Manual Therapy 19 (2014) 602–607

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Patient-reported perception of difficulty as a clinical indicator of dysfunctional neuromuscular control during the prone hip extension test and active straight leg raise test

Paul A. Bruno [a, *], Dale A. Goertzen [b], David P. Millar [b]

[a] Faculty of Kinesiology and Health Studies, University of Regina, 3737 Wascana Parkway, Regina, Saskatchewan, S4S 0A2, Canada
[b] Private Practice, Regina, Saskatchewan, Canada

ARTICLE INFO

Article history:
Received 2 December 2013
Received in revised form
28 May 2014
Accepted 5 June 2014

Keywords:
Low back pain
Rehabilitation
Diagnostic test

ABSTRACT

Two clinical tests used to assess for neuromuscular control deficits in patients with low back pain (LBP) are the prone hip extension (PHE) test and active straight leg raise (ASLR) test. For these tests, it has been suggested that patients be classified as "positive" if they demonstrate specific "abnormal" lumbopelvic motion patterns. For the ASLR test, the use of patient-reported perception of difficulty is also used to assess neuromuscular control. Thirty participants with LBP and 40 asymptomatic controls took part in this cross-sectional observational study. Participants performed both tests and were classified as "positive" or "negative" based on the presence or absence (respectively) of specific "abnormal" motion patterns. The participants also rated their perceived difficulty in performing the tests using a six-point scale. A two-way analysis of covariance (ANCOVA) was used to examine the effects of group (LBP/control) and examiner classification (positive/negative) on the perceived difficulty scores for each test. The LBP group perceived greater difficulty in performing both tests compared to the control group. Conversely, there was no significant difference in the perceived difficulties of the positive and negative examiner classifications for either test. Additional investigation is required to comment further on the relative usefulness of the perceived difficulty and observable motion patterns during these tests in assessing the neuromuscular control strategies of the lumbopelvic region, and their potential as a diagnostic tool or treatment outcome.

1. Introduction

It is well-established that the coordination of muscle activity around the lumbopelvic region is vital to the generation of mechanical spinal stability (Cholewicki and McGill, 1996; McGill et al., 2003). People with low back pain (LBP) have been shown to demonstrate neuromuscular control alterations in a variety of muscles and during the performance of a variety of tasks (Hodges and Richardson, 1996, 1998; Leinonen et al., 2000; Newcomer et al., 2002; Hungerford et al., 2003; Vogt et al., 2003; Bruno and Bagust, 2007; Scholtes et al., 2009). As highlighted in a recent review by Hodges and Tucker (2011), current evidence suggests that these alterations are highly variable (i.e. they do not appear to be uniform within or between individuals) and involve multiple levels of the neuromuscular control system. Assessing the neuromuscular control strategies of patients with LBP would allow clinicians to target treatment aimed at correcting specific neuromuscular control deficits. Methods have been proposed to estimate spinal stability by objectively quantifying the neuromuscular control strategies used during specific postures or tasks (Cholewicki and McGill, 1996; Howarth et al., 2004). However, these have limited value clinically since they involve the use of advanced technology (e.g. electromyography, motion capture) and complex mathematical modelling. Practical clinical tests that demonstrate sufficient reliability and validity in assessing the neuromuscular control strategies of patients with LBP are therefore needed. Two tests that have potential in this regard are the prone hip extension (PHE) test and active straight leg raise (ASLR) test.

The PHE test involves having a patient lay prone and alternately lift each leg off the table to a height of ~20 cm whilst an examiner observes for three specific "abnormal" lumbar spine motion patterns during the test: 1) rotation of the lumbar spine such that the spinous processes appear to move toward the side of hip extension, 2) a lateral shift of the lumbar spine toward the side of hip

* Corresponding author. Tel.: +1 (306) 337 3343; fax: +1 (306) 585 4854.
E-mail address: paul.bruno@uregina.ca (P.A. Bruno).

http://dx.doi.org/10.1016/j.math.2014.06.002
1356-689X/

extension, and 3) extension of the lumbar spine (Murphy et al., 2006). The inter-examiner agreement of classifying patients with LBP as "positive" or "negative" based on the presence or absence (respectively) of these motion patterns has been shown to be good (Murphy et al., 2006). However, the trustworthiness of this result has been questioned by the authors of a recent systematic review (Carlsson and Rasmussen-Barr, 2013), who deemed the study by Murphy et al. (2006) to be at a high risk of bias using the Quality Appraisal of Reliability Studies (QAREL) checklist (Lucas et al., 2010).

