Prospective Study

The Validity and Reliability of Provocation Tests in the Diagnosis of Sacroiliac Joint Dysfunction

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Background: Although sacroiliac joint dysfunction (SIJD) is generally regarded as a source of lumbar pain, its anatomical position and the absence of a diagnostic 'gold standard' lead to difficulties at examination and differential diagnosis. However, since sacroiliac (SI) joint blocks only provide information about pathologies of joint origin and since SIJD developing secondary to pathologies in structures around the joint can be missed. Provocation and palpation tests also need to be used in diagnosis.

Objectives: The purpose of this study was to examine the reliability of clinical examination and provocation tests used in the diagnosis of SIJD.

Study Design: Retrospective analysis of prospectively collected data.

Setting: Outpatient physical medicine and rehabilitation clinic.

Methods: One hundred and seventeen patients presenting with lumbar and/or leg pain and diagnosed with SIJD through clinical evaluation were included in the study. Range of lumbar joint movement, pain location and specific tests used in the diagnosis of SIJD were evaluated. Positivity in 3 out of 6 provocation tests was adopted as the criterion.

Results: 75.2% of patients were female and 24.8% were male. Mean age was 46.41 ± 10.45 years. A higher level of females was determined in ender distribution. SIJD was determined on the right in 52.6% of patients and on the left in 47.4%. When SI joint provocation tests were analyzed individually, the highest positivity, in 91.4% patients diagnosed with SIJD, was in the FABER test. The lowest positivity, in 56.4% of patients, was determined in the Ganslen test. The same patients were assessed by the same clinician at 2 different times. In these data, the simple consistence, kappa and PABAK coefficient values of all tests were close to 1 and indicating good agreement. The thigh thrust (POSH) and sacral thrust tests exhibited very good agreement with a kappa coefficient of 0.90 and a PABAK coefficient of 0.92, while the FABER test exhibited good agreement with a kappa coefficient of 0.78 and a PABAK coefficient of 0.92.

Limitation: Agreement between different observers was not evaluated, and also no comparison was performed with SI joint injection, regarded as a widely used diagnostic technique.

Conclusion: The anatomical position of the SI joint and the lack of a diagnostic 'gold standard' make the examination and diagnosis of SIJD difficult. Most SI joint clinical tests have limited reliability and validity on their own, while a multitest regimen consisting of SI joint pain provocation tests is a reliable method, and these tests can be used instead of unnecessary invasive diagnostic SI joint procedures.

Key words: Dysfunction, lumbar, sacroiliac joint, provocation test, sacroiliac joint pain, pain pattern

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The sacroiliac (SI) joint is a common but generally overlooked cause of lumbar pain. Goldthwaite described the SI joint as one of the sources of lumbar pain in 1905 (1). In 1934, Mixter and Barr reported that the intervertebral disk can be a frequent cause of lumbar and leg pain, and interest in the SI joint as a source of pain subsequently decreased (2). However, the recently reported success achieved with SI joint blocks and manipulative therapy corroborates a relation between the SI joint and lumbar pain (3,4).

Although every physician evaluating patients' vertebrae will frequently encounter SI joint dysfunction (SIJD) and SI joint pain at differential diagnosis of vertebral pathologies, no progress has been recorded to date in the evaluation of the SI joint within the concept of mechanical pain at differential diagnosis of lumbar pain. In terms of clinical diagnosis of mechanical pain deriving from the SI joint, Merskey and Bogduk (5) recommended pain originating from the SI joint capable of referral to the hip or lower extremity, pain in the SI joint region and worsening with particular provocation tests, and pain resolving following local anesthetic injection of a symptomatic SI joint as diagnostic criteria at the International Association for the Study of Pain in 1994.

The purpose of this study was to assess the validity and reliability of tests used in the diagnosis of patients diagnosed with SIJD on the basis of provocation tests and presenting to the physiotherapy and rehabilitation clinic with lumbar-leg pain.

