

Diagnosing painful sacroiliac joints: A validity study of a McKenzie evaluation and sacroiliac provocation tests

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Research suggests that clinical examination of the lumbar spine and pelvis is unable to predict the results of diagnostic injections used as reference standards. The purpose of this study was to assess the diagnostic accuracy of a clinical examination in identifying symptomatic and asymptomatic sacroiliac joints using double diagnostic injections as the reference standard. In a blinded concurrent criterion-related validity design study, 48 patients with chronic lumbopelvic pain referred for diagnostic spinal injection procedures were examined using a specific clinical examination and received diagnostic intra-articular sacroiliac joint injections. The centralisation and peripheralisation phenomena were used to identify possible discogenic pain and the results from provocation sacroiliac joint tests were used as part of the clinical reasoning process. Eleven patients had sacroiliac joint pain confirmed by double diagnostic injection. Ten of the 11 sacroiliac joint patients met clinical examination criteria for having sacroiliac joint pain. In the primary subset analysis of 34 patients, sensitivity, specificity and positive likelihood ratio (95% confidence intervals) of the clinical evaluation were 91% (62 to 98), 83% (68 to 96) and 6.97 (2.70 to 20.27) respectively. The diagnostic accuracy of the clinical examination and clinical reasoning process was superior to the sacroiliac joint pain provocation tests alone. A specific clinical examination and reasoning process can differentiate between symptomatic and asymptomatic sacroiliac joints. [Laslett M, Young SB, Aprill CN and McDonald B (2003): **Diagnosing painful sacroiliac joints: A validity study of a McKenzie evaluation and sacroiliac provocation tests. Australian Journal of Physiotherapy 49: 89-97**]

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Introduction

Most of the structures and tissues found in the low back, hip and pelvis are capable of producing symptoms. The sacroiliac joint (SIJ) may produce pain in the back, the buttock, groin and lower extremity similar to patterns from other lumbosacral sources (Dreyfuss et al 1996, Fortin et al 1994a and 1994b, Schwarzer et al 1995a). It may be presumed that treatment strategies for SIJ lesions should differ from strategies intended to relieve pain emanating from the lumbar discs, zygapophyseal joints, nerve roots or other structures. Without a readily reliable and valid means of differentiating between these possible sources of pain, treatment strategies are perforce non-specific and likely to have modest efficacy at best.

Studies in normal volunteers have shown that back, buttock and lower extremity symptoms can be evoked by stimulation of the lumbar zygapophyseal (McCall et al 1979) and sacroiliac joints (Fortin et al 1994b). Lumbar discs do not provoke pain when mechanically challenged by discography in normal subjects (Walsh et al 1990). In clinical studies of LBP patients, back, buttock, and lower extremity symptoms can be produced or aggravated by stimulation of the lumbar discs (O'Neill et al 2002). Back and lower extremity symptoms may be abolished by injection of local anaesthetic either into the SIJ (Fortin et al

1994a) or zygapophyseal joint, or by blocking the medial branches of the dorsal rami that supply the joint (Jackson et al 1988, Moran et al 1988, Schwarzer et al 1994b, Schwarzer et al 1994c) Walsh et al 1990).

Previous studies have concluded that there is no composite of symptoms or clinical signs that enable the clinician to identify pain originating from the SIJ (Dreyfuss et al 1996, Maigne et al 1996, Schwarzer et al 1995a, Slipman et al 1998), and that only fluoroscopically-guided contrast-enhanced anaesthetic injection is of diagnostic value (Adams et al 2002, Dreyfuss et al 1996, Maigne et al 1996, Merskey and Bogduk 1994, Schwarzer et al 1995a). In one study, sacral sulcus tenderness was found to be the most sensitive factor in predicting the results of diagnostic SIJ injection, with pain over the posterior superior iliac spine (PSIS), buttock pain, and the patient pointing to the PSIS as the dominant pain found to be less sensitive (Dreyfuss et al 1996). However, these clinical signs had very low specificity. In another study, the presence of groin pain was associated with SIJ pain (Schwarzer et al 1995a) While certain SIJ tests have been shown to have acceptable inter-rater reliability (Kokmeyer et al 2002, Laslett and Williams 1994), studies have shown that these tests alone cannot predict the results of diagnostic injection (Dreyfuss et al 1996, Maigne et al 1996, Slipman et al 1998).



