Pain, Disability, and Diagnostic Accuracy of Clinical Instability and Endurance Tests in Subjects With Lumbar Spondylolisthesis

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Abstract

Objective: The aims of this study were (1) to investigate the relationship between the main clinical tests to detect spinal instability, the perceived pain and disability, and symptomatic spondylolisthesis (SPL) characteristics, (2) to investigate the relationship between endurance and instability tests, and (3) to measure the diagnostic accuracy of these tests in unstable SPL diagnosed against dynamic radiographs.

Methods: Four instability tests were evaluated on 119 subjects: aberrant movements, active straight leg raising (ASLR), prone instability test, and passive lumbar extension test (PLE); and 2 endurance tests, prone bridge test and supine bridge test (SBT). The results were compared with the numeric rating scale for pain and the Oswestry Disability Index for disability. These tests were used as index tests and compared with dynamic radiographs as reference standard on 64 subjects.

Results: A significant relationship between disability and all the clinical tests but ASLR was observed. The relation between tests and pain was weaker, not significant for prone instability test and aberrant movement and critical for ASLR ($P = .05$). There was a low relationship between endurance tests and instability tests. Only PLE showed a significant association with dynamic radiographs ($P = .017$).

Conclusion: Endurance and instability tests appear to be weakly related to the amount of pain but significantly related to the disability in symptomatic SPL. Of the tests evaluated, PLE exhibited the best ability to predict positive dynamic radiographs. (J Manipulative Physiol Ther 2014;37:647-659)

Key Indexing Terms: *Joint Instability; Musculoskeletal Disease; Physical Examination; Spondylolisthesis*

Recurrent low back pain (LBP) in symptomatic spondylolisthesis (SPL) is thought to be due to abnormal segmental movement.[1,2] Traditionally, the radiologic diagnosis of SPL, in subjects with chronic LBP attributable to this finding, has been considered one of the most obvious manifestations of lumbar instability.[3,4]

The concept of structured lumbar segmental instability was first proposed by Knuttson[5] who advocated the assessment of lumbar segmental instability from the displacement (anterior or posterior translation) of lumbar vertebrae on lateral radiographs taken at end-range spinal flexion and extension. This is still considered a criterion standard.[6-8]

A proportion of patients with SPL presents highly abnormal movements. Furthermore, some clinical signs turned out to be positively related with radiologic assessment.[9,10] However, it is questionable whether a spine with SPL (radiologically positive) is always an unstable spine.[11-13]

Subsequently, White and Panjabi[14] proposed to define spinal functional instability as the loss of the spine's ability to limit its movements under physiologic loads such that neurologic disturbances, deformation, or pain is prevented. Panjabi[15] further emphasized that spinal stability depends on the contributions of 3 subsystems (the passive, the active, and the control subsystem). Whereas functional instability is

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assumed to exist throughout all spinal motion, its assessment is specifically focused on midrange spinal movements, where the neutral zone is suggested to be more manifested.

Some evidence linked a poor control of intervertebral motion with specific LBP groups, and different tests were proposed to subclassify LBP, improve management strategies, and measure outcomes.[16-18] More specifically, these tests aim at recognizing a loss of dynamic trunk stabilization during tests and functional movements or a loss of muscle endurance.[19]

Some tests use palpation techniques and passive movements to determine if the mobile segment is in fact symptomatic and responsible of the patient's symptoms.[20-22] Other tests assess the patient's ability to isolate the activation of the local muscle system without a relevant activation of the global muscle system[23,24] or seek any lack of control of deep muscles and/or compensation during posture and movements.[25,26] Moreover, other tests detect the presence of aberrant movement (AM) during lumbar active motion.[1,27]

Concerning the endurance, some studies showed that endurance is more effective than strength to discriminate between healthy subjects and individuals with CLBP,[28,29] and people with LBP presented lower muscle endurance than those without LBP.[30-33] Bridging exercises are a commonly used form of endurance assessment and training, and they can be applied to a large spectrum of patients with LBP.[34,35]

The tests most commonly used to detect the lumbar instability are the AMs, the active straight leg raising test (ASLR), the passive lumbar extension test (PLE), and the prone instability test (PIT); whereas the tests most commonly used to detect the lumbar muscles endurance are the prone bridge test (PBT) and the supine bridge test (SBT). Recently, some of tests cited above were included in the American "Clinical Practice Guidelines linked to the International Classification of Functioning, Disability and Health," and their use was suggested to assess the impairments of body functions in patients with LBP.[19]

Unfortunately, a complete investigation of their diagnostic accuracy is still needed. The different characteristics of the studies (population, signs, comparison, and outcomes) do not allow to understand which tests are indicated in which subgroups of patients. Most of the studies concerned nonspecific or chronic LBP, and only the study of Kasai et al[22] focused on specific conditions of LBP (spinal stenosis, lumbar degenerative scoliosis, and lumbar SPL). As a consequence, we do not know if signs and symptoms used to identify instability and mechanical dysfunction in LBP subjects are pathognomonic also in SPL subjects.

Therefore, the aims of this study are (1) to investigate the relationship between the results of the main clinical tests to detect spinal impairments (instability and endurance) and the perceived pain and disability and SPL characteristics in subjects with symptomatic SPL; (2) to investigate the relationship between endurance tests and instability tests; and (3) to investigate the diagnostic accuracy of these tests in symptomatic unstable SPL diagnosed by dynamic radiographs, particularly their ability to predict positive dynamic radiographs.

Methods

This study involved the physical and rehabilitation medicine units of a research hospital and 2 affiliated rehabilitative centers. The Institutional Review Board of the Operative Unit of Physical and Rehabilitation Medicine, Salvatore Maugeri Foundation, Scientific Institute of Lissone, Milan, Italy approved the study.

Subjects

Subjects with symptomatic SPL as diagnosed by orthopedic doctors or spinal surgeons and referred to the physical therapy facilities to receive conservative treatments were eligible for the study (n = 128). The inclusion criteria were older than 18 years, LBP with or without referred pain, diagnosis of SPL confirmed by radiographs, computed tomography or magnetic resonance imaging (MRI), and ability in spoken and written Italian. Exclusion criteria were any previous lumbar surgery, systemic diseases (inflammatory, infectious, cancer, etc), neuromuscular disorders, or cognitive deficits. In the end, 119 subjects participated to the study (Fig 1), which was performed from March 2012 to September 2013.

Each subject gave written consent and was informed that data concerning her/his case would have been submitted for publication. In the informed consent form, it was stated that the study involved some diagnostic tests and that the results of these tests would not have influenced the physical therapy program. Patients' rights and confidentiality were protected. The included subjects filled out a form with questions concerning some demographic and clinical information, such as age, sex, level of education, height, weight, location, duration and frequency of pain, medications, and comorbidity.

Examiners

Before the study started, the examiners standardized the execution of the tests in a meeting. In the first physical therapy sessions, researchers' assistants collected information on the sensitive data of the patients, on the type, level, and grade of SPL, and on results of imaging, in a separate room. Each examiner was blinded to this information. The examiners were physical therapists with several years of practice in orthopaedic manual therapy of musculoskeletal disorders. The administrative staff built an electronic database with the collected data.