Methods

This cross-sectional study investigated patients presenting to the Erzurum Regional Training and Research Hospital Physical Medicine and Rehabilitation Clinic, Turkey, due to lumbar-leg pain between April and December, 2017. One hundred seventeen patients aged 18 to 60 with pain and tenderness in the SI joint and with lumbar pain of a mechanical character, diagnosed with dysfunction using SI joint provocation tests were enrolled in the study. Potential infectious, tumoral, endocrine and metabolic causes of lumbar pain, fractures and pains reflected from the abdominal or pelvic organs were excluded. Patients with a history of spinal surgery, hip pathology or scoliosis were excluded from the study. In this study we aimed to evaluate the sacroiliac joint pain caused by sacroiliac dysfunction. That's why we set the upper age limit to 60 in order to exclude the degenerative causes which are more frequently seen in elderly population.

The study was performed in accordance with the principles of the Declaration of Helsinki. Patients were informed about the aim and content of the study and gave verbal consent to participate.

Patients' demographic characteristics, such as age, height, body weight (BW), body mass index (BMI), marital status, education level and employment status, and information concerning history of trauma, location of pain, and character and duration of pain were investigated and recorded onto patient report forms.

Six provocation tests (distraction test (Fig. 1), compression test (Fig. 2), thigh thrust test (Fig. 3), Gaenslen test (Fig. 4), sacral thrust test (Fig. 5) and the FABER test (Fig. 6)) were evaluated in the diagnosis of SIJD in this study. SIJD was diagnosed in patients with 3 or more positive provocation tests. Patients were re-assessed in terms of the presence of SIJD by the same specialist one week later.

At statistical analysis, categoric variables were expressed as numbers and rations. The chi square test was used to analyze categoric data. The simple agreement coefficient (p0), Cohen's kappa coefficient (κ) and Prevalence Adjusted Bias Adjusted Kappa (PABAK) coefficient were used to determine agreement between results of assessments performed by the same specialist physician at different times. Data were analyzed on SPSS for Windows 16.0 software.

Results

SIJD was diagnosed clinically on the basis of 3 or more positive provocation tests. One hundred fifty-six patients were enrolled in the study, 118 (75.6%) women and 38 (24.4%) men. Dysfunction was determined in the right SI joint in 52.6% of patients and in the left SI joint in 47.4%. The mean age of patients in whom SIJD was determined was 46.17 ± 11.61 years. Sociodemographic data of the study population are shown in Table 1.

Patients' areas of pain distribution were assessed as the lumbar region, leg and hip region indicating the SI joint, and the data obtained are shown in Table 2.

The 6 provocation tests used in the diagnosis of SIJD on the right and left (distraction test, compression test, Gaenslen test, thigh thrust test. Sacral thrust test and the Faber test) were assessed for all patients. On the basis of data from previous tests, SIJD was diagnosed in patients with three or more positive provocation tests. Dysfunction in patients with SIJD was determined on the right in 52.6% of patients and on the left in 47.4%. When the SI joint provocation tests were assessed individually, the highest positivity was observed

Fig. 1. *Distraction test: The patient lies in a supine position. Direct posterolateral pressure is applied to the bilateral anterior superior iliac spines, thus stressing the anterior sacroiliac ligament.*

Fig. 2. *Compression test: The patient lies on his side with the affected side on top, with the hip at 45° flexion and the knees at 90° flexion. The physician stands behind the patient and applies pressure to the pelvis over the iliac crest directly toward the contralateral iliac crest. This test can be applied in a supine or prone position.*

Fig. 3. *Thigh thrust test: The patient lies in a supine position. The hip is brought to 90° flexion. Pressure is applied directly toward the examination table. Pathology in the SI joint is considered if pain occurs in the hip. Pain provocation is established with hip flexion and adduction.*

Fig. 4. *Gaenslen test: The patient lies in a supine position close to the edge of the bed. The patient draws his leg toward the abdomen so as to place the knee and hip in flexion. The outside leg (closest to the practitioner) is allowed to hang down from the examination table, while the SI joint is contracted by placing pressure on the inside (furthest from the practitioner) iliac crest and outside leg. Pain indicates pathology of the SI joint on the tested side.*

