

## Reliability and Validity of the Active Straight Leg Raise Test in Posterior Pelvic Pain Since Pregnancy

Jan M. A. Mens, MD,\*† Andry Vleeming, PhD,\* Chris J. Snijders, PhD,‡  
Bart W. Koes, PhD,§ and Henk J. Stam, MD, PhD†

**Study Design.** A cross-sectional analysis was performed in a group of women meeting strict criteria for posterior pelvic pain since pregnancy (PPPP). The scores on the Active Straight Leg Raise Test (ASLR test) were compared with the scores of healthy controls.

**Objectives.** To develop a new diagnostic instrument for use in patients with PPPP. The objectives of the present study were to assess the validity and reliability of the ASLR test.

**Summary of Background Data.** Various diagnostic tools are used to diagnose PPPP, but there is still a need for simple tests with high reliability, sensitivity, and specificity.

**Methods.** Reliability of the ASLR test was assessed in a group of 50 women with lumbopelvic pain of various etiologies and various degrees of severity. Sensitivity was assessed in 200 patients with PPPP and specificity in 50 healthy women. Sensitivity and specificity of the ASLR test were compared with the posterior pelvic pain provocation test (PPPP test).

**Results.** The test-retest reliability measured with Pearson's correlation coefficient between the two ASLR scores 1 week apart was 0.87. The intraclass correlation coefficient (ICC) was 0.83. Pearson's correlation coefficient between the scores of the patient and the scores of a blinded assessor was 0.78; the ICC was 0.77. In the patient group, the ASLR score ranged from 0-10; in the control group it ranged from 0-2. The best balance between specificity and sensitivity was found when scores 1-10 are designated as positive and zero as negative. With this cut-off point sensitivity of the test was 0.87 and specificity was 0.94. The sensitivity of the ASLR test is higher than the sensitivity of the PPPP test; an advantage of the ASLR test is the simplicity of measuring the score.

**Conclusion.** The ASLR test is a suitable diagnostic instrument to discriminate between patients who are disabled by PPPP and healthy subjects. The test is easy to perform; reliability, sensitivity, and specificity are high. It seems that the integrity of the function to transfer loads between the lumbosacral spine and legs is tested by the ASLR test. [Key words: diagnostic tests, low back pain, sacroiliac joint, pregnancy] *Spine* 2001;26:1167-1171

The use of diagnostic instruments in lumbopelvic pain is mainly to categorize patients in groups with different prognoses and to measure disease severity. The value of physical examination, and radiography is limited.<sup>9,16,19-21</sup> A need exists for simple tests with high validity, sensitivity and specificity.<sup>9</sup>

From the \*Spine & Joint Centre, and the Departments of †Rehabilitation Medicine, ‡Biomedical Physics and Technology, and §General Practice Medicine, Faculty of Medicine and Health Sciences, Erasmus University Rotterdam, Rotterdam, The Netherlands.  
Acknowledgment date: April 21, 2000.

Pregnancy is frequently complicated by the occurrence of lumbopelvic pain; the reported cumulative 9-month incidence ranges from 48%-56%.<sup>2,4,8,12</sup> Posterior pelvic pain since pregnancy (PPPP) is often described as a distinct category.<sup>7,12,13,17</sup> It remains questionable whether PPPP is a specific syndrome or just nonspecific lumbopelvic pain with an onset during pregnancy or delivery. Regardless of the answer, detailed study on the characteristics of PPPP could provide better understanding of lumbopelvic pain in general.

To discriminate patients with PPPP from healthy subjects, various instruments have been investigated. Mobility of the pelvic joints assessed by the Chamberlain method showed a range of motion between the pubic bones of  $5.9 \pm 3.3$  mm in puerperal women with pelvic pain since pregnancy and  $1.9 \pm 2.2$  mm in a group of puerperal women without pelvic pain.<sup>1,3</sup> As far as is known, the specificity of this method was never studied in PPPP with a disease duration exceeding 6 months. In two studies in pregnant women the posterior pelvic pain provocation test (PPPP test) scored high both on sensitivity (0.69-0.81) and specificity (0.80-0.90).<sup>7,13</sup> "Catching" of the leg (the phenomenon whereby a patient feels difficulty in moving one or both legs forward when walking) is described as a diagnostic sign in PPPP.<sup>17</sup> The specificity of this sign was similar to that of the PPPP test, but its sensitivity was much lower; the reliability of this sign has, as far as we know, never been investigated.