Figure 1A. Distraction SIJ pain provocation test.



Figure 1B. Thigh thrust SIJ pain provocation test.

The current study was conceived to examine the utility of the SIJ tests when used within the context of a clinical reasoning process using the McKenzie evaluation to identify patients suspected of having discogenic pain. The study utilised a concurrent criterion-related validity design and compared the conclusions regarding the presence or absence of symptomatic SIJ derived from a specific clinical examination with diagnosis obtained through diagnostic injection into the SIJ.

Previous experience has shown that many patients with symptomatic discs have (false) positive SIJ pain provocation tests that become negative when the pain has resolved (Laslett 1997), suggesting that positive SIJ pain provocation tests should be discounted when clinical evidence for discogenic pain is present, and a symptomatic SIJ should be suspected only when three or more SIJ pain provocation tests provoke the familiar pain in the absence of clinical evidence suggesting discogenic pain.

There is preliminary evidence that the McKenzie evaluation (McKenzie 1981) may be able to detect discogenic low back pain, especially if there is an intact anulus (Donelson et al 1997). While Donelson et al did not report the sensitivity and specificity of centralisation, an independent analysis of their data estimated the sensitivity to be 94% and specificity 52% (Bogduk and Lord 1997).

Movement of pain from a distal location to the midline of the spine (centralisation) is a phenomenon believed to be associated with discogenic pain (Donelson et al 1990 and 1997, McKenzie 1981). Inter-rater reliability judgments regarding the elicitation of the centralisation phenomenon has been found to be acceptable in a study using physical therapists with six or more years of experience ($\kappa = 0.82$; Fritz et al 2000). The McKenzie evaluation has been shown to be unreliable in one study using novice and minimally trained therapists (Riddle and Rothstein 1993), but was found to be reliable in most of its components in

another study using therapists with minimal training (Kilby et al 1990). Greater agreement was found among examiners who had completed formal training in the McKenzie method of assessment (Razmjou et al 2000).

Methods

Inclusion criteria Patients with buttock pain, with or without lumbar or lower extremity symptoms, referred to a New Orleans private radiology practice specialising in spinal diagnostics between December 1996 and August 1998, were invited to participate in the study. All patients had undergone imaging studies and unsuccessful therapeutic interventions. They had been referred for diagnostic injections by a variety of medical practitioners including orthopaedists, neurosurgeons, physiatrists, pain management specialists, chiropractors and physiotherapists. A few patients were self-referred. Patients were drawn from the New Orleans metropolitan area, with some intrastate and interstate referrals. Participants were not consecutive.

Exclusion criteria Patients were excluded from the study if they had only midline or symmetrical pain above the level of L5, clear signs of nerve root compression (complete motor or sensory deficit), or were referred for specific procedures excluding SIJ injection. Those deemed too frail to tolerate a full physical examination, or who declined to participate, were also excluded.

Background data collection Patient data collected included age, gender, occupation, employment status, pending litigation, cause of current episode, duration of symptoms, and aggravating/relieving factors. In accordance with the usual practice of the clinic, patients completed detailed pain drawings (Beattie et al 2000, Ohnmeiss et al 1999) and visual analogue scales (Scott and Huskisson 1976) of back and leg pain before and after injections. Visual analogue scales were measured and



Figure 1C. Gaenslen's test SIJ pain provocation test.



Figure 1D. Compression SIJ pain provocation test.

recorded as numeric rating scales (0-10). Disability was estimated by the Roland-Morris questionnaire (Jensen et al 1992) and the Dallas Pain Questionnaire (Lawlis et al 1989).

Operational definitions

Familiar symptom - Familiar symptoms are the pain or other symptoms identified on a pain drawing, and verified by the patients as being the complaint that led them to seek diagnosis and treatment. During a diagnostic test, the familiar symptoms must be distinguished from other symptoms produced by the test. Familiar pain may be produced, increased, peripheralised, centralised, decreased or abolished.

Sacroiliac joint pathology - References to symptomatic SIJ, SIJ pathology or SIJ pain, are confined to meaning that SIJ structures contain the pain-generating tissues.

Positive SIJ pain provocation test - Any SIJ pain provocation test that produces or increases familiar symptoms.

Negative SIJ pain provocation test - Any SIJ pain provocation test that does not produce or increase familiar symptoms.

Concordant pain response - A concordant pain response is one in which there is provocation of the familiar pain.

