Knee Surg Sports Traumatol Arthrosc (2014) 22:882–888
DOI 10.1007/s00167-013-2758-7

HIP

Diagnostic accuracy of clinical tests for sciatic nerve entrapment in the gluteal region

Hal D. Martin · Benjamin R. Kivlan · Ian J. Palmer · RobRoy L. Martin

Received: 28 April 2013 / Accepted: 28 October 2013 / Published online: 12 November 2013

Abstract

Purpose The purpose of this study was to determine the diagnostic accuracy of the straight leg raise (SLR), active piriformis, and seated piriformis stretch tests in identifying individuals with sciatic nerve entrapment.

Methods Thirty-three individuals (female = 25 and male = 8) with a mean age of 43 years (range 15–64; SD ± 11 years) were included in the study. Twenty-three subjects had endoscopic findings of sciatic nerve entrapment. Ten subjects without entrapment during endoscopic assessment were used as a control group. The results of the SLR, active piriformis, and seated piriformis stretch tests were retrospectively reviewed for each subject and compared between both groups. The accuracy of these tests for the endoscopic finding of sciatic nerve entrapment was determined by calculating the sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio.

Results The SLR had sensitivity of 0.15, specificity of 0.95, positive likelihood ratio of 3.20, negative likelihood ratio of 0.90, and diagnostic odds ratio of 3.59. The active piriformis test had sensitivity of 0.78, specificity of 0.80, positive likelihood ratio of 3.90, negative likelihood ratio of 0.27, and diagnostic odds ratio of 14.40. The seated piriformis stretch test had sensitivity of 0.52, specificity of 0.90, positive likelihood ratio of 5.22, negative likelihood ratio of 0.53, and diagnostic odds ratio of 9.82. The most accurate findings were obtained when the results of the active piriformis test and seated piriformis stretch test were combined, with sensitivity of 0.91, specificity of 0.80, positive likelihood ratio of 4.57, negative likelihood ratio of 0.11, and diagnostic odds ratio of 42.00.

Conclusions The active piriformis and seated piriformis stretch tests can be used to help identify patients with and without sciatic nerve entrapment in the deep gluteal region.

Level of evidence II.

Keywords Piriformis syndrome · Sensitivity · Specificity · Sciatica

Electronic supplementary material The online version of this article (doi:10.1007/s00167-013-2758-7) contains supplementary material, which is available to authorized users.

H. D. Martin
Medical Director Hip Preservation Center, Dallas, TX, USA

B. R. Kivlan (✉)
Tri-State Physical Therapy, Seven Fields, PA 16046, USA
e-mail: bkivlan@zoominternet.net

B. R. Kivlan · R. L. Martin
John G. Rangos Sr., School of Health Sciences, Duquesne University, Pittsburgh, PA 15282, USA

I. J. Palmer
Baylor University Medical Center, Dallas, TX, USA

R. L. Martin
Department of Physical Therapy, Duquesne University, Pittsburgh, PA, USA

R. L. Martin
UPMC Center for Sports Medicine, Pittsburgh, PA, USA

Introduction

Pain in the gluteal (posterolateral hip) region is becoming a more recognized and common complaint encountered in an orthopaedic practice, affecting an estimated 10–25 % of the population [20]. The possible causes of pain in the gluteal region are extensive and may encompass referred symptoms from the lumbosacral spine, sacroiliac joint, the hip joint, or extra-articular structures of the hip region [9]. Extra-articular sources of gluteal pain may be the result of tendinopathy of the gluteus medius, gluteus minimus [15], the deep rotators of the hip joint [5, 19], the hamstrings [9, 22], or an entrapment of the pudendal or the sciatic nerve [17]. Entrapments of the sciatic nerve have been commonly attributed to an abnormal anatomic relationship between the sciatic nerve and fibrovascular tissue found in the deep gluteal region [17] or from the muscle/tendon complexes of the piriformis [10, 23, 26], obturator internus/gemelli [5, 19], and/or proximal hamstring [17, 22]. Given that the source of gluteal pain can be from various intra- and extra-articular structures of the posterolateral hip region, determining the specific source of symptoms through a clinical examination can be difficult.