Fig. 5. *Sacral thrust test: The patient lies in a prone position. The practitioner places one hand on the apex of the sacrum while applying direct pressure with the other hand.*

Fig. 6. *Faber (Patrick) test: The patient lies in a supine position, while the practitioner stands beside the patient and bends the patient's knee, bringing the heel to the opposite knee. With the other hand, the practitioner ensures that the contralateral anterior superior iliac spine remains in a neutral position. The physician applies mild pressure to the bent knee. Pressure is assumed to be applied to the bilateral sacroiliac ligaments and hip joints. Pain provocation occurs with flexion, adduction and external rotation of the hip.*

in the FABER test, which exhibited positivity in 91.4% of patients diagnosed with SIJD, and the lowest positivity was observed in the Gaenslen, which resulted positive in 56.4% of patients diagnosed with SIJD. Although some studies have reported a difference in extremity length measurements in the presence of SIJD, no significant difference was determined between the groups in the present study. Data concerning SIJD provocation tests are shown in Table 3.

Additionally, all patients were re-evaluated after a 1-week interval by the same physician using the 6 provocation tests (distraction, compression, Gaenslen, thigh thrust, sacral thrust and Faber tests). Agreement between 2 observations was assessed using 2*2 agreement tables. The findings are shown in Table 4 and 5.

Discussion

Although SIJD is generally regarded as a source of lumbar pain, its anatomical position and the absence of a diagnostic 'gold standard' lead to difficulties at examination and differential diagnosis (6). In addition, imaging methods in SIJD are also used in the differential diagnosis of infections, metabolic disorders, fractures and tumors (7). Several studies have reported prevalences of SIJD in individuals with lumbar pain of 13%-48%, and that the condition is more common in females (8-11).

Studies, which are performed to determine potential risk factors of the SIJP, have been reported as female gender, lower BMI, pregnancy-induced changes such as weak pelvic blood circulation and muscle endurance, SI joint hemorrhage occurring during birth and hormonal induced joint laxity, and gender realted different biomechanical behaviors in the SIJ (12,13).

The greater prevalence of SIJD in female patients is thought to be associated with load-bearing surfaces in the SI joint, the standing sacrum position being more horizontal, the effects of fertility on the SI joint or with a sedentary lifestyle (14,15). Madania et al (8) described female gender, a history of recurrent lumbar pain and a heavy workload as significant risk factors for SJD. In that study, 55.9% of patients with SJD were female. It has been suggested that the greater incidence of SJD in female patients may be due to the effects on the SIJ of fertility, life style or low levels of exercise (7,8). DePalma et al (16) reported that older age, lower BMI and female gender was related to increase probability of SJD . Irwin et al (17) evaluated that older age was related SJD, but BMI and gender has been identified not a risk factor for SJD.

Table 1. *Sociodemographic data of the study population.*

	n	
Age	117	46.41 ± 10.45
Height (cm)	117	165.37 ± 9.65
Body weight (kg)	117	74.47 ± 13.27
BMI (kg/m^2)	117	27.55 ± 4.64
Gender		
Female	89	75.2%
Male	28	24.8%
Education level		
Unschooled	20	17.1%
Literate	12	10.3%
Primary school	43	36.8%
Middle school	28	24%
High school	8	6.9%
University	6	4.3%
Occupation		
Housewife	65	55.5%
Sedentary	18	15.4%
Physically tiring work employment	23	19.7%
Retired	11	9.4%
Marital status		
Single	31	26.4%
Married	86	73.6%

Table 2. *Pain location.*

	n	%
Site of pain		
Lumbar region	42	35.8%
Right leg	10	8.5%
Left leg	7	5.9%
Lumbar region-right leg	27	23%
Lumbar region-left leg	31	26.4%
Pain in the hip		
None	33	28.2%
On the right	40	34.2%
On the left	44	37.6%

The incidence of lumbar pain secondary to SI joint ankylosis is higher in male patients. Steward et al investigated individuals from various races and reported that ankylosis of the SI joint is very rare in women, even in advanced age groups. In contrast, they showed a tendency to ankylosis and compromise of articular