The setting provides the opportunity to examine a large group of patients with PPPP. It was noticed that in most patients active raising of one or both legs in the supine position was weak. Many patients report pain during this action, even though most also describe feeling as though they were paralyzed. As early as 1839, the Swedish gynecologist Cederschjöld gave a description of a condition that he called "joint loosening" in pregnant and puerperal women.<sup>5</sup> One of the described characteristics was the "difficulty or almost impossibility of even moving the lower limbs." He assessed "... an instantaneous relief in the pains and the ability to move the limbs when the hips are pressed hard together with the hands." In a previous study, a significant association was found between impaired active straight leg raising (ASLR) and radiographically measured mobility of the pelvic joints.<sup>11</sup>

The aim of the present study is to investigate the usefulness of this phenomenon as a diagnostic instrument in women with PPPP. More specifically, the reliability and

the validity of the Active Straight Leg Raising Test (ASLR test) to diagnose PPPP were investigated.

### ■ Materials and Methods

**Subjects.** Patients were selected from the outpatient clinic of a rehabilitation center, specialized in the treatment of pregnancy-related lumbopelvic pain.

**Reliability.** Test-retest reliability was performed in a group of 50 women with lumbopelvic pain of various etiologies and various degrees of severity. The test was scored two times with a 1-week period in between.

To be sure that the test-retest reliability of the two scores one week apart was not largely based on good memory of the patient, the scores of the patient were compared with the scores of a blinded assessor. The assessor was an experienced examiner (I.R.) and scored the impairment to raise the leg by observing the velocity of leg raising, the appearance of any tremor in the leg, the amount of rotation of the trunk, and verbal and non-verbal expressions of the patient. The patients and the assessor were blinded for each others' scores and for the scores from the previous week. Moreover, the assessor was blinded for the results of all other measurements and the patients' medical history.

**Sensitivity.** Two hundred consecutive patients who fulfilled the criteria were included. Patients generally have two main reasons to consult the center: for treatment of (relatively severe) complaints or because they have (relatively minor) complaints and need information about the risks in case of a new pregnancy. To investigate the diagnostic properties of the ASLR test in patients with minor as well as severe disease intensity, patients were selected from the entire population. The sensitivity of the 50% of the patients with the highest disability and that of the 50% with the lowest disability were both computed. Disability was measured on the Québec Back Pain Disability Scale (QBPDS). This scale was developed to measure the grade of disability in non-specific low back pain;<sup>6,14</sup> in a pilot study the scale appeared also suitable in patients with PPPP (unpublished data).

**Inclusion Criteria.** The inclusion criteria were:

1. Pain in the lumbopelvic region. Defined as pain experienced between the upper level of the iliac crests and the gluteal fold.
2. Pain beginning during pregnancy or within 3 weeks after delivery.
3. The patient was not pregnant and the last delivery was 6 months to 5 years previously.
4. Aged 20–40 years.

**Exclusion Criteria.** The exclusion criteria were:

1. A history of fracture, neoplasm or previous surgery of the lumbar spine, the pelvic girdle, the hip joint, or the femur.
2. Signs indicating radiculopathy: asymmetric Achilles tendon reflex and/or (passive) straight leg raising restricted by pain in the lower leg.
3. A systemic disease of the locomotor system.
4. Insufficient knowledge of the Dutch language to fill in forms, or any restriction to be tested.

**Specificity.** Control subjects were 50 nonpregnant women who consulted a primary care unit because of local problems of

the locomotor system, e.g., tennis elbow. Only those women were included who had at some time been pregnant and were without previous medical consultations or time lost from work because of lumbopelvic pain, and scored zero on the QBPDS at the moment of examination.

