Clinical presentation and physiotherapy treatment of 4 patients with low back pain and isthmic spondylolisthesis

Silvano Ferrari PT^{a,b,*}, Carla Vanti PT, OMT^{c,d}, Caroline O'Reilly PT^e

^a Lecturer of Manual Therapy, Masters of Manual Therapy and Musculoskeletal Rehabilitation, University of Padova, Padova, Italy

^b Physical Therapist, Private Practitioner, Milan, Italy

^c Lecturer of Manual Therapy Sciences, School of Physiotherapy, University of Bologna, Bologna, Italy

^d Physical Therapist, Private Practice, Castenaso, Bologna, Italy

^e Senior Physiotherapist, Primary Care Team, Health Service Executive, Dublin South East Area, Dublin, Ireland

Received 10 July 2011; received in revised form 15 November 2011; accepted 18 November 2011

Key indexing terms:

Spondylolisthesis;
Low back pain;
Treatment outcome;
Physical examination;
Joint instability

Abstract

Objective: Spondylolisthesis is a pathological condition characterized by the slipping of a vertebral body, compared with the underlying one, following structural and/or degenerative changes of the spine. The purpose of this case series is to describe clinical presentations and the conservative physiotherapy management of 4 patients with low back pain and lumbar isthmic spondylolisthesis.

Clinical Features: Four patients aged 25, 43, 36, and 50 years presented with low back pain of various duration. Radiographs confirmed the presence of lumbar isthmic spondylolisthesis. Outcome measures included numerical rating scale, disability outcome measure (Oswestry Disability Index), spinal instability tests (Prone Instability Test, Passive Lumbar Extension test), and muscle function tests (Aberrant Movement Patterns, Active Straight Leg Raising, Prone and Supine Bridge Tests).

Intervention and Outcomes: Treatment consisted of postural reeducation, stretching, and strengthening exercises. Over the course of individualized treatment, ranging from 8 to 10 treatment visits, outcomes improved for all 4 patients.

Conclusion: This report describes varying clinical presentations and treatment of 4 patients with isthmic spondylolisthesis, suggesting that different pain generators could be managed by different conservative approaches.

© 2012 National University of Health Sciences.

* Corresponding author. Studio Arcobaleno, via Ramazzini 7, 20129 Milan, Italy. Tel.: +39 2 29517414; fax: +39 2 29512207.

E-mail address: silvano.ferrari@fastwebnet.it (S. Ferrari).

Introduction

Spondylolisthesis is a pathological condition characterized by the slipping of a vertebral body, compared with the underlying one, following structural and/or degenerative changes of the spine. Isthmic spondylolisthesis is the most common type of spondylolisthesis in young adults.^{1,2}

Patients with spondylolisthesis complain of pain that starts as incidental and worsens with activity. Usually, the pain is exacerbated by repetitive extension, rotation, return from a flexed position, and sudden or trivial activities; and it is relieved by resting.²⁻⁵ In some cases, patients may report radicular symptoms in one or both legs.⁶

Classification of patients with low back pain (LBP) into clinical subgroups is considered as being important.⁷ Instability is commonly considered a subgroup of chronic LBP,⁸⁻¹⁰ and recurrent LBP in spondylolisthesis is thought to be due to abnormal segmental movement.¹¹

However, clinical practice does not always confirm this hypothesis; and the pathomechanical behavior of lumbar spine instability is ambiguous and poorly defined. Correct diagnosis of patients whose pain is related to spinal instability is a controversial topic. For this reason, a Delphi Study was carried out by Cook et al¹² in 2006 to select the most common signs and symptoms associated with clinical instability of the spine.

There are some previously published case studies that describe treatment of patients with disk injury and LBP concomitant with spondylolisthesis,¹³⁻¹⁵ but these case studies do not focus on the practical relevance of the main clinical tests in detection of spinal instability. The aim of this study is to report clinical assessment and treatment in 4 symptomatic patients with isthmic spondylolisthesis referred to physiotherapy by a spine surgeon. These patients were of a similar age and had similar radiological imaging, but dissimilar clinical signs and symptoms. The varying clinical presentations among these patients oriented the physical therapist toward different physiotherapy treatment strategies.

Case reports

This study was done in compliance with Italian standards for informed consent. Each patient included in this report was informed that data

concerning his or her case would be submitted for publication and that patient confidentiality would be protected.

Description of tests and diagnosis procedures

Passive Lumbar Extension test (PLE)—The patient is in the prone position; both lower extremities are then elevated simultaneously to a height of about 30 cm from the table while maintaining the knees extended and gently pulling the legs.

The result of this test is considered as positive if the patient, during elevation of both lower legs, complains of symptoms in his or her lumbar region, including “low back pain,” “very heavy feeling on the low back,” and “feeling as if the low back was coming off” and if such pain disappears when the lower legs are repositioned in the starting position.