Discordant pain response - Discordant pain response is the provocation of a pain that is unlike the pain for which the patient sought treatment.

Centralisation - "Centralisation is the phenomenon whereby as a result of the performance of certain repeated movements or the adoption of certain postures, radiating symptoms originating from the spine and referred distally, are caused to move proximally towards the midline of the

spine" (McKenzie 1990).

Peripheralisation - The phenomenon of peripheralisation is observed when symptoms are caused to move farther distally as a result of certain repeated movements or postures.

Clinical examination The clinical examination included a mechanical assessment of the lumbar spine (McKenzie protocol) to identify patients likely to have discogenic pain, SIJ provocation tests, and a hip joint assessment. The clinical examination followed a standard format and sequence for all patients, ie in order: history taking, McKenzie evaluation, SIJ tests, hip examination. The examination was carried out by physiotherapists with credentials in spinal mechanical diagnosis and therapy as described by McKenzie (1981). Two training sessions were held prior to the beginning of the study to ensure standardisation of techniques. The physiotherapy evaluation (history and clinical examination) typically required between 30 minutes and one hour. Therapists completed the clinical examination prior to application of the reference standard and were blinded to all previous radiological investigations. Patients were scheduled for the clinical examination in an opportunistic fashion on a day when the physical therapist would be in the clinic. Clinical examinations were conducted and conclusions recorded prior to and on the same day as the diagnostic injections. Inconclusive findings or incomplete examinations were documented.

The McKenzie assessment The McKenzie lumbar mechanical assessment utilises, but is not limited to, single and repeated end range movements. These consist of flexion in standing, extension in standing, right and left side gliding (a form of lateral flexion), flexion in lying (knees to chest), extension in lying (a half press-up with the pelvis remaining in contact with the table). Baseline symptoms were noted, and the effect on symptoms during



Figure 1E. Sacral thrust pain provocation SIJ test.

and immediately following a single movement was documented. The test movements were repeated in sets of 10 and the effect, if any, was documented. It was recorded if centralisation or peripheralisation occurred. If a clear symptomatic response to repeated movements revealed the centralisation or peripheralisation phenomena, the lumbar assessment was terminated, and the clinical decision that symptoms were produced by disc pathology was reached.

The sacroiliac pain provocation tests The tests employed in this study have been found to have good to excellent inter-rater reliability ($\kappa = 0.52-0.88$) (Laslett and Williams 1994). They are:

Distraction: The patient lies supine and the examiner applies a posteriorly directed force to both anterior superior iliac spines. The presumed effect is a distraction of the anterior aspects of the SIJ (Figure 1A).

Thigh thrust: The patient lies supine with the hip and knee flexed where the thigh is at right angles to the table and slightly adducted. One of the examiner's hands cups the sacrum and the other arm and hand wraps around the flexed knee. The pressure applied is directed dorsally along the line of the vertically oriented femur. The procedure is carried out on both sides. The presumed action is a posterior shearing force to the SIJ of that side (Figure 1B).

Gaenslen's test: The patient lies supine near the edge of the table. One leg hangs over the edge of the table and the other hip and knee are flexed towards the patient's chest. The examiner applies firm pressure to the knee being flexed to the patient's chest and a counter pressure is applied to the knee of the hanging leg, towards the floor. The procedure is carried out on both sides. The presumed action is a posterior rotation force to the SIJ of the side of the flexed hip and knee, and an anterior rotation force of the SIJ on the side of the hanging leg (Figure 1C).

Compression: The patient lies on the side with hips and knees flexed to about a right angle. The examiner kneels on

the table and applies a force vertically downward on the uppermost iliac crest. The presumed action is a compression force to both SIJs (Figure 1D).

Sacral thrust: The patient lies face down. The examiner applies a force vertically downward to the centre of the sacrum. The presumed action is an anterior shearing force of the sacrum on both ilia (Figure 1E).

The direction of force application is indicated in each figure.

