Correlation of clinical examination characteristics with three sources of chronic low back pain

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Abstract

BACKGROUND CONTEXT: Research has demonstrated some progress in using a clinical examination to predict discogenic or sacroiliac (SI) joint sources of pain. No clear predictors of symptomatic lumbar zygapophysial joints have yet been demonstrated