Table 3. *SIJD provocation tests.*

	n	%
Distraction Test		
No	37	31.6%
Present on the right	42	35.9%
Present on the left	38	32.4%
Compression Test		
No	25	21.3%
Present on the right	51	43.5%
Present on the left	41	35%
FABER Test		
No	10	8.5%
Present on the right	54	46.1%
Present on the left	53	45.3%
Gaenslen Test		
No	51	43.6%
Present on the right	34	29.05%
Present on the left	32	27.35%
Posterior Shear Test (POSH)		
No	33	28.2%
Present on the right	45	38.5%
Present on the left	39	33.3%
Sacral Thrust Test		
No	34	29.05%
Present on the right	44	37.65%
Present on the left	39	33.3%

Table 4. *SIJD provocation test 2 different evaluation.*

	1st Observation	2nd Observation
Distraction Test		
No	37 (31.6%)	48 (41%)
Present on the right	42 (35.9%)	36 (30.7%)
Present on the left	38 (32.4%)	33 (28.2%)
Compression Test		
No	25 (21.3%)	19 (16.2%)
Present on the right	51 (43.5%)	53 (45.2%)
Present on the left	41 (35%)	45 (33.4%)
FABER Test		
No	10 (8.5%)	14 (11.9%)
Present on the right	54 (46.1%)	49 (41.8%)
Present on the left	53 (45.3%)	54 (46.1%)
Gaenslen Test		
No	51 (43.6%)	45 (38.4%)
Present on the right	34 (29.05%)	31 (26.5%)
Present on the left	32 (27.35%)	41 (35%)
Thight Trust Test (POSH)		
No	33 (28.2%)	36 (30.7%)
Present on the right	45 (38.5%)	47 (40.2%)
Present on the left	39 (33.3%)	34 (29%)
Sacral Thrust Test		
No	34 (29.05%)	30 (25.6%)
Present on the right	44 (37.65%)	42 (35.8%)
Present on the left	39 (33.3%)	45 (38.5%)

surfaces in the SI joint in men after the age of 35 (15). Considering our study population, the rate of female patients and average age of patients were higher in comparison with previous studies.

Studies using diagnostic analgesia blocks in patients with suspected SI joint pain, one of the International Association for the Study of Pain (IASP) criteria, have determined prevalences of pain of SI origin of 19%-30% (8,18,19). However, since SI joint blocks only provide information about pathologies of joint origin and since SIJD developing secondary to pathologies in structures around the joint can be missed, provocation and palpation tests also need to be used in diagnosis (8,9,18,20-22). Numerous studies have been performed to determine the clinical validity of these tests, and these have reported that SIJD can be diagnosed in the presence of pain in the region of the SI joint worsening with provocation tests (9,23-25).

Lasett and Williams investigated the reliability of the 6 commonly used SI joint pain provocation tests and showed reliability for the distraction, compression, Gaenslen and thigh thrust provocation tests. They observed low reliability for the sacral thrust and cranial shear tests (22,23). Zelle et al (26) similarly determined clinical reliability exceeding 80% for the Gaenslen, FABER and POSH tests. Robinson et al (27) reported acceptable reliability for the compression and distraction tests.

However, these studies all recommend the use of multiple tests for the diagnosis of SIJD (19,28). Laslett et al (29) reported that individual tests for the SI joint exhibited low reliability. Dreyfuss et al (30) examined SI joint tests in a group consisting of asymptomatic individuals and observed symptoms of SIJD in 20% of asymptomatic patients. Another study reported anatomical variation in the bone crest, excessive fatty tissue and the physician lacking the ability to identify the correct bone as the most common causes of low test reliability (31).