**Measurements.** The ASLR test was performed in a supine position with straight legs and feet 20 cm apart. The test was performed after the instruction: "Try to raise your legs, one after the other, above the couch for 20 cm without bending the knee." The patient was asked to score impairment on a six-point scale: not difficult at all = 0; minimally difficult = 1; somewhat difficult = 2; fairly difficult = 3; very difficult = 4; unable to do = 5. The scores of both sides were added, so that the summed score ranged from 0-10.

**Comparison With the PPPP Test.** Because the PPPP test is a well-documented, reliable, sensitive and specific diagnostic instrument to assess PPPP,<sup>7,12,13</sup> the ASLR test was compared with this test. The test was scored positive if pain was provoked on at least one side.

**Statistical Analysis.** SPSS statistical software was used for data analysis. Test-retest reliability and comparison of the score of the patient with the score of the assessor were determined by calculating Pearson's correlation coefficient and intraclass correlation coefficient (ICC). The estimates of variance for the ICC were obtained from a one-way random effect model. Sensitivity and specificity were calculated for different levels of the ASLR score. A  $\chi^2$ -test and Pearson's correlation coefficient were used to investigate the correlation between the ASLR test and the PPPP test. A *P*-value < 0.05 was considered significant.

### ■ Results

Mean age of the patients was  $32.7 \pm 3.5$  years. Parity ranged from 1 to 6 with a median of 2. Postpartum period ranged from 0.5 to 4.8 years with a median of 1.7 years.

Mean age of the control subjects was  $47.7 \pm 8.1$  years. Parity ranged from 1-9 with a median of 2. Postpartum period ranged from 0.27 to 40.4 years with a median of 18.5 years. Age, parity, and duration of the postpartum period of the control group were higher than those of the patient group (independent samples *t*-test *P* < 0.001).

#### **Reliability**

In this group of 50 patients the score at the first examination ranged from 0-10 with a mean value of  $4.6 \pm 2.4$ . The test-retest reliability measured with Pearson's correlation coefficient between the two ASLR scores 1 week apart was 0.87; the ICC was 0.83.

The test-retest reliability for the scores of the assessor measured with Pearson's correlation coefficient between the two ASLR scores 1 week apart was 0.82; the ICC was also 0.82. When the scores of the patient were compared with the scores of the assessor, Pearson's correlation coefficient was 0.78 and the ICC was 0.77.

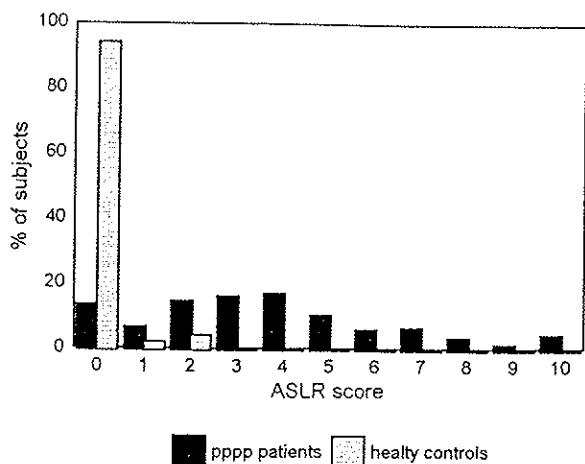


Figure 1. ASLR scores of 200 patients with posterior pelvic pain since pregnancy (PPPP) and 50 healthy controls.

**Sensitivity and Specificity**

Figure 1 shows the ASLR scores of patients and controls; Figure 2 shows the sensitivity and specificity for various scores of the ASLR test. The sum of specificity and sensitivity was highest when a cut-off was made between ASLR score 0 and 1. Based on these figures it is proposed to indicate scores 1-10 as positive and zero as negative. At that level sensitivity was 0.87 and specificity was 0.94. The QBPDS score in the patient group ranged from 1 to 85. The mean score was  $43.8 \pm 18.7$ . The ASLR score of the 100 patients with a QBPDS score 45 or higher was positive in all patients (sensitivity 1.00); the ASLR score of the 100 patients with a QBPDS score below 45 was positive in 73 patients (sensitivity 0.73).