A comprehensive physical examination of the hip region has been described to identify the source of hip-related pain [16, 18, 24]. The examination includes the straight leg raise test, active piriformis test, and seated piriformis stretch test to diagnose patients with sciatic nerve entrapment [16, 18, 24]. Clinical tests used to identify sciatic nerve entrapment stretch or contract the fibrovascular or musculotendinous structures in an effort to reproduce familiar symptoms experienced by the patient. However, the relationship of clinical tests to the anatomic source of entrapment has yet to be adequately studied.

Recent advances in minimally invasive surgical techniques now enable surgeons to visualize and treat sources of sciatic nerve entrapment in the peri-trochanteric space and deep gluteal region through endoscopic exploration [6, 17]. Given that endoscopic evaluation can identify the anatomic source of sciatic nerve entrapment, a new perspective on the diagnostic accuracy of clinical tests used in the examination of posterolateral hip pain can be determined. By comparing the results of clinical tests to endoscopic evidence of nerve entrapment, surgeons may establish stronger clinical indications for endoscopic surgery to treat suspected sciatic nerve entrapment.

The purpose of this study was to determine the diagnostic accuracy of the straight leg raise (SLR), active piriformis, and seated piriformis stretch tests in identifying patients with endoscopically confirmed sciatic nerve entrapment. Diagnostic accuracy refers to the ability of a test to distinguish between patients with a specific condition versus those without the condition and is commonly expressed in terms sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratios [11]. Because the sciatic nerve is commonly entrapped by the piriformis and neighbouring deep rotators of the hip joint, it is hypothesized that the piriformis-specific tests (the active piriformis test and/or the seated piriformis stretch test) will demonstrate greater evidence of diagnostic accuracy compared to the SLR test in detecting sciatic nerve entrapment.

Materials and methods

Clinical records of patients who underwent endoscopic evaluation of the sciatic nerve between 2008 and 2009 were retrospectively reviewed by an orthopaedic surgeon (HM) with 9.5 years of experience in hip arthroscopy. Indications for endoscopic evaluation were (1) complaints of gluteal pain (lateral and/or posterior hip region) that did not respond to diagnostic intra-articular injection, (2) the inability to sit without pain, (3) paraesthesia to the posterior aspect of the thigh or leg, and/or (4) complaints of radicular pain into the lower extremity distal to the knee joint [1].

Thirty-three subjects (female = 25 and male = 8) with a mean age 43 of years (range 15–64; SD ± 11 years) were included in the review. The mean duration of symptoms was 36 months (range 2–192 months; SD ± 41 months). Preoperative symptoms as reported by the subjects can be found in Table 1. All patients failed conservative treatment that included physical therapy prior to surgery and had negative findings for lumbosacral pathology. Lumbosacral pathology was ruled out by (1) radiographs (2) magnetic resonance imaging (MRI), and (3) clinical examination of the lumbosacral spine that included active lumbar range of motion testing and posterior to anterior compression over the joints of the lumbar and sacral spine.

Clinical examination procedures

Prior to surgery, all subjects underwent a consistent clinical examination that included the SLR test, active

Table 1 Frequency and location of symptoms experienced by patients diagnosed with sciatic nerve entrapment in the gluteal region versus patients without sciatic nerve entrapment in the gluteal region

	Endoscopically diagnosed sciatic nerve entrapment	
	Yes ($N = 23$) Number of subjects (%)	No ($N = 10$)
Symptoms		
Inability to sit greater than 30 min	18 (78 %)	7 (70 %)
Lower extremity paraesthesia	17 (74 %)	2 (20 %)
Pain distal to the knee	8 (35 %)	2 (20 %)
Location		
Buttock pain	21 (91 %)	6 (60 %)
Lateral hip pain	10 (43 %)	5 (50 %)
Groin pain	11 (48 %)	6 (60 %)