The sensitivity and specificity of the PLE are good (0.84 and 0.90, respectively).¹⁶

Prone Instability Test (PIT)—The patient lies in the prone position with the trunk on the examining table and both legs over the edge, with the feet resting on the floor. The examiner performs passive lumbar intervertebral motion testing posteroanterior (PA) mobilization. The patient is asked to report any provocation of pain. The patient then lifts the legs off the floor (hand-holding to the table may be used to maintain position), and the passive intervertebral motion testing is reapplied to any segments that were identified as painful. A positive test result occurs when pain is provoked during the first part of the test but disappears when the test is repeated with the legs off the floor.

The interexaminer reliability of the PIT is good (0.87).¹⁷

Active Straight Leg Raise Test (ASLR)—This test investigates the ability of the pelvic girdle to transfer loads from the lumbopelvic region to the legs. The patient lies in the supine position with his or her legs straight and relaxed in physiological lateral rotation, and feet 20 cm apart. The patient is instructed to raise a straight leg about 20 cm off the table. The patient is asked to report any weakness, pain, or other unpleasant feelings during the test and any difference in feeling between the 2 sides. The examiner observes the speed of raising, the appearance of a tremor in the leg, the amount of rotation of the trunk, and the verbal and nonverbal emotional expressions of the patient. Impairment is scored on a 4-point scale: 0 (the patient feels no restriction), 1 (the patient reports decreased ability to raise the leg, but the examiner does not observe any sign of impairment), 2 (the patient reports

decreased ability to raise the leg, and the examiner observes signs of impairment), and 3 (inability to raise the leg).

The ASLR results are clinically reliable in patients with LBP and pelvic girdle dysfunction.^{18,19} The sensitivity and specificity of the ASLR are good (0.87 and 0.94, respectively) for posterior pelvic pain in pregnancy.²⁰

Bridging maneuvers (Prone and Supine Bridge Tests) also seem to be reliable and valid methods to investigate stabilization endurance in patients with LBP.²¹

To perform the Prone Bridge Test, the patient lies in the prone position propped on his or her elbows. The elbows are spaced shoulder-width apart; and the feet are placed with a narrow base, but not touching. The patient raises his or her pelvis off the table so that only the forearms and the toes are in contact with the table. Shoulders, hips, and ankles are maintained in a straight line. This position is sustained until fatigue or pain prevents the maintenance of the test position. The Supine Bridge Test is performed in the supine position, with the lower limbs flexed and the soles of the feet on the table with a narrow base, but without touching. The thighs should not be in contact. The hands are positioned by the ears. The patient raises his or her pelvis from the table so that the shoulders, hips, and knees are maintained in a straight line. This position is held until fatigue or pain prevents the continued holding of the test position.

Aberrant Movement Pattern During Active Trunk Flexion is an observational test starting from the standing position. Selected authors¹⁻³³ have suggested that aberrant spinal motion during physiological movements that produce catching and disruption of a normal smooth arc of motion is suggestive of spinal instability. The patient is asked to bend forward as much as possible while the examiner identifies any abnormality in the movement pattern (painful arc during bending, painful arc on return, Gowers sign, instability catch, or reversal of lumbopelvic rhythm). The test result is considered as positive if any of these patterns is present.

Judgments of a painful arc during flexion and return from flexion both demonstrate substantial agreement (0.69 and 0.61, respectively). The other observations associated with trunk active range of motion (AROM) (Gowers sign, instability catch, reversal of lumbopelvic rhythm) demonstrate poor to fair reliability.¹⁷

Clinical Prediction Rules (CPRs) have been developed by Hicks et al³³ to determine which patients with LBP will respond to a stabilization exercise program.

The most important findings are age (<40 years), Straight Leg Raise (SLR) greater than 91°, positive PIT result, Aberrant Movement Pattern During Active Trunk Flexion, lumbar hypermobility during lumbar segmental spring testing, and fear-avoidance beliefs. The best prediction rule based on the positive likelihood ratio value is the presence of at least 3 of the predictor variables.

Finally, a Clinical Diagnosis System has been proposed by O' Sullivan⁴ for lumbar segmental instability based on the reporting of pain and the observation of movement dysfunction within the neutral zone and the associated finding of excessive intervertebral motion at the symptomatic level. Five different clinical patterns are described based on the directional nature of the injury and the manifestation of the patient's symptoms and motor dysfunction. The intertester reliability of this system appears to be from moderate to substantial for a range of patients within the nonspecific LBP population.³⁴

First case

A 50-year-old woman presented with LBP and symptoms referred to the right leg. Radiographs demonstrated a grade 1 isthmic anterolisthesis (L5 on S1) with bilateral spondylolytic defects of the pars interarticularis. Magnetic resonance imaging showed prolapse and pseudoprotrusion of the L5/S1 disk with normal diameter of the spinal canal. Radiographs during maximum flexion/extension were not available.