Clinical reasoning A McKenzie evaluation does not specifically aim to identify a symptomatic structure, but when centralisation or peripheralisation of symptoms is reported, the pathology is regarded as a derangement of an intervertebral disc (Donelson et al 1997, McKenzie 1981 and 1990). Prior to the commencement of the study, the threshold of three positive SIJ pain provocation tests was set to indicate the presence of SIJ pathology, based on clinical experience that suggests not all SIJ tests are positive when this joint is known to be painful, but most are. Therefore, in the absence of centralisation or peripheralisation of symptoms, the presence of at least three positive SIJ pain provocation tests was determined a priori as the threshold for identifying a symptomatic SIJ. Where these criteria for symptomatic discs or SIJs were not met, the patient was assumed to have some other source of pain. The core clinical reasoning process employed in this study is represented in Figure 2. However, it is acknowledged that the potential for dual or multiple sources of pain exists. If, in the course of the examination, the lumbar pain and dominant buttock pain were clearly provoked independently of each other, dual pain generators were suspected and recorded.

Radiology examination The radiologist examiner has had more than 20 years of experience in diagnostic spinal injection procedures, including SIJ injection. The SIJ injection was carried out blinded to the results of the physiotherapy clinical examination and diagnosis. The radiology examination was carried out within 30 minutes of completion of the physiotherapy clinical examination. All patients received a screening examination immediately prior to the injection procedure by the radiologist to ensure inclusion and exclusion criteria were met. The technique used for fluoroscopically guided contrast enhanced SIJ arthrography has been previously described (Fortin et al 1994b, Schwarzer et al 1995a). Pain drawings and numeric pain rating scales for pain intensity were acquired prior to and one hour after diagnostic injection.

The SIJ injection was considered positive if slow injection of solutions provoked familiar pain, and instillation of a small volume of local anaesthetic (less than 1.5 mL) resulted in at least 80% reduction in pain for the duration of anaesthetic effect. The anaesthetic effect was assessed by change in pre- and post-injection numeric pain rating scales. Patients who had a concordant pain response and at least 80% relief of familiar pain were scheduled for a confirmatory injection. Lidocaine was used in the initial

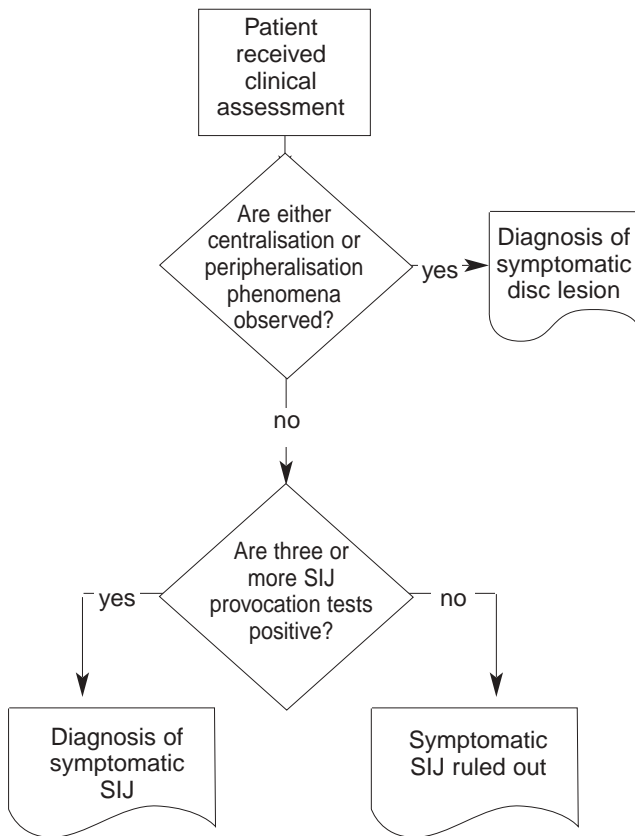


Figure 2. Diagnostic algorithm used to arrive at conclusion of symptomatic SIJ.

injection and Bupivacaine was used in the confirmatory injection to eliminate the need for a sham injection (Barnsley et al 1993). When the initial injection of contrast and Lidocaine provoked familiar symptoms, corticosteroid was introduced into the joint as a therapeutic procedure. Diagnostic injections were considered indeterminate when there was a concordant pain response but insufficient pain relief, or when substantial pain relief was reported in the absence of provocation of familiar pain. Indeterminate responses were considered negative. Injections not causing concordant pain provocation or analgesic response were deemed negative. Unanticipated in the study design was the event of a positive initial injection leading to reduction or abolition of pain sufficient to make a confirmatory injection inappropriate. These cases were excluded from the primary analysis since their management did not conform to the reference standard set prior to the commencement of the study.

