of spondylolisthesis begins with the standard lateral, anterior-posterior, and oblique views. The classic presentation of spondylolysis in the oblique view is the collar or broken neck of the “Scottie Dog”. This represents the radiolucent defect in the pars. Dynamic studies with lateral views in flexion and extension are helpful in determining instability.^{5,32}

Treatments

Surgical intervention in the minority of patients with spondylolisthesis is an option if conservative treatment

fails. Generally, children respond well to conservative measures. However, those who have higher grades of slippage or who have progression of slippage may require surgical intervention. Typically the results of surgical treatment are better in children than those with adults.²²

The widely acceptable criteria for surgical intervention include:

- 1 Persistence of pain or neurological symptoms despite an adequate course of non-operative treatment,
- 2 Presentation with greater than Grade 2 medical subluxation,
- 3 Cosmetic deformity secondary to postural and gait difficulties.

Operative interventions may include decompression, in situ (bony) fusion, instrument-assisted fusion, and reduction surgery.^{2,22}

Non-operative treatment used by physicians commonly involves the utilization of non-steroidal anti-inflammatory drugs, selective nerve/pars injections, brace therapy, restriction of athletic activities, and bed rest.² It has been suggested by Smith and Hu²² that physical therapy should be aimed at decreasing the extension stresses at the lumbar spine and include abdominal muscle strengthening exercises and flexibility exercises for the spinal extensor muscles, hamstrings, and lumbodorsal fascia.^{22,29} However, each patient should be evaluated for specific deficiencies of the muscles involved before prescribing the exercises. Even though patients with isthmic spondylolisthesis may have the same defect, each patient will have tissue involvement and functional capacity results that are unique to the individual. This would necessitate an individualized treatment program aimed at resolving the deficiencies. Conservative treatment of the isthmic spondylolisthesis must be the first option for the patient. Chiropractic manipulative therapy and rehabilitation of the spine with isthmic spondylolisthesis can be an effective method of resolving symptoms associated with this condition.^{28,36,37}

Discussion

Al-Sebai⁶ reported an unusual case of triple spondylolysis of the lumbar spine. In this report the author stated that the patient's parents were close relatives. The implication of a close marriage as a cause of spinal defects

may be a causative factor in this case report. The patient's family history revealed that both his maternal and paternal grandparents were close relatives.

In evaluating a spondylolytic spine, radiographic analysis is a necessity. In this case study, the aid of the previous radiographs was helpful in determining that there was a progression of the spondylolisthesis. In addition it was determined that a second pars defect had been overlooked in the first two radiographic studies. It is suggested that practitioners should not simply rely on reports of others and if possible the treating practitioner should analyze the radiographs themselves.

Instability of the spine can be determined using dynamic radiographs of the lumbar spine in flexion and extension. If a 4 mm or more displacement of the vertebra is measured on the dynamic study then it is considered as an unstable segment.^{5,32} In this patient, there was a concern of whether his spine was unstable. Consequently, dynamic films were taken to investigate if there were excessive movement at the vertebral segments in question. The result of this patient's dynamic x-rays revealed a displacement of 1.5 mm at the L5 level, and 3mm at the L4 level. These amounts of displacement indicate that there was no instability. However, the L4 displacement of 3 mm would indicate a segmental hyper-mobile area. This would be reason enough for the clinician to highly recommend core strengthening and stability exercises in the rehabilitation program.

If spinal instability of the spine has been determined, chiropractic manipulation should be directed at the joint fixations above and below the spondylolysis and the sacroiliac joints when indicated.³⁸ Cassidy et al.³⁸ found that 80% of patients with spondylolysis responded favorably to spinal manipulations.^{38,39} However there is no evidence that a slippage can be reduced by a spinal adjustment directed at the level of spondylolisthesis. Even if possible, the normal loading elements of the vertebral motion segment would not be able to maintain the reduction.²¹ Direct manipulation of the involved area, especially in the prone position, has the potential risk of aggravating an instability of the spine.²¹

A possible serious sequelae of excessive displacement of an unstable lumbar vertebra is cauda equina.³⁴ It is suggested that the patient be informed that if symptoms of cauda equina syndrome arises then the situation calls for an emergency decompression. There is a 100%

chance of bowel and bladder dysfunction recovery if decompression is performed within 48 hours time.³³ If no immediate action is taken when spinal cord compression occurs then permanent damage may occur resulting in loss of bowel and bladder control, impotence, peri-anal anesthesia, and lower limb paresis.³⁴

In patients who do not have an unstable spondylolisthesis a rehab program should be implemented. The program should include short, medium and long term goals. Short term goals should be aimed at reducing pain and inflammation. Also, educating the patient in proper ergonomics, sleep, and sitting posture is recommended. Medium goals should be focused on activating the patient early on in the treatment process to prevent deconditioning. The transition of passive to active care is also important because this will help to minimize dependence, avoidance behavior, and abnormal illness behavior.⁴⁰ Long term goals should be directed at restoring normal strength, proprioception, coordination and efficiency of functioning elements.