The patient complained of daily pain in the right lumbar zone with episodic paresthesia in the right leg, which had started 6 months previously and at the time of assessment was in a stable phase. The patient denied any history of trauma.

Her pain worsened on forward bending, in flexion or rotation activities, with changes in the lumbar spine position (eg, in the lying or sitting position), when using the ski lift, and when breaststroke swimming; the pain decreased on sitting.

Postural assessment showed segmental loss of the lower lumbar lordosis, which increased in flexion (posterior pelvic tilt). Flexion was associated with a painful arc, and the patient was unable to return from flexion to neutral without the use of her hands. Palpation of lumbar multifidus muscles revealed less muscular tone on the painful side.

The findings of the physical assessment are reported in Table 1.

Table 1 Results of clinical tests

Patient	PIT	PLE	ASLR	AM	SBT	PBT	NRS	ODI	SLR	CPR
Initial assessment										
1st case	+	–	++	+	20 s (onset of pain)	20 s (no pain)	60/100 (100/100 in the dynamic change position)	18%	>91°	3 of 4 present
2nd case	–	–	+	+	180 s	120 s	0/100	0%	80°	1 of 4 present
3rd case	–	–	+	±	150 s	25 s	70/100	20%	>91°	2 of 4 present
4th case	+	+	+	+	Absolutely impossible	Absolutely impossible	90/100	61%	10° right 20° left	3 of 4 present
Final assessment										
1st case (4 mo, 10 tx) ^a	+	–	–	–	100 s	55 s	10/100	12%	>91°	2 of 4 present
2nd case (6 mo, 8 tx) ^a	–	–	–	–	180 s	120 s	0/100	0%	85°	1 of 4 present
3rd case (3 mo, 8 tx) ^a	–	–	+	–	150 s	30 s	0/100	8%	>91°	1 of 4 present
4th case (4 mo, 10 tx) ^a	±	–	–	–	180 s	50 s	0/100	2%	>91°	1 of 4 present

AM, Aberrant Movement Test; SBT, Supine Bridge Test; PBT, Prone Bridge Test; tx, treatments.

^a Duration in months, number of treatments.

Clinical impression and physiotherapy treatment

The results of most of the instability tests and muscular endurance tests were positive. The patient was included in the instability subgroup. The clinical assessment suggested a lateral shift pattern, and the CPRs suggested likely benefit from stabilization exercises. Treatment aimed at improving motor control of the spinal muscles was established, according to the suggestions of Richardson et al.²³ Initially, specific exercises for the activation of the inner fibers of transversus abdominis and multifidus were performed. Progressively, the “core” exercises involved other muscles (rectus abdominis, internal oblique, spinal erectors, latissimus dorsi, gluteus maximus) that work together to improve stability. During the final phase of treatment, exercises to increase loading and stimulate a coordinated effort of these muscles were performed, with the goal of stabilizing and supporting the spine. A Swiss ball, “Step,” and “Bouncer” were used for this purpose. Much of the core strengthening exercises prescribed were performed at home with regular supervision by the physical therapist.

After 4 months and 10 treatment sessions, the CPR parameters were changed only with regard to aberrant movement patterns. At the end of treatment, the aberrant movement patterns were performed without any pain or postural modification. Several instability test results became negative, muscular endurance improved, and disability due to LBP decreased.

Second case

A 46-year-old man, working as a journalist and a very fit person, presented with LBP.

Radiographs showed a grade 1 isthmic anterolisthesis (L5 on S1) with bilateral spondylolytic defects of the pars interarticularis. Dynamic radiographs during maximum flexion/extension were not available.

The patient did not complain of pain on initial assessment, but 3 acute episodes during the previous year were reported. All of these episodes began with painful blocking during left flexion-rotation movements. The patient's pain improved with stretching exercises or with use of the inversion bench. He attended a gym, ran, and practiced martial arts.

Postural analysis showed moderate lordosis and relevant right rotation of the pelvic girdle. Forward bending was painless, and return from flexion to the neutral position was performed without difficulty. However, spinal flexion was combined with a lateral and rotational movement to the right. Palpation of the lumbar multifidus muscle revealed asymmetrical muscular tone.

The findings of the physical assessment are reported in Table 1.

Clinical impression and physiotherapy treatment

Three episodes of spinal blocking in a short time caused by the same movement could suggest lumbar

instability, but the absence of pain or disability between acute episodes was remarkable. Results of lumbar instability tests were contradictory, perhaps because of the patient's high level of fitness. The ASLR result was positive on the left side; and during this test, there was asymmetrical movement between the anterior superior iliac spines. This was probably not due to muscle dysfunction, but to asymmetric pelvic stiffness. Furthermore, lateral lumbar shift and right rotation in forward bending could be caused by incorrect posture, characterized by relevant right rotation of the pelvic girdle on the transverse plane in standing. The presence of only 1 of 4 CPRs did not indicate training with stability exercises, and the clinical diagnosis system proposed by O'Sullivan was inconclusive.