piriformis test, and seated piriformis stretch test [17]. The SLR test was performed with the patient supine. The SLR is thought to tension the sciatic nerve along its entire course from the posterior hip region to the plantar aspect of the foot. With the knee remaining in full extension, the hip joint was taken to an endpoint of hip flexion or until the subject reported complaints of radiating pain and/or paraesthesia (Fig. 1). The active piriformis test was performed with the patient in a lateral position. The examiner palpated the piriformis as the patient was instructed to drive their heel into the examination table, initiating active hip abduction and external rotation against resistance from the examiner (Fig. 2). The active piriformis test is believed to elicit familiar pain as the deep rotators, specifically the piriformis and obturator internus/gemelli complex, compress the sciatic nerve. The seated piriformis stretch test is performed with the patient seated over the edge of an examination table with the hip flexed to approximately 90° and the knee extended. While palpating the sciatic notch, the examiner adducts and internally rotates the limb (Fig. 3). The seated piriformis stretch test is thought to lengthen the deep rotators of the hip joint and create dural tension of the sciatic nerve in an effort to elicit familiar pain. For each of these three clinical tests, recreation of the patient's familiar complaints of gluteal pain and/or paraesthesia radiating into the posterior aspect of the lower extremity was considered a positive test [17]. The results of each of the aforementioned tests were recorded for all subjects and utilized for statistical analysis.

Fig. 1 The examiner performs the straight leg test with the patient supine as the hip is maximally flexed and the knee remains in full extension

Fig. 2 The examiner performs the active piriformis test by resisting abduction and external rotation of the hip joint

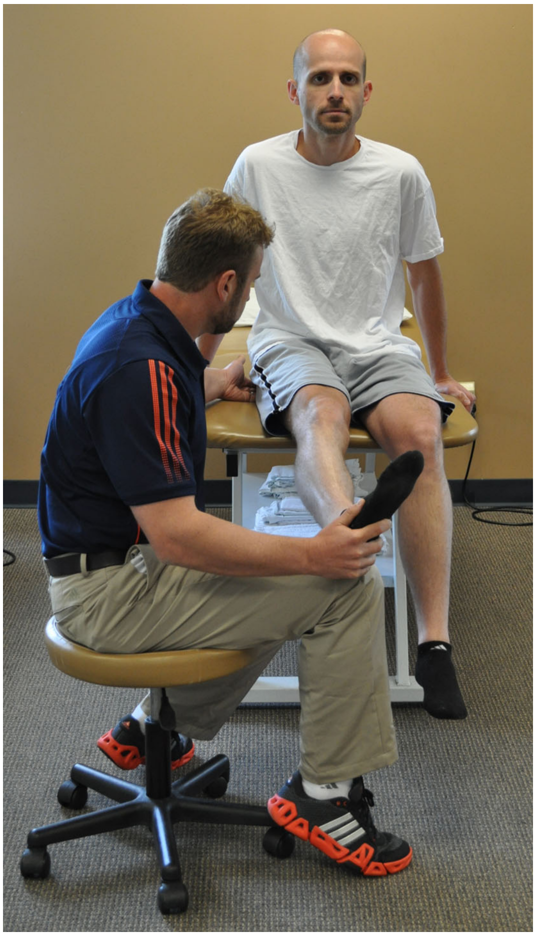

Fig. 3 The examiner performs the seated piriformis stretch test with the patient seated off the edge of the examination table. The hip is flexed with the knee extended. While palpating the greater sciatic notch, the examiner adducts and internally rotates the limb to elicit symptoms

Endoscopic evaluation

Endoscopic evaluation of the sciatic nerve was performed from a supine position as described by Martin et al. [17]. Observation of the sciatic nerve was made during peritrochanteric space assessment [25] using a 70° arthroscope through the anterolateral and posterolateral portals standardly established for hip arthroscopy. When necessary, an auxiliary portal was placed 3 cm posterior and 3 cm superior to the greater trochanter for decompression of the sciatic nerve [17]. The kinematics of the sciatic nerve was observed as the limb was internally and externally rotated as the hip joint was moved from a flexed to an extended position. Sciatic nerve entrapment was defined as binding of the nerve by muscle/tendon and/or fibrous scar adhesions in the posterolateral hip region. Evidence of entrapment was noted when the nerve had a hypovascular appearance, diminished epineural fat, and absent excursion during passive rotation of the hip joint [17]. (Supplementary Video 1: Normal Sciatic Nerve; Supplementary Video 2: Sciatic Nerve Entrapment) When necessary, intra-articular hip arthroscopy was performed to rule out intra-articular pathology as the source of gluteal pain. Indications for intra-articular hip arthroscopy were complaints of groin, lateral hip, or buttock pain that accompanied radiographic evidence of abnormal hip morphology or magnetic resonance arthrogram evidence of an acetabular labral tear.