**Comparison With the PPPP Test**

Sensitivity of the PPPP test in the patient group was 0.69 (Table 1). Pearson's correlation coefficient between the

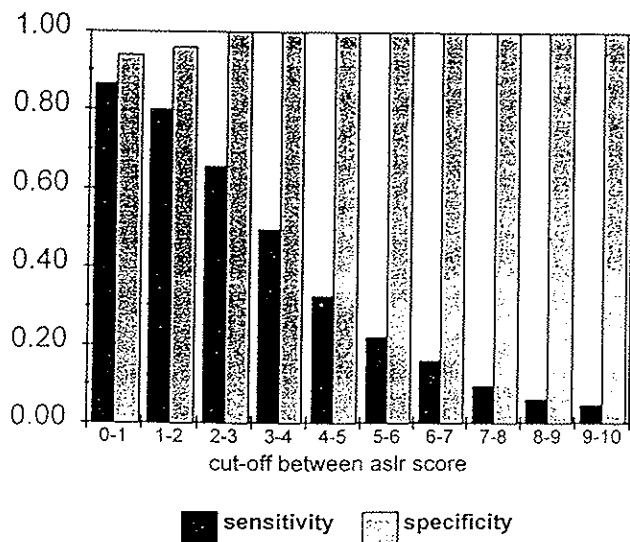


Figure 2. Sensitivity and specificity of the ASLR test in 200 patients with PPPP and in 50 healthy controls.

**Table 1. Association Between PPPP Test and ASLR Test in Patients With PPPP**

	PPPP Test Negative	PPPP Test Positive	Total
ASLR test negative	17	10	27
ASLR test positive	45	128	173
Total	62	138	200

Data are number of patients. Pearson's correlation coefficient = 0.27 ( $P < 0.001$ ); Pearson's  $\chi^2$ ,  $P < 0.001$ .  
 PPPP = posterior pelvic pain since pregnancy; ASLR = Active Straight Leg Raise; PPPP Test = Posterior Pelvic Pain Provocation Test.

ASLR test and the PPPP test was 0.27 ( $P < 0.001$ ; Pearson's  $\chi^2$  test,  $P < 0.001$ ). In 17 of the 200 patients (8.5%) both tests were negative.

**Discussion**

In the present study the validity and reliability of the ASLR test were assessed to decide whether this instrument can be used to diagnose PPPP.

**Reliability**

The results show that the test-retest reliability is high. The scores from the patient and from the experienced assessor showed a high correlation; this substantiates the reliability of the test. In case an objective verdict is needed the score of an experienced examiner would be preferred. In case the assessor is not experienced, or in situations where blinding is needed (e.g., clinical trials) the score of the patient might be preferable. It would be interesting to investigate the cause of an occasional large discrepancy between the score of an individual patient and that of a skilled assessor. The discrepancy might give the investigator more insight into how the patient is facing her disability, especially in case of a large discrepancy between the severity measured with the self-assessment scales and assessed with the physical examination.

**Sensitivity and Specificity**

The best balance between specificity and sensitivity was found when score 0 is negative and 1-10 is designated as positive. It is possible that in some clinical situations a higher cut-off point may be preferable. For example, between ASLR score 2 and 3 the sensitivity is 0.66 (not very high), but specificity is 100%. The results of this study show that the degree of disability influences the ASLR score. The sensitivity of 0.73 in cases with QBPDS score below 45 is still acceptable.

**Comparison With the PPPP Test**

Sensitivity of the ASLR test is higher than the sensitivity of the PPPP test: 0.87 and 0.69, respectively. The correlation coefficient between both tests (0.27) is rather low. It seems that both tests measure different aspects of PPPP. An advantage of the ASLR test is that, when the score is given by the patient, it is not necessary to be skilled in examination of the locomotor system to measure the score.