The clinical picture of this patient suggested that his lumbopelvic dysfunction may have been provoked by postural anomalies due to asymmetric pelvic rigidity.

The treatment was directed toward postural correction through specific stretching and Global Postural Reeducation (GPR).

The GPR is a physical therapy method based on the concept of the muscular system as formed by muscle chains, which can face shortening resulting from constitutional, behavioral, and psychological factors. The aim of GPR is to stretch the shortened muscles using the creep property of viscoelastic tissue and to enhance contraction of the antagonist muscles, thus avoiding postural asymmetry.³⁵

At the time of writing, following 8 sessions and 6 months of treatment, there have been no further acute episodes.

Third case

A 43-year-old woman presented with LBP. Static and dynamic radiographs showed a grade 1 isthmic anterolisthesis (L4 on L5) with bilateral spondylolytic defects of the pars interarticularis, which worsened significantly during dynamic radiographs in maximum flexion.

The onset of LBP was 4 months before assessment. The pain was located in the central lumbar zone and worsened when driving, during housework in spinal flexion, and when standing. There was a feeling of "giving way." Difficulty was reported in returning to an upright position after prolonged sitting on the sofa or after prolonged flexion.

Hyperlordotic posture was present. In forward bending, the hands reached the floor; and pain and spinal deviation were absent on return. A more

attentive observation showed that this movement was performed without modifying the lumbar lordosis. Moreover, there was inability to sustain the lumbar spine neutral position in semiflexed postures. Palpation revealed stiffness of lumbar muscles.

The findings of the physical assessment are reported in Table 1.

Clinical impression and physiotherapy treatment

The history indicated characteristics of lumbar instability (pain in semiflexed activities, feelings of "giving way," etc). However, the objective examination was contradictory because the PIT and PLE results were negative but, conversely, the ASLR and Aberrant Movement Patterns test (AMP) results were positive. The endurance test result was satisfactory, and only 2 signs were present among the CPRs: as a consequence, we were able to assume that a stabilization exercise program was not necessary. Nevertheless, a directional pattern of lumbar segmental instability was present. Although most of the instability findings were contradictory, the positive dynamic radiograph results during spinal flexion enforced the hypothesis that a flexion pattern was present. This was despite the fact that the lordosis did not flatten in flexion. The continuous spine relocation after every test prompted us to hypothesize a subtle form of instability, and the treatment was based on this hypothesis. After 3 months of motor control exercises (8 sessions of therapeutic exercises for spinal segmental stabilization according to Richardson et al), the patient was pain-free and had recovered full function.

Fourth case

A 25-year-old woman presented with LBP. Radiographs showed a grade 1 isthmic anterolisthesis (L5 on S1) with bilateral spondylolytic defects of the pars interarticularis; magnetic resonance imaging revealed a prolapse and pseudoprotrusion of the L5/S1 disk. The slipping of L5 significantly worsened during dynamic radiograph (particularly in maximum flexion).

The onset of LBP was 1 month before assessment, with no apparent cause. The pain was located in the left lumbar zone and referred along the left leg down to the ankle. All movements were painful and difficult.

The standing position was very painful, and a wide-based gait pattern was observed. Lumbar lordosis appeared to be significantly decreased. We could not perform lumbar flexion, extension, side bending, and twisting or the endurance tests because of the

significant pain the patient was experiencing. Palpation revealed relevant stiffness of the lumbar muscles. Weakness of the tibialis anterior and extensor hallucis longus muscles was found during the neurological examination. The SLR and crossed SLR test results were positive; superficial sensitivity on the lateral aspect of the left foot was also reduced.

The findings of the physical assessment are reported in Table 1.

Clinical impression and physiotherapy treatment

The high level of pain during the examination affected the results of the instability and movement tests. Three of 4 items were present among the CPRs, but the clinical presentation did not suggest a stabilization exercise program as being the most indicated treatment. In fact, this presentation could have potentially hidden a dominant discogenic pain. The goal of physiotherapy intervention was therefore treatment of disk derangement according to the McKenzie method of mechanical diagnosis and treatment. Left leg symptoms resolved, and this leg was pain-free after 2 months. Subsequently, a stabilization trial was carried out (therapeutic exercises for spinal segmental stabilization according to Richardson et al). After 4 months and 10 sessions, this patient was completely free of pain.

Discussion

Discussion of case presentation

The main history findings for lumbar instability are a feeling of “giving way” or of the back “giving out”; frequent self-manipulation to crack or pop the back; recurrent episodes; painful catching or locking during spine twisting or bending; pain during transitional activities (eg, sit to stand); greater pain returning to the erect position from flexion; and increase of pain with sudden, trivial, or mild movements. The main clinical signs are poor lumbopelvic control (including segmental hinging or pivoting with movement) as well as poor proprioceptive function, poor coordination/neuromuscular control (including juddering or shaking, and decreased strength and endurance of local muscles), and aberrant movement, including changing lateral shift during AROM.