The radiologist documented the procedures, radiographic findings and conclusions, including pain provocation and analgesic responses to SIJ injection. All data sheets were sent to a statistician for independent data entry and analysis.

Data reduction and analysis Data analysis was performed using Minitab (Version 13) computer software. Sensitivity,

specificity, likelihood ratios and 95% confidence intervals were computed using CIA software (Altman et al 2000).

Results

Sixty-two patients with buttock pain with or without lumbar or lower extremity symptoms were seen by both radiologist and physiotherapist during a 19-month period. A flow diagram (Figure 3; Reitsma 2001) illustrates recruitment patterns and results. Of these 62 patients, three were unable to tolerate the physical examination, two were pain free on the day of the clinical examination, seven had no SIJ injection, and two had a bony obstruction causing a technical failure to inject the SIJ. These patients were excluded from the study. Forty-eight patients (32 women and 16 men) satisfied all inclusion criteria. Twenty-seven patients received the clinical examination at their initial visit to the clinic, and 21 on a subsequent visit. Mean time between initial injection and confirmatory injection was 4.4 weeks (range 1-20 weeks, SD 4.1 weeks, median 4 weeks, inter-quartile range 2-5 weeks). In all cases the clinical examination was undertaken on the same day as either the initial or confirmatory SIJ injection. Patient characteristics, pain and disability measured by the Roland-Morris questionnaire (Jensen et al 1992) the Dallas Pain Questionnaire (Lawlis et al 1989) and are presented in Table 1. Nineteen patients had litigation pending.

Forty-eight patients received the initial SIJ diagnostic injection. Sixteen patients had positive SIJ injections. Two subsets were identified for analysis. Five positive responders did not receive a confirmatory diagnostic injection because they derived such symptomatic relief from the initial procedure that a confirmatory injection could not be justified. It is presumed that corticosteroid included in the initial injection was responsible for the improvement. These cases were removed from the full dataset to create the first subset because the reference standard for this study was a double block. In the second subset, cases identified by clinical evaluation as having discogenic pain were also removed from analysis.

Eleven patients received a confirmatory SIJ injection and all were positive. In most cases confirmatory blocks were carried out between two and four weeks after the initial procedure. Thirty-two patients had negative SIJ diagnostic injections and did not require a confirmatory injection.

As expected, the SIJ tests more commonly provoked familiar pain in patients with positive diagnostic SIJ injections. Table 2 contains results for the prediction of symptomatic SIJ based solely on the presence of three or more positive tests in the first subset of 43 patients. Sensitivity was 0.91 (95% CI 0.62 to 0.98), specificity was 0.78 (0.61 to 0.89), the positive likelihood ratio was 4.16 (2.16 to 8.39) and the negative likelihood ratio was 0.12 (0.02 to 0.49).

Nine patients reported centralisation or peripheralisation of pain in the course of repeated movement testing in the clinical examination, and were deemed to have discogenic