The ASLR test was originally proposed as a clinical tool to evaluate the ability of the sacroiliac joints to effectively transfer loads between the pelvis and legs in females with pregnancy-related pelvic pain (Snijders et al., 1993; Mens et al., 1999). More recently, some authors have proposed that this test may have potential in the assessment of the neuromuscular control strategies of the lumbopelvic region in the general LBP population (Roussel et al., 2007; Liebenson et al., 2010). The test is similar to the PHE test, with the patient supine (rather than prone) and asked to alternately lift each leg away from the table to a height of ~20 cm (Mens et al., 2001; Roussel et al., 2007). The method of rating the patient's performance on the test is described variously in the literature. Most descriptions involve having the patient rate his/her perceived difficulty in performing the movement using a six-point scale (Mens et al., 2001; Mens et al., 2002; Roussel et al., 2007; Mens et al., 2010; Robinson et al., 2010a, 2010b; Mens et al., 2012). The test–retest reliability of this rating scale (weighted kappa = 0.70–0.71: Roussel et al., 2007) in patients with non-specific LBP has been reported. This study by Roussel et al. (2007) was deemed to be at a low risk of bias by the authors of a recent systematic review (Carlsson and Rasmussen-Barr, 2013). Additionally, the sensitivity and specificity of this rating scale has been reported for pregnancy-related pelvic pain (Sensitivity: 0.54–0.87, Specificity: 0.88–0.94; Mens et al., 2001, 2012) and for non-pregnancy-related low back and/or pelvic pain (Sensitivity: 0.71, Specificity: 0.59–0.91; Kwong et al., 2013; Nelson-Wong et al., 2013).

Some authors have also proposed that an inability to maintain a neutral alignment of the pelvis during the ASLR test indicates the presence of a neuromuscular control deficit (Mens et al., 2001; Hungerford et al., 2004; Roussel et al., 2007; Rabin et al., 2013). The inter-examiner agreement of classifying patients with LBP as "positive" or "negative" based on their inability or ability (respectively) to maintain a neutral pelvic alignment during the test has not been reported. There are also no published studies related to the potential usefulness of a patient's perceived difficulty as an outcome during the PHE test. Additionally, whether an association exists between examiner-reported classifications (positive/negative) and patient-reported perceptions of difficulty during either of these tests has not been reported.

Therefore, the objectives of this study were to investigate: 1) whether participant-reported perception of difficulty for these two tests is different between patients with LBP and asymptomatic individuals, 2) whether participant-reported perception of difficulty for these two tests is different between positive and negative examiner classifications, and 3) the sensitivity and specificity of participant-reported perception of difficulty scores in individuals with non-pregnancy-related LBP (sensitivity) and asymptomatic controls (specificity).

2. Methods

2.1. Participants

A convenience sample of 30 participants with LBP and 40 asymptomatic controls were recruited to take part in this cross-sectional observational study. The demographic information for the LBP group and control group is presented in Table 1. LBP participants were recruited from local medical, chiropractic, physiotherapy, and massage therapy clinics. Control participants were recruited from the students, faculty, and staff of the University of Regina. All participants were naïve to the purpose of the study and provided written informed consent. The study was approved by the University of Regina Research Ethics Board.

A priori exclusion criteria for *all* participants included: adults under 20 years of age or over 40 years of age; history of hip joint injury or trauma, lumbar spine surgery, spinal arthritic disorders, central nervous system disorders, or neuromuscular disorders; unable to perform painless active hip ranges of motion; true leg length inequality >1 cm; and currently pregnant or recently postpartum (<1 year) females. Additional exclusion criteria for the *LBP group* included: history of significant trauma or unexplained weight loss; LBP not confined to an area between the lower ribs and gluteal folds with or without referral into the lower limbs above the knees; presence of radicular signs (e.g. myotomal motor weakness, deep tendon reflex differences) or nerve root tension tests (e.g. straight leg raise test) in the lower limb; current episode of LBP was not present for at least one month and on most days over the previous month; and average LBP over the previous week <2/10 on a Numerical Pain Rating Scale (NPRS) (Childs et al., 2005). An additional criterion for the *control group* was a history of any spinal or lower limb injury that prevented the performance of normal activities for at least one day in the previous three months.

2.2. Examiners

Two of the investigators (DG, DM), both of whom are licensed chiropractors with over 30 years of clinical experience, examined and provided classifications (see Procedures) for all participants. Prior to the initiation of data collection, the examiners underwent a joint training phase. At the first meeting, a consensus was achieved between the two examiners regarding the specific procedure and criteria to be used for each test. Following this, three sessions were conducted during which undergraduate student and faculty volunteers performed the tests whilst the examiners discussed their findings and clarified any discrepancies in classifications. Adequate training has been shown to be more important than the examiners' collective experience with a testing procedure for observation-based clinical tests (Ageberg et al., 2010).

2.3. Procedures

All data collection sessions took place in the same room in the Faculty of Kinesiology and Health Studies' Neuromechanical Research Centre at the University of Regina. Upon presentation, participants were provided with a study information sheet and

Table 1
Demographic information for the low back pain (LBP) group and control group.

		LBP group	Control group
Gender (#)	Males	10	20
	Females	20	20
Age (years)	Mean (SD)	27.7 (5.9)	27.7 (6.1)
Height (cm)	Mean (SD)	171.1 (9.8)	173.3 (10.3)
Weight (kg)	Mean (SD)	71.0 (16.4)	71.2 (17.7)
LBP duration (months)	Median (range)	6 (1–168)	–
NPRS (0–10)	Median (range)	5 (2–7)	–
ODI (0–100)	Median (range)	14 (6–36)	–

Abbreviations: Numerical Pain Rating Scale (NPRS), Oswestry Disability Index (ODI).
No statistically significant ($p < 0.05$) between-group differences were noted for gender, age, height, or weight.