Many clinical tests use signs and symptoms to identify instability in LBP patients. In scientific

literature, the PLE, PIT, ASLR, and AMP are the most cited ones. Other tests examine the endurance of spinal muscles (Bridge Testing). Nevertheless, we do not know if they are also pathognomonic in spondylolisthesis patients. Differential diagnosis of clinical instability associated with spondylolisthesis requires several clinical and diagnostic tests.²²⁻²⁴ Based on the current literature, the only pathognomonic finding during physical examination in spondylolisthesis is a reproduction of pain performing the 1-legged hyperextension maneuver (patient stands on 1 leg and leans backward). Unilateral lesions often produce pain standing on the ipsilateral leg.²⁵⁻²⁷ Nevertheless, controversial opinions are expressed about its usefulness for diagnosis,^{28,29} particularly because all studies of this sign concern young people with spondylolysis.

Regardless of the type of radiographic imaging (static or dynamic), there is insufficient evidence to relate the pathophysiological condition of spinal instability to the severity of the symptoms.³⁰ However, a weak abdominal wall, paravertebral muscle hypertrophy, increase in lumbar lordosis, observed slipping, hamstrings spasm, and pain during lateral trunk flexion-extension tasks and during double-leg raising tasks have been found to be positively related to radiological assessment.³¹

Some imaging modalities such as radionuclide scintigraphy (bone scan) and single-photon emission computed tomography can help in distinguishing symptomatic (active) from asymptomatic (inactive) spondylolysis.^{1,32} A lesion of the pars in the active phase could be either an impending stress fracture or one that has recently occurred. In both cases, there is an increase in local osteoblastic activity and therefore the potential for osseous healing. In the case of an inactive lesion, radiographs show an evident pars defect; but the result of the scintigraphic examination is normal. Many clinicians are unfamiliar with this concept of active and inactive lesions, but it is important for treatment options because an active situation must be treated with rest.

Instability of the spine may be classified into 2 categories: radiologically positive and clinically positive instability. However, it is questionable whether presentation of spinal pain depends on spondylolisthesis and whether spondylolisthesis (radiologically positive) always means an unstable spine. If the answer is yes, then instability tests should always be positive in symptomatic spondylolisthesis.

Several case studies have described treatment of patients with disk injury, LBP, and spondylolisthesis.¹³⁻¹⁵ Conservative management generally consists

of a variety of manipulative and exercise methods, with initial activity modification and a graded increase in activity along with therapeutic exercises including low-impact aerobic conditioning and core stabilization.^{1,4,36} Outcome measures indicated that our physiotherapy treatment was appropriate.

There is little scientific evidence to support the prognostic value of the history and physical examination in clinical decision making. Nevertheless, data from anamnesis and clinical tests are crucial in establishing the aims and procedures of physiotherapy.

Classification of patients with LBP into clinical subgroups seems to facilitate a more specific treatment approach and better outcomes.⁷ Lumbar segmental instability is considered to represent one of these subgroups,^{3,14,19,30} and correct diagnosis of patients whose pain comes from instability appears to be relevant for establishing effective treatment. Recurrent LBP in spondylolisthesis is thought to be due to abnormal segmental movement,⁶ weakness, and lack of muscle endurance: as a consequence, the treatment of this condition is directed toward the recovery of motor control.^{4,7,14}

However, clinical practice does not always confirm this hypothesis; and instigating motor control training in all patients with symptomatic spondylolisthesis without the certainty that the instability is the source of pain could be ambiguous and confusing.

In this study, we attempted to investigate the possibility of spondylolisthesis not having a linear relationship with clinical instability tests and the pain referred by patients. Four cases, similar for age, level, and grade of listhesis, showed that the findings from the subjective assessment and from various clinical tests were different: consequently, pain in these patients may have been due to different causes; and only for some patients were instability exercises the most appropriate treatment. Moreover, the adult age of the patients and the absence of early trauma excluded the possibility of an active phase of spondylolisthesis and the need for therapeutic rest.^{32,37}

Unfortunately, only 2 patients had initial dynamic radiographs; and we were unable to repeat dynamic radiographs at the end of treatment. Therefore, we cannot say if the clinical improvements observed were due to better joint stability or to improved muscle endurance, without any specific effect on spinal stability. However, from a clinical perspective, these considerations were not the main focus of this study.

Some relevant suggestions from the expert's panel of the Delphi Study¹² have been considered. This panel

was representative of the most talented clinicians in this targeted field. The Delphi information was used as a scale to determine those findings specifically associated with lumbar spine clinical instability. The Delphi participants also identified some tests to diagnose pain and excessive motion of 1 of 2 segments (segmental mobility) during a PA Spring Test, but no conclusions about the diagnostic accuracy of these tests were drawn.³⁸ There was little evidence to support the reliability of palpation for spinal instability assessment.^{39,40} As a consequence, we decided not to use these tests.