### Possible Explanation for the Phenomenon

In previous studies it was hypothesized that symptoms in PPPP are caused by overloading of the ligaments of the pelvic ring and/or lumbopelvic junction during activities in which loads have to be transferred between legs and trunk.<sup>10,11,15</sup> The ASLR test could be seen as a check for this system. Radiographic films taken during the ASLR test suggest that during active raising of the leg the pelvic bone at the tested side is forced to an anterior rotation about a horizontal axis near the sacroiliac joint. Secondary mobility of the lumbar spine and the contralateral sacroiliac joint are involved.<sup>11</sup> The hypothesis that joint laxity plays a role in PPPP and in the ASLR test is also supported by our experience that in the majority of patients with PPPP fastening of a pelvic belt and, in severe cases, fusion of the three joints of the pelvic ring are beneficial in the majority of cases. In daily practice it became evident that the influence of a pelvic belt on the ASLR test predicts the usefulness of a pelvic belt during activities of daily living in individual patients. With this procedure the best position of the belt and the required tension are determined in a simple instant manner.

The suggested anterior rotation of the pelvic bone at the tested side during the ASLR test is probably the same as accomplished during the PPPP test. However, the rather low correlation between both tests suggests that the tests measure different aspects of this phenomenon. We hypothesize that the ASLR test measures the decreased function to transfer loads from legs to trunk and that the PPPP test shows whether the system has been overloaded or not during the preceding days or weeks.

Besides joint laxity as explanation it is suggested that problems in lumbopelvic pain are caused by a disturbed proprioception and decreased function of muscles because of pain and fatigue.<sup>17,18</sup> Enlarged joint mobility as well as decreased muscle function may play a role. Especially patients with joint laxity may be vulnerable being trapped in a vicious circle with pain and fatigue, decreased proprioception, decreased muscle function, decreased muscular stability, decreased load transfer between spine and legs, pain and fatigue, etc. It seems that the ASLR test measures, in particular, the mechanical part of this vicious circle even in the absence of pain.

The "catching of the leg" phenomenon (whereby the patient feels difficulty in moving one or both legs forward when walking) seems to be based on the same mechanism as weakness during the ASLR test.<sup>17</sup> Both phenomena are based on impaired ability to perform active hip flexion. Because of the difference of the lever arm it is obvious that moving the leg in flexion from a horizontal position is more difficult than from a vertical position. This could explain the difference in the sensitivity of both signs.

Waddell et al. described weakness of active raising of both legs together in supine position (bilateral active straight leg raising).<sup>21</sup> The test was positive when the patient was not able to raise both legs six inches off the couch during 5 seconds. The test had a sensitivity of 0.40

in patients with chronic non-specific low back pain and a specificity of 1.00. It seems that this sign is related to the ASLR test.

The use of the ASLR test to discriminate between PPPP and healthy subjects is substantiated in the present study. Further studies are needed to evaluate the usefulness of the test to discriminate PPPP from other syndromes with pain in the lumbopelvic region. It would be interesting to score the ASLR test in a population of patients with lumbopelvic pain of various etiologies and to analyze whether the patients with a positive test are different with respect to other diagnostic tests, etiologies and prognoses. It might be that the effects of mechanical influences (e.g., pelvic belt, improvement of muscle function, surgical joint fusion) are more marked in patients with lumbopelvic pain with a positive ASLR test than in those with a negative test.

### Conclusion

The ASLR test is a suitable diagnostic instrument to discriminate between patients who are disabled by PPPP and healthy subjects and can be recommended as an instrument to diagnose PPPP. The test is easy to perform; reliability, sensitivity, and specificity are high. It seems that the integrity of the function to transfer loads between the lumbosacral spine and legs is tested by the ASLR test.

### Acknowledgments

The authors thank Inge Ronchetti, research assistant, for assessing the test-retest reliability, and Ronald TM van Kalmthout, MD, for examining a large number of control subjects.