Van der Wurff et al (32) reported that the presence of 3 or more positive provocation tests in patients with

pain deriving from the SI joint varied between 65% and 93%. That study also reported that these tests can be used instead of unnecessary invasive diagnostic SI joint procedures for early diagnosis. Taşkaynatan et al (33) used injection for diagnosis with patients with positivity in 3 or more out of 5 provocation tests. At post-injection evaluation they determined the presence of a lower segment lumbar disc hernia capable of causing hip pain in 9 out of 12 patients. They concluded that despite improvement in pain of 75% or more following one or 2 injections, it was still not certain that the pain derived from the SI joint. Kokmeyer et al (34) suggested that a multitest regimen consisting of 5 SI joint pain provocation tests (distraction, compression, Gaenslen, Patrick and thigh thrust tests) was a reliable method for assessing SIJD. A more recent study reported that the best reliability was obtained with 36 or more positive palpation tests together with 2 or more positive provocation tests (35).

Laslett et al (25) reported specificity of 91% and sensitivity of 78% for 3 or more positive provocation tests. Two other studies reported specificity of 79% and 85% and sensitivity of 78% and 94% for positivity in 3 out of 4 provocation tests in diagnosing SIJD. These findings were confirmed with meta-analysis, the 3 or more positive provocation tests having differentiating power and perfect reliability in the diagnosis of SI joint pain (36,37). Cibulka et al (38) showed that the combined use of tests exhibits better differentiation than a single test in identifying SIJD. Several studies have reported that a combination of tests and at least 3 out of 4 tests resulting positive is reliable in diagnosis (23,24,39-43).

In a study performed to determine the prevalence of SIJD, Weksler et al (44) determined positivity rates of 80% for FABER, 94% for the compression test, 90% for the thigh thrust (POSH), 64% for the Gillet test, 88% for the Yeoman test and 60% for the resisted hip abduction test. One study examining specific combinations of SI joint provocation tests reported that the distraction test had the highest positive predictive value, and that the thigh thrust (POSH), compression and sacral thrust tests had average positive predictive values for diagnosis. At analysis of reliability, the Gaenslen, FABER and POSH tests exhibited more than 80% clinical reliability, while at analysis of validity, only the POSH test had acceptable specificity and sensitivity (more than 80%), and the study therefore concluded that it was therefore superior to the other clinical SI joint tests. On the basis of the study data, the use of various combinations of tests was recommended for the diagnosis of SIJD. In particular, they reported that the presence of 2 or more positive provocation tests was significant in a multitest regimen consisting of a cluster of distraction, thigh thrust, compression and sacral thrust tests (23).

Table 5. *SIJD provocation test agreement evaluation.*

	Simple	Kappa	PABAK
Distraction Test	0.91	0.80	0.82
Compression Test	0.94	0.80	0.88
Faber Test	0.96	0.78	0.92
Gaenslen Test	0.94	0.87	0.88
Thight trust Test (POSH)	0.96	0.90	0.92
Sacral Thrust Test	0.96	0.90	0.92

In a study by Arab et al (28) investigating the reliability of provocation and palpation tests, patients were assessed at 3 different times by 2 different observers. The Kappa coefficient and PABAK values were calculated to evaluate reliability. When the tests were evaluated individually, the study concluded that PABAK values ranged between 0.36 and 0.84 for reliability at comparison of 2 separate observations by observers and PABAK values ranged between 0.52 and 0.84 for reliability when the observers were compared. When combinations of tests were evaluated, PABAK values for reliability at comparison of two separate observations ranged between 0.44 and 1.00, while PABAK values for reliability when the two observers were compared ranged between 0.52 and 0.92. They suggested that the multitest regimen consisting of palpation and provocation tests was seen to exhibit moderate-perfect reliability at clinical evaluation of the presence of SIJD (28).

In this study, patients were assessed using SI joint provocation tests at different times but by the same clinician. Provocation tests have investigated agreement between observations in terms of simple consistence, kappa and PABAK coefficients. Based on these data, the kappa and PABAK coefficients for all tests were similar and close to 1, indicating good agreement. The POSH and sacral thrust tests exhibited good agreement with a kappa coefficient of 0.90 and a PABAK coefficient of 0.92, while the FABER test exhibited good agreement with a kappa coefficient of 0.78 and a PABAK coefficient of 0.92. The existing findings enhance the significance of our study data and support the idea that a multitest regimen should be used in the diagnosis of SIJD.