Outcome measures

Different outcomes were used to detect levels of pain, disability, and functional spinal stability in these patients.

The pain scores were based on self-reporting values, assigned by patients on a 101-point pain intensity numerical rating scale (NRS), where 0 = no pain and 100 = worst possible pain.

To rate the disability, the Italian version of the Oswestry Disability Index (ODI-I) was used. This questionnaire demonstrates good factorial structure and psychometric properties, replicating the results of the original and of other translated versions. It has been proven to be sensitive in detecting clinical changes after conservative treatment of subacute and chronic LBP.^{41,42}

According to Ostelo and de Vet,⁴³ the minimal clinically important change (MCIC) of the NRS for patients with subacute or chronic LBP is considered to be 2.5 points, in a scale ranging from 0 to 10. The MCIC of the ODI is considered to be 10 points.

On initial assessment, pain scores on the NRS ranged from 0 to 90 of 100. After treatment, the improvement regarding pain perception in all 3 symptomatic patients was superior to the above-cited MCIC because pain scores at the final evaluation ranged from 0 to 10 of 100.

The initial disability scores (ODI-I) ranged from 0% to 61%. Three patients had low disability scores (less than 20%), whereas 1 patient had a significant disability score (61%). All patients improved their score after treatment; interestingly, the patient with the greatest disability had the best results.

The tests for spinal stability (PIT, PLE) and the tests for muscular function (AMP, ASLR, and Prone and Supine Bridge Tests) showed different outcomes between the patients.

All patients improved following treatment that addressed both the specific complaints and the muscular function aspects.

In the cases presented here, a feeling of “giving way”; a need to frequently crack or pop the back; recurrent episodes of symptoms; history of painful catching or locking during spine twisting or bending; pain during transitional activities; increased pain returning to the erect position from flexion; and pain worsening with sudden, trivial, or mild movements were referred by 3 patients.

The true usefulness of many specific instability tests (PIT, PLE, ASLR) was not clear. In our cases, these test results were sometimes negative despite the fact that motor control training was necessary. The Bridge Tests, on the other hand, were coherent with other outcome measures and may be useful in detecting improvement.

Clinical Prediction Rules to identify which patients need motor control exercises are an interesting tool to improve clinical practice.¹² However, in these 4 cases, patients 1 and 4 had 3 signs of the 4 required to hypothesize successful motor control training; but only the first patient needed this treatment. Furthermore, patient 3 greatly improved with motor control training despite having only 2 favorable signs of 4.

O’Sullivan’s clinical diagnosis system,^{44,45} based on the reporting of pain and the observation of movement dysfunction, is a further way to detect which patients need stability exercises. In these 4 cases, it was useful in 2 patients.

Our opinion is that treatment should focus on attention to each specific clinical presentation and not on “diagnostic labeling” (ie, not assuming that spondylolisthesis = instability). These 4 cases showed differing clinical presentations. In our experience, it is preferable to consider each sign and symptom of the patient and then proceed to correct treatment through comprehensive clinical reasoning.

Based on the literature concerning clinical examination and treatment of isthmic spondylolisthesis, we used various orthopedic tests and tried to establish whether or not their results were related to the clinical presentation of each patient.

Lumbar instability depends not only on the altered morphology of the spine, but also (if not, indeed, principally) on the incorrect functioning of the neuromuscular system. Thus, to assess clinical instability, we propose the use of a cluster of signs and symptoms, which might include the principles of the CPRs, the suggestions of the Delphi Study experts, the clinical diagnosis system proposed by O’Sullivan, and

specific instability and endurance tests. No one part of this system could be considered more effective than another, but all of the parts used together might contribute to appropriate clinical diagnosis.

This study prompts us to suggest future directions of research based on investigation of specific patterns or clusters of signs and symptoms in patients suspected of suffering from clinical instability in the presence of spondylolisthesis. The diagnostic accuracy and reliability of specific tests for spinal instability in populations with measured instability need to be studied because, as this study has shown, clinical instability is quite difficult to assess and demonstrate.

Limitations

The limitations of this work are consistent with the specific type of article. A case report is anecdotal in nature. As a consequence, it should be interpreted with caution; and its results cannot be generalized beyond any individual case.

The outcome measures cited in this article have different rankings of validity. All tests used have sufficient reliability; but the diagnostic accuracy of tests such as the AMP, PIT, and the Bridge Tests are, at this time, still unknown. Furthermore, the ASLR seems clinically reliable in patients with LBP and pelvic girdle dysfunction; but its diagnostic accuracy has been tested only in pregnant women. The diagnostic validity of postural assessment is again a disputed topic. As a consequence, the use of orthopedic testing that lacks established validity may hold some pitfalls.