### Key Points

- The active straight leg raise test is introduced as a reliable test.
- The active straight leg raise test can be recommended to diagnose posterior pelvic pain since pregnancy.

### References

1. Berezin D. Pelvic insufficiency during pregnancy and after parturition. *Acta Obstet Gynecol Scand* 1954;23(3):1-130.
2. Berg G, Hammar M, Möller-Nielsen J, et al. Low back pain during pregnancy. *Obstet Gynecol* 1988;71:71-5.
3. Chamberlain WE. The symphysis pubis in the roentgen examination of the sacroiliac joint. *Am J Roentgenol Rad Ther* 1930;24:621-5.
4. Fast A, Shapiro D, Ducommun EJ, et al. Low back pain in pregnancy. *Spine* 1987;12:368-71.
5. Genell S. Studies on insufficientia pelvis (gravidarum et puerpartum). *Acta Obstet Gynecol Scand* 1949;28:1-33.
6. Kopec JA, Esdaile JM, Abrahamowicz M, et al. The Québec back pain disability scale. *Spine* 1995;20:341-52.
7. Kristiansson P, Svärdsudd K. Discriminatory power of tests applied in back pain during pregnancy. *Spine* 1996;21:2337-44.
8. Mantle MJ, Greenwood RM, Currey HLF. Backache in pregnancy. *Rheumatol Rehabil* 1977;16:95-101.
9. McCombe PF, Fairbank JCT, Cockersole BC, et al. Reproducibility of physical signs in low back pain. *Spine* 1989;14:908-17.

10. Mens JMA, Vleeming A, Stoeckart R, Stam HJ, Snijders CJ. Understanding peripartum pelvic pain: Implications of a patient survey. *Spine* 1996;21:1363-70.
11. Mens JMA, Vleeming A, Snijders CJ, et al. The active straight leg raising test and mobility of the pelvic joints. *Eur Spine J* 1999;8:468-73.
12. Ostgaard HC, Andersson GBJ, Karlsson K. Prevalence of back pain in pregnancy. *Spine* 1991;16:549-52.
13. Ostgaard HC, Zetherström GBJ, Roos-Hansson E. The posterior pelvic pain provocation test in pregnant women. *Eur Spine J* 1994;3:258-60.
14. Schoppink LEM, Tulder MW van, Koes BW, et al. Reliability and validity of the Dutch adaptation of the Québec Back Pain Disability Scale. *Phys Ther* 1996;76:268-75.
15. Snijders CJ, Vleeming A, Stoeckart R. Transfer of lumbosacral load to iliac bones and legs. Part I: Biomechanics of self-bracing of the sacro-iliac joints and its significance for treatment and exercise. *Clin Biomech* 1993;8:285-94.
16. Strender LE, Sjöblom A, Sundell K, et al. Interexaminer reliability in physical examination of patients with low back pain. *Spine* 1997;15:814-20.
17. Sturesson B, Uden G, Uden A. Pain pattern in pregnancy and "catching" of the leg in pregnant women with posterior pelvic pain. *Spine* 1997;22:1880-3.
18. Taimela S, Kankaanpää M, Luoto S. The effect of lumbar fatigue on the ability to sense a change in lumbar position. *Spine* 1999;24:1322-7.
19. Thomas E, Silman AJ, Papageorgiou AC, et al. Association between measures of spinal mobility and low back pain. An analysis of new attenders in primary care. *Spine* 1998;23:343-7.
20. van Tulder MW, Assendelft WJ, Koes BW, et al. Spinal radiographic findings and nonspecific low back pain. A systematic review of observational studies. *Spine* 1997;22:427-34.
21. Waddell G, Somerville D, Henderson L, et al. Objective clinical evaluation of physical impairment in chronic low back pain. *Spine* 1992;17:617-28.

*Address reprint requests to*

J.M.A. Mens  
Spine & Joint Centre  
Westerlaan 10  
3016 CK Rotterdam, The Netherlands  
E-mail: sjceco@wxs.nl