The 33 subjects that received an endoscopic evaluation for sciatic nerve entrapment were divided into two groups based on endoscopic evidence for sciatic nerve entrapment. The two groups were created to determine the diagnostic accuracy of the clinical examination tests. Group 1 consisted of patients with endoscopic confirmation of sciatic nerve entrapment ($n = 23$), and Group 2 consisted of patients with endoscopic confirmation of the absence of sciatic nerve entrapment ($n = 10$). The procedures of this retrospective study protected patient privacy and were conducted with approval (#10–31) from the Institutional Review Board at Duquesne University.

Statistical analysis

A commercially available statistical software package (SSPS 17.0, Chicago IL) was used to perform statistical analyses. Descriptive statistics for age, symptom duration, frequency of symptoms, self-reported pain scale using the numeric pain scale, and self-reported functional rating using the Modified Harris Hip Score were computed for all subjects included in this review. Diagnostic properties including sensitivity, specificity, positive likelihood ratio (+LR), negative likelihood ratio (−LR), and diagnostic odds ratios were computed individually for the SLR test, active piriformis test, and seated piriformis stretch test in identifying those with and without sciatic nerve entrapment on endoscopic evaluation. The diagnostic properties were also computed for the presence of the piriformis-specific tests (active piriformis test or the seated piriformis stretch test). Postoperative assessment was completed within 24 months of surgery in which the tests for sciatic nerve entrapment were repeated, and the patient's frequency of symptoms, self-reported pain scale, and functional rating (Modified Harris Hip Score) were recorded.

Results

All 33 subjects included in this review met criteria for both endoscopic evaluation of the deep gluteal region and intra-articular examination of the hip joint by hip arthroscopy. Using surgical findings as the gold standard for sciatic nerve entrapment, 23 of the 33 subjects (70 %) were

Table 2 Diagnostic properties of clinical examination tests for deep gluteal nerve syndrome

	Straight leg raise test	Active piriformis test	Seated piriformis stretch test	Active piriformis test or seated piriformis stretch test
Sensitivity 95 % CI	0.15 (0.05–0.33)	0.78 (0.58–0.90)	0.52 (0.33–0.71)	0.91 (0.73–0.98)
Specificity 95 % CI	0.95 (0.68–1.00)	0.80 (0.49–0.94)	0.90 (0.60–0.98)	0.80 (0.49–0.94)
Positive likelihood ratio 95 % CI	3.20 (0.18–56.92)	3.90 (1.11–13.77)	5.22 (0.78–34.89)	4.57 (1.31–15.87)
Negative likelihood ratio 95 % CI	0.90 (0.73–1.10)	0.27 (0.12–0.63)	0.53 (0.33–0.85)	0.11 (0.03–0.42)
Diagnostic odds ratio 95 % CI	3.59 (0.17–76.09)	14.40 (2.29–90.60)	9.82 (1.06–90.59)	42.00 (5.03–350.75)

CI confidence interval

diagnosed and treated with endoscopic debridement of fibrotic bands attaching to the sciatic nerve or release from the piriformis and obturator internus muscle–tendon complex. Intra-articular examination of the hip joint during hip arthroscopy revealed 27 (82 %) subjects had concurrent acetabular labral tears.