The rehabilitation program should also include outcome assessment forms that should be filled out by the patient at the onset of care and at regular intervals until discharge. Outcome assessment forms are extremely useful in validating treatment, determining baseline values, and evaluating the recovery progress. Either Roland-Morris Low Back Disability Index (RMLBDI)⁴¹ or the OLBDQ²⁰ can be utilized along with Visual Analog Scale⁴² or Numeric Pain Scale.¹⁸ RMLBDI is more effective in assessing acute low back conditions whereas OLBDQ is more useful in assessing sub-acute and chronic low back problems.⁴³

An important focus of the rehabilitation program involving spondylolisthesis should be spinal stabilization exercises.^{44,45} Specifically, exercises should target and activate the transversus abdominus and multifidus muscles. In this case report, this patient achieved this using abdominal hollowing with trunk rotation and later with distal upper and lower limb exercises. Further advanced stabilization exercises were performed on a gym ball and wobble board.

Since the physical evaluation revealed that the patient had poor balance sensori-motor training was included in the rehabilitation program. In this patient, his proprioceptive training included the use of rocker boards, wobble boards, balance sandals, and gym balls.⁴⁶⁻⁴⁸

Garry and McShane⁴⁹ state that individuals who perform repetitive hyperextension in sports (such as weight lifting, gymnastics, football, and volleyball) have a higher incidence of spondylolysis. To avoid potential exacerbation of the patient's spondylolisthesis one should exclude extension type of exercises in the rehabilitation program.

Rehabilitative exercises should eventually continue at home upon discharge. The integration of a home program can be supervised during the treatment phase and eventual discharge of the patient with a good understanding of how to continue their individual care at home. Continued home exercises are important because dysfunction may persist or reoccur even though the pain level has resolved. In this case study, the patient continued to improve his OLBDQ scores even as he continued his program after discharge. The patient's OLBDQ score had dropped another 6%.

A home stretching program is important in maintaining adequate range of motion. In the spine with spondylolisthesis there are predictable muscles that have a tendency to become tight. Muscles that may require flexibility exercises include iliopsoas, hamstrings, lumbar erector spinae, gastrocnemius, and hip adductor muscles. Strength exercises in the patient with spondylolisthesis should include muscles such as the gluteals, abdominals, and quadriceps femoris muscles.

Conclusion

Many sources recommend limitations or complete elimination of sport activities once a diagnosis of spondylolisthesis is made. However, no evidence exists to support the theory that cessation of sports activity will prevent the development of more serious complications of spondylolisthesis in adults.⁴ Therefore, management of patients should be based on their clinical symptoms rather than the mere presence of spondylolysis or spondylolisthesis. Manipulation directly at the level of the involved segment is a contraindication. It is recommended that manipulation should be directed at joint fixations above and below the spondylolysis. Other contraindications to spinal manipulation include progressive neurological symptoms, and cauda equina syndrome. The clinician should give their patients the option of a conservative method of care before surgical intervention. Recommendations to the patient with symptoms related

to spondylolytic spondylolisthesis should include chiropractic manipulation, spinal rehabilitation and encouragement in continuing appropriate exercise and activity. The rehabilitation program in this patient played an important role in early activation of the patient, improving his coordination, strength, flexibility, spinal stability and function.

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CCA Research Career Award Announcement

The goal of this award is to recognize outstanding contributions to research on chiropractic topics and to advance the discipline of chiropractic. Eligible individuals will have contributed substantially during their professional career to chiropractic research topics as:

- a.) researchers, or as
- b.) facilitators of chiropractic research.

This is a career award given to both chiropractors and non-chiropractors. Those not eligible include members of the CCA Research Committee, CCRF Board and CCA Board.

The Chair of the CCA Research Committee invites nominations which must include:

1. a letter of nomination outlining the specific contribution,
2. a short CV of the nominee, and
3. a letter from the nominee stating that he/she is prepared to accept the award at the CCA Annual Meeting.

Please forward nominations by September 9, 2004 to:

Dr. Chris Martin, DC
Chair, CCA Research Committee
Canadian Chiropractic Association
1396 Eglinton Avenue West
Toronto, Ontario M6C 2E4
Email: clmchiro@telus.net