Moreover, the results of functional tests used to evaluate possible changes between baseline and discharge could be biased because of the same clinician performing both assessment and treatment.

We should also consider the fact that the absence of any intermediate follow-up and the long duration of the survey (from 3 to 6 months) do not allow us to exclude the possibility that factors besides physiotherapy treatment (spontaneous remission, modifications in lifestyle, etc) may have negatively or positively influenced the course of the patients’ LBP. Because there was no control group used, it is possible that the conditions were self-limiting or that the improvements were influenced by a placebo effect of getting supervised treatment. Finally, we cannot evaluate the amount and the clinical effectiveness of home exercises performed by the patients; and it is also possible that a nonspecific spinal stabilization program provided in each case could have achieved similar outcomes.

Conclusion

This report describes varying clinical presentations and treatment of 4 patients with isthmic spondylolisthesis, suggesting that different pain generators could be managed by different conservative approaches.

Funding sources and potential conflicts of interest

No funding sources or conflicts of interest were reported for this study.

References

- Haun DW, Kettner NW. Spondylolysis and spondylolisthesis: a narrative review of etiology, diagnosis, and conservative management. *J Chiropr Med* 2005;4(4):206-17.
- Earl JE. Mechanical aetiology, recognition, and treatment in spondylolisthesis. *Phys Ther in Sport* 2002;3:79-87.
- Garry J, McShane J. Lumbar spondylolisthesis in adolescent athlete. *J Fam Pract* 1998;47(2):145-9.
- O'Sullivan P. Lumbar segmental instability. Clinical presentation and specific stabilizing exercise management. *Man Ther* 2000;5(1):2-12.
- Smith J. Moving beyond the neutral spine: stabilizing the dancer with lumbar extension dysfunction. *J Dance Med Sci* 2009;13(3):73-82.
- Jenkins J, Rauch A. Magnetic resonance imaging of entrapment of lumbar nerve root in spondylolytic spondylolisthesis. *J Bone Joint Surg Am* 1994;76:1643-8.
- Delitto A, Erhard RE, Bowling RW. A treatment based classification approach to low back syndrome: identifying and staging patients for conservative treatment. *Phys Ther* 1995;75:470-89.
- Fritz J, Erhard R, Hagen B. Segmental instability of the lumbar spine. *Phys Ther* 1998;78:889-96.
- Panjabi MM, Lydon C, Vasavada A, Grob D, Crisco JJ, Dvorak J. On the understanding of clinical instability. *Spine* 1994;19:2642-50.
- Silfies SP, Metha R, Smith SS, Karduna AR. Differences in feedforward trunk muscle activity in subgroups of patients with mechanical low back pain. *Arch Phys Med Rehabil* 2009;90(7):1159-69.
- Stinson G. Spondylolysis and spondylolisthesis in the athlete. *Clin Sports Med* 1993;12(3):517-28.
- Cook C, Brismée JM, Sizer PS. Subjective and objective descriptors of clinical lumbar spine instability: a Delphi study. *Man Ther* 2006;11(1):11-21.
- Wong LC. Rehabilitation of a patient with a rare multi-level isthmic spondylolisthesis: a case report. *J Can Chiropr Assoc* 2004;48(2):142-51.
- Taylor DN. Spinal synovial cysts and intersegmental instability: a chiropractic case. *J Manipulative Physiol Ther* 2007;30(2):152-7.
- Excoffon SG, Wallace H. Chiropractic and rehabilitative management of a patient with progressive lumbar disk injury, spondylolisthesis, and spondyloptosis. *J Manipulative Physiol Ther* 2006;29(1):66-71.
- Kasai Y, Morishita K, Kawakita E, Kondo T, Uchida A. A new evaluation method for lumbar spinal instability: passive lumbar extension test. *Phys Ther* 2006;86:1661-7.
- Hicks GE, Fritz JM, Delitto A, Mishock J. Interrater reliability of clinical examination measures for identification of lumbar segmental instability. *Arch Phys Med Rehabil* 2003;84:1858-64.
- Liebenson C, Karpowicz AM, Brown SH, Howarth SJ, McGill SM. The active straight leg raise test and lumbar spine stability. *PM R* 2009;1:530-5.
- Roussel NA, Nijs J, Truijzen S, Smeuninx L, Stassijms G. Low back pain: clinimetric properties of Trendelenburg test, active straight leg raise test, and breathing pattern during active straight leg raising. *J Manipulative Physiol Ther* 2007;30:270-8.
- Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. *Spine* 2001;26:1167-71.
- Schellenberg KL, Lang JM, Chan KM, Burnham RS. A clinical tool for office assessment of lumbar spine stabilization endurance: prone and supine bridge maneuvers. *Am J Phys Med Rehabil* 2007;86:380-6.
- Cresswell A, Thortensson A. Changes in intra-articular pressure, trunk muscle activation and force during isokinetic lifting and lowering. *Eur J Appl Physiol* 1994;68:315-21.
- Richardson C, Jull G, Hodges P, Hides J. Therapeutic exercise for spinal segmental stabilization in low back pain: scientific basic and clinical approach. Edinburgh: Churchill Livingstone; 1999. p. 158.
- Taylor J, O'Sullivan P. Lumbar segmental instability: pathology, diagnosis and conservative management. In: Twomey L, Taylor J, editors. *Physical therapy of the low back*. 3rd ed. Philadelphia: Churchill Livingstone; 2000. p. 201-47.
- Logroscino G, Mazza O, Aulisa AG, Pitta L, Pola E, Aulisa L. Spondylolysis and spondylolisthesis in the pediatric and adolescent population. *Child's Nerv Syst* 2001;17:644-55.
- Standaert DC, Herring S, Halpern B, King O. Spondylolysis. *Phys Med Rehabil Clin North Am* 2000;11:785-803.
- Syrrou E, Tsitsopoulos PP, Marinopoulos D, Tsonidis C, Anagnostopoulos I, Tsitsopoulos PD. Spondylolysis: a review and reappraisal. *Hippokratia* 2010;14(1):17-21.
- Masci L, Pike J, Malara F, Phillips B, Bennell K, Brukner P. Use of the one-legged hyperextension test and magnetic resonance imaging in the diagnosis of active spondylolysis. *Br J Sports Med* 2006;40:940-6.
- Ralston S, Weir M. Suspecting lumbar spondylolysis in adolescent low back pain. *Clin Pediatr (Phila)* 1998;37(5):287-93.
- Hayes MA, Howard TC, Gruel CR, Kopta JA. Roentgenographic evaluation of the lumbar spine flexion-extension in asymptomatic individuals. *Spine* 1989;14:327-31.
- Kalpakioglu B, Altinbilek T, Senel K. Determination of spondylolisthesis in low back pain by clinical evaluation. *J Back Musculoskelet Rehabil* 2009;22(1):27-32.
- Yochum TR, Rowe LJ. Natural history of spondylolysis and spondylolisthesis. *Essentials of skeletal radiology*. Baltimore: Williams & Wilkins; 1987. p. 243-72.