The clinical examination found the active piriformis test was positive in 18/23 subjects (78 %), the seated piriformis stretch test was positive in 12/23 (52 %) subjects, and the presence of either the active piriformis test or the seated piriformis stretch test was present in 20/23 (87 %) subjects with confirmed sciatic nerve entrapment. The straight leg raise was present in only 4/23 (17 %) subjects with confirmed sciatic nerve entrapment. The sensitivity, specificity, +LR, −LR, and diagnostic odds ratio for the individual and combination of the piriformis-specific tests (active piriformis test or seated piriformis stretch test) in detecting sciatic nerve entrapment are reported in Table 2.

Postoperative assessment was completed at an average of 12 months following surgery (range 6–24 months). All 23 subjects that received endoscopic release of the sciatic nerve reported complete resolution of paraesthesia and pain radiating distal to the knee. Eighty-three percent of subjects noted an improved ability to sit greater than 30 min without experiencing familiar pain. None of the patients presented with positive findings for the SLR test, seated piriformis stretch test, or active piriformis test following endoscopic release of the sciatic nerve during postoperative assessment. The average self-reported pain scale of subjects that received sciatic nerve release improved from 7 ± 2 to 2 ± 3 postoperatively. The Modified Harris Hip Score improved from 54 ± 13 to 78 ± 14 postoperatively.

Discussion

The most important finding of this study was that the active piriformis test and seated piriformis stretch test proved to be valuable tests in diagnosing sciatic nerve entrapment. The presence of either a positive active piriformis test or seated piriformis stretch test indicated endoscopically confirmed sciatic nerve entrapment, while negative findings indicated no entrapment with a high degree of accuracy. This confirmed the hypothesis that the piriformis-specific tests have greater value than the SLR test in diagnosing sciatic nerve entrapment.

The active piriformis, seated piriformis stretch, and SLR tests have been commonly used in examination of posterior hip pain, but have never been studied to determine diagnostic accuracy. A systematic review of subjects presenting with piriformis syndrome found the active piriformis test to be positive in 34–74 % and the seated piriformis stretch test to be positive in 32–62 % of patients [12]. In this current study, the active piriformis and seated piriformis stretch tests were positive in 75 and 52 % of cases with endoscopically confirmed sciatic nerve entrapment, respectively. Comparatively, the SLR was positive in only 17 % of those with sciatic nerve entrapment. Although the seated piriformis stretch test proved to be useful, the active piriformis test was the single best test for diagnosing sciatic nerve entrapment. Sensitivity and specificity values for the active piriformis test demonstrated only 1 out 5 with a negative test had sciatic nerve entrapment, while 4 out of 5 with a positive test were noted to have sciatic nerve entrapment. The odds of a false positive for this test were 1 out of 14 cases. The ability to accurately diagnosis sciatic nerve entrapment improved considerably when the results of the active piriformis and seated piriformis stretch tests were combined. A positive active piriformis or seated piriformis stretch test reduced the odds of a false positive finding to 1 out of every 42 patients.

The active piriformis test and seated piriformis stretch test are similar in that both target the musculotendinous structures of the deep gluteal region to elicit symptoms. Each test, however, elicits symptoms differently. The active piriformis test elicits symptoms by a contraction of the deep rotators, whereas the seated piriformis test elicits symptoms by lengthening the soft tissue of the deep gluteal region. The inherent differences of the tests may explain the difference found in diagnostic accuracy. Future study may reveal that each test may be related to different underlying aetiology of sciatic nerve entrapment. The SLR test differs from both piriformis-specific tests as it does not attempt to localize the source of sciatic nerve entrapment to the deep gluteal region. Rather, the SLR test assesses the mobility of the sciatic nerve with respect to sagittal plane movement of the entire limb [2, 4]. This may explain why the SLR test had poorer diagnostic accuracy compared to the piriformis-specific tests. According to our results, utilizing clinical examination tests that isolate the source of entrapment in the deep gluteal region as opposed to assessing the general mobility of the sciatic nerve are more effective at accurately diagnosing sciatic nerve entrapment in the deep gluteal region.

There are limitations to the present study that deserve consideration when interpreting the results. Although a standardized evaluation of the patients was preformed, reliability of the tests was not determined. Only the SLR test has evidence of intra-rater reliability at 0.79–0.81 [13]. If the tests for sciatic nerve entrapment are to be routinely used in clinical practice, evidence of reliability needs to be established.