SIJD pain referral maps may be useful in assessing the presence of pain deriving from the SI joint in pa-

tients with chronic lumbar pain. Inflammatory mediators released from a damaged capsule and multilevel innervations from the anterior and posterior L2–S3 branches of the SI joint account for the variable distribution of SIJD pain (45). Fortin et al reported that a pain chart should be established as a useful method of determining SIJD. They established a pain referral chart as assessment following injection to the SI joints of healthy volunteers. The study data showed that pain in patients with SIJD was generally unilateral and in the posterior superior iliac spine (46). Pain diffusion map data are consistent with those of several previous clinical studies describing unilateral pain in the posterior superior iliac spine region in patients with SJD (15,47-49).

In terms of pain distribution, Van der Wurff et al (32) reported that in SJD the patient directly indicated the painful joint. In a study of 50 patients diagnosed with SIJD and lumbar disc herniation, Weksler et al (44) reported pain referral levels of 36% to the hip, 26% to the inguinal region, 14% to the knee, 14% to the calf and 10% to the foot. Slipman et al (51) reported hip pain in 94% of patients with SJD, lumbar pain in 72%, lower extremity pain in 50%, leg pain descending below the knee in 28% and pain in the foot in 1%. Cibulka et al (38) assessed 219 patients with lumbar pain and reported lumbar pain in 92% of the 86 patients diagnosed with SIJD and lumbar-leg pain in 8%. Seventy-eight percent of patients reported that pain in the lumbar region was located on the right or left, while 22% reported pain in the middle part of the lumbar area of referred to both sides. Additionally, 74% of patients described unilateral pain in the posterior superior iliac spine region (38). When pain location in the patients participating in this study was assessed, irrespective of right or left sides, patients most commonly presented with lumbar-leg pain, and when right and left side discrimination was introduced, they most commonly presented with lumbar and lumbar-left leg pain. At analysis of presence of pain in the hip and gluteal region, no hip pain was present in 28.8% of 156 patients, while among patients with hip pain, levels between the 2 hips were similar, with a slight preponderance on the left.

Feinstein (40) reported that it is very difficult to differentiate patients with silent or latent form SIJD without clinically distinct findings from patients with false positive findings. Cibulka et al (38) suggested that some asymptomatic patients with SIJD findings only might have a greater disposition to be at a greater risk of developing lumbar pain in the future. Taşkaynatan et al (50) investigated the prevalence of congenital lumbosacral malformation in young males with chronic lumbar pain and the clinical significance thereof. They reported that equal load distribution on the SI joint may be impaired in lumbar disc pathologies and that pain may occur associated with increased local stress in this region as a result.

Conclusion

SIJD is a significant pathology with a high probability of being observed in cases of lumbar pain. The presence of SIJD must be considered in patients with lumbar pain, particularly in the absence of neurological deficit, and care must be taken in treatment decisions in pathologies of the intervertebral disk.

Intraarticular injection into the SI joint for analgesic purposes is regarded as helping identify the SI joint as a source of pain and as the gold standard in the diagnosis of SIJD. However, since intraarticular injections do not include periarticular pathologies in particular, the idea of moving to a diagnostic algorithm consisting entirely of clinical examination in the diagnosis of SIJD has arisen in recent years. Several studies therefore recommend the use of a combination of different provocation tests.

The exclusion of degenerative causes that might lead to pain deriving from the SI joint by imposing an upper age limit of 60 for our patients, and patient examinations and assessments being performed by a single clinician and under equivalent conditions are features that enhance the power of this research. Limitations of the study include the fact that agreement between observers was not evaluated, although 2 separate observations were assessed at agreement analysis, and that no comparison was performed with SI joint injection, regarded as the gold standard diagnostic technique.

In summary, multitest assessment consisting of a combination of provocation tests exhibited sufficient reliability and validity in the diagnosis of SIJD. In addition, we think that our study results can serve as a guide for future studies on this subject and permit comparison with our study findings.

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