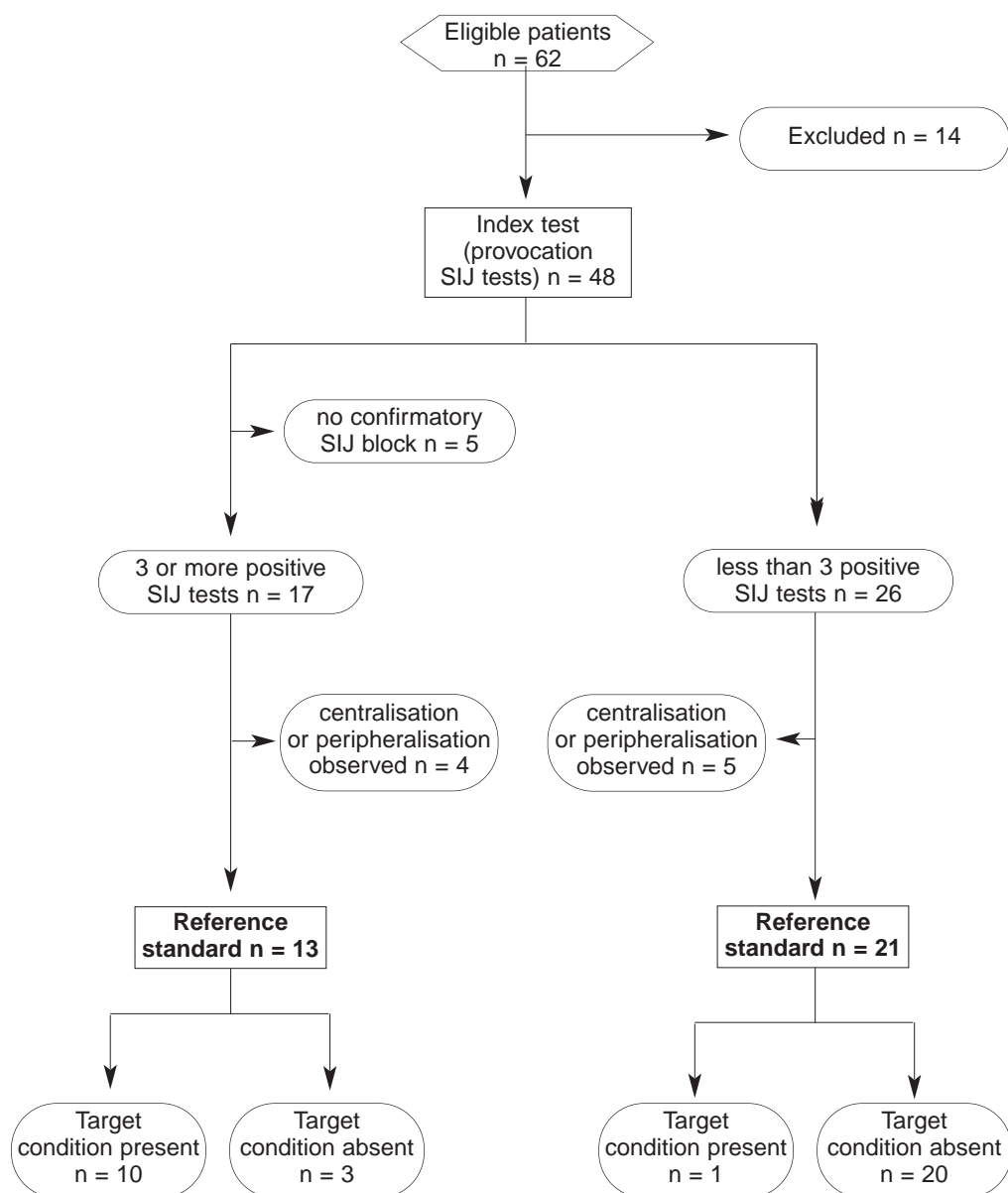


Figure 3. Flow diagram of recruitment pattern and results.

pain. None of these patients had a symptomatic SIJ based on diagnostic injection. The second subset was created by removal of these cases from the dataset leaving 34 patients deemed by clinical examination as having a non-discogenic source of pain. Table 3 contains results of the conclusions of the clinical examination versus the reference standard for these 34 patients. Sensitivity was 0.91 (95% CI 0.62 to 0.98), specificity was 0.87 (95% CI 0.68 to 0.96) and the negative likelihood ratio was 0.11 (95% CI 0.02 to 0.44). Exclusion of patients whose pain centralised or peripheralised increases the positive likelihood ratio for identifying symptomatic SIJ from 4.16 (95% CI 2.16 to 8.39) to 6.97 (95% CI 2.70 to 20.27).

There were no adverse effects from the clinical examination or the diagnostic injection procedure.

Discussion

This study provides evidence that employing a McKenzie evaluation to exclude discogenic pain and a composite of three or more SIJ pain provocation tests has clinically useful diagnostic accuracy when compared with a reference standard. Using this clinical reasoning process, the combination of three or more positive provocation SIJ tests and no centralisation or peripheralisation is at least three and possibly 20 times more likely in patients having

Table 1. Patient characteristics (n = 48).

	Mean	Median	SD	Range
Age (years)	42.1	42.0	12.3	20-79
Symptom duration (months)	31.8	22	38.8	2-156
Off work (months)	17.8	19	33.4	2-84
Roland-Morris score (%; n = 42)	75.7	82.5	21.6	22-100
Dallas Pain score (%)				
Daily activities interference	61.2	66.0	18.1	23-93
Work leisure interference	66.2	75.0	22.6	14-95
Anxiety/depression	54.3	55.0	27.2	0-100
Social interference	48.7	50.0	24.8	0-85

Table 2. Comparison of double SIJ diagnostic injection and SIJ positive pain provocation tests (n = 43).