Another limitation is that the diagnostic properties of the tests for sciatic nerve entrapment were determined from a retrospective review of a select group of patients recruited from a single surgeon. The subject sample for this study was biased in that all subjects included for the review elected to undergo surgery. Subjects that did not elect to undergo surgery therefore may have been missed. Furthermore, the surgeon has a highly specialized practice in treating conditions of the hip region and may have a unique sample of patients compared to the general population. A majority of the patients presenting with posterolateral hip pain in this study were female. This is consistent with previous literature that has demonstrated greater prevalence of sciatic nerve pain in females compared to males [27]. A prospective study that utilizes multiple evaluators, a standardized examination procedure, and a broader sample of patients is needed.

It must also be recognized that the subjects in the present study had concurrent pathology of the hip joint. Although 82 % of the subjects had acetabular labral tears, diagnostic injection to the hip joint revealed that gluteal pain and distal lower extremity symptoms persisted after injection. This suggested that the majority of the symptoms experienced by the subjects were not caused by intra-articular sources, such as a labral tear. Additional study investigating the relationship of intra-articular hip pathology and sciatic nerve entrapment is warranted.

Another limitation may be related to the diagnostic criteria. Sciatic nerve entrapment was defined by the visualization of sciatic nerve entrapment that impeded neural mobility during movement of the hip joint. There is some subjectivity when interpreting surgical results and the reliability and validity of these findings have not been previously examined. However, postoperative assessment revealed that all subjects that received endoscopic release of the sciatic nerve had complete resolution of paraesthesias and pain distal to the knee. All subjects also presented with negative findings with the SLR, seated piriformis stretch, and active piriformis tests and showed improvement in self-reported function and pain. Collectively, these postoperative findings indicate that sciatic nerve entrapment was the primary source of symptoms and validates the endoscopic criteria used for determining sciatic nerve entrapment.

Finally, it should be noted that there are many possible causes for pain and paraesthesia to the gluteal region and the posterior aspect of the lower extremity. Among the most likely causes is lumbosacral pathology. A thorough preoperative work-up that included clinical examination, radiographs, and MRI of the lumbosacral spine eliminated the likelihood that common lumbosacral spine conditions were a cause of the symptoms experienced by the subjects in our study. Other diagnostic modalities including electrodiagnostic testing of the sciatic nerve and imaging of the deep gluteal region could have been used in addition to clinical examination and lumbosacral imaging. Several studies have demonstrated abnormal electrodiagnostic findings of the sciatic nerve among patients with entrapment in the deep gluteal region [1, 3, 7, 8, 14]. Magnetic resonance imaging that includes images of the deep gluteal region may also help identify abnormality of the sciatic nerve, piriformis morphology [21], or hip joint structure that may have an influence on symptoms [17]. Future studies should determine how the clinical tests used in this study can be used in conjunction with electrodiagnostic testing and imaging modalities to determine patients that may benefit from endoscopic surgery for sciatic nerve entrapment.

This study was the first to compare clinical examination results to endoscopic evidence of sciatic nerve entrapment. Surgeons may utilize the results of this study to interpret the results of a clinical examination of patients with complaints posterolateral hip pain. Surgeons may choose to specifically use the active piriformis and seated piriformis stretch tests to determine with a high amount of confidence whether a patient has entrapment of the sciatic nerve in the deep gluteal region. Positive findings on the active piriformis and seated piriformis stretch tests could be used as an indication for endoscopic release of the sciatic nerve.

Conclusions

In subjects with complaints of gluteal (lateral and/or posterior hip) pain and a negative evaluation for lumbosacral spine involvement, the active piriformis test and seated piriformis stretch test can be used to help identify patients with and without sciatic nerve entrapment in the deep gluteal region. The SLR test added little additional value to diagnosing those with sciatic nerve entrapment.

Acknowledgments The authors disclose no financial support to complete this research project. The Institutional Review Board of Duquesne University approved this research protocol.

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