33. Hicks GE, Fritz JM, Delitto A, McGill SM. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil* 2005;86:1753-62.
34. Vibe-Fersum K, O'Sullivan PB, Kvåle A, Skouen JS. Inter-examiner reliability of a classification system for patients with non-specific low back pain. *Man Ther* 2009;14:555-61.
35. Bonetti F, Curti S, Mattioli S, Mugnai R, Vanti C, Violante F, et al. Effectiveness of a 'Global Postural Reeducation' program for persistent low back pain: a non-randomized controlled trial. *BMC Musculoskelet Disord* 2010;16(11):285.
36. Dunn AS, Baylis S, Ryan D. Chiropractic management of mechanical low back pain secondary to multiple-level lumbar spondylolysis with spondylolisthesis in a United States Marine Corps veteran: a case report. *J Chiropr Med* 2009;8(3):125-30.
38. Cattrysse E, Swinkels R, Oostendorp R, Duquet W. Upper cervical instability: are clinical tests reliable? *Man Ther* 1997; 2:91-7.
39. Olson K, Paris S, Spohr C, Gorniak G. Radiographic assessment and reliability study of the craniovertebral side-bending test. *J Man Manip Ther* 1998;6:87-96.
40. Gonnella C, Paris S, Kutner M. Reliability in evaluating passive intervertebral motion. *Phys Ther* 1982;62:436-44.
41. Monticone M, Baiardi P, Ferrari S, Foti C, Mugnai R, Pillastrini P, et al. Development of the Italian Version of the Oswestry Disability Index (ODI-I). A cross-cultural adaptation, reliability, and validity study. *Spine* 2009;34(19):2090-5.
42. Monticone M, Baiardi P, Vanti C, Ferrari S, Pillastrini P, Mugnai R, et al. Responsiveness of the Oswestry Disability Index and the Roland Morris Disability Questionnaire in Italian subjects with sub-acute and chronic low back pain. *Eur Spine J* 2012;21(1):122-9.
43. Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. *Best Pract Res Cl Rh* 2005;19(4):593-607.
44. O'Sullivan PB, Twomey LT, Allison GT. Evaluation of specific stabilizing exercise in the treatment of chronic low back pain with radiologic diagnosis of spondylolysis or spondylolisthesis. *Spine* 1997;22(24):2959-67.
45. Dankaerts W, O'Sullivan P. The validity of O'Sullivan's classification system (CS) for a sub-group of NS-CLBP with motor control impairment (MCI): overview of a series of studies and review of the literature. *Man Ther* 2011;16:9-14.