	Positive injection	Negative injection
3 or more positive pain provocation tests	10	7
0-2 positive pain provocation tests	1	25

Table 3. Comparison of double SIJ diagnostic injection with clinical examination using three or more positive SIJ tests and exclusion of suspected discogenic cases (n = 34).

	Positive injection	Negative injection
Positive clinical examination	10	3
Negative clinical examination	1	20

positive diagnostic SIJ injections than in patients having negative injections. Maigne et al used a reference standard similar to this study and found that SIJ pain provocation tests were not predictive (Maigne et al 1996). Maigne et al assessed only the results of individual tests in relation to the reference standard. The current study, in comparison, had different inclusion and exclusion criteria, and the duration of patients' symptoms was appreciably longer (median 22 months versus 4.2 months). In addition, the interpretation that the predetermined threshold of three or more positive SIJ tests implicates the SIJ as a source of pain was applied only after excluding the disc as a pain source, in order to reduce expected false positive responses. The study by Dreyfuss et al (1996) did investigate a wide variety of possible combinations of symptoms and signs that might improve diagnostic accuracy, but did not prospectively seek to reduce suspected false positive responses. Specifically they did not test for the centralisation and peripheralisation phenomena. The differences in method and technique in the current study may account for the opposite outcomes from those earlier studies.

Clinical implications In the view of the current authors, a potential source of error when using SIJ pain provocation tests may be the technique of application, and may partly explain the differences between these results and those of previous studies. The SIJ is a large joint with relatively

little mobility (Sturesson et al 1989). Reasonably large forces are required to ensure that the SIJ structures are adequately stressed. The techniques are simple but insufficient force of application may produce false negatives. Inappropriate hand placement often provokes discordant pain responses and is another potential source of error in the form of false positives.

The clinical reasoning process used in this study results in a useful improvement in diagnostic accuracy over evaluation of SIJ tests alone, by reducing the false positives rate. A number of patients were excluded from the study because of either unwillingness to participate or inability to tolerate the assessment process. In these patients, diagnostic injection was the preferred method of determining the likely pain generator. In other patients, because of technical difficulties, the diagnostic injection was indeterminate, whereas the clinical examination yielded a clear result. Treatment programs for SIJ pain could reasonably be predicated on diagnoses reached in this manner.

It is our experience that illness behaviours, severe pain, body size, structure and shape can all conspire to confuse the clinician performing the clinical examination or radiological examination. Where such factors are a feature of the presentation, the clinician must accept that a clear diagnosis by clinical evaluation alone may not be possible.

Implications for future research Patients not receiving a confirmatory diagnostic injection because of a good or excellent steroid response were excluded from data analysis to conform to the reference standard of double diagnostic injection. In so doing, five patients who probably had a symptomatic SIJ were excluded from analysis. Future studies can eliminate the loss of these patients from data analysis by not adding the steroid injection at the time of the first injection. Including steroid in the confirmatory injection would not affect data analysis, and would still permit the introduction of a potentially useful therapeutic agent for the patient's benefit. These five patients excluded from the primary analysis were all diagnosed as having symptomatic SIJs based on the clinical examination, as all had three or more positive SIJ tests and did not report either centralisation or peripheralisation of their symptoms during repeated movements testing.

The range of 95% confidence intervals for the likelihood ratios is wide (2.7 to 20.27). A larger sample size would narrow this range and should be considered in any future study of similar type.

The prevalence of cases with more than one source of pain is unknown, although in one study, discogenic pain and symptomatic zygapophyseal joints were found to co-exist in 3% of that sample of chronic back pain patients (Schwarzer et al 1994a). The prevalence of combined symptomatic SIJ and disc, or combined symptomatic SIJ and zygapophyseal joint is unknown. To our knowledge, there is only one report containing information on the results of diagnostic injections into all three major potential pain sources in the low back (disc, facet and SIJ; Fortin et al 1994a). These authors found that, of the 10 patients identified by diagnostic injections as having SIJ pain and also receiving provocation discography and facet joint injections, none had discogenic or facetogenic contributions to their pain complex.

Conclusion

This study provides evidence that SIJ pain provocation tests used within the context of a specific clinical reasoning process can enable the clinician to differentiate between symptomatic and asymptomatic sacroiliac joints in the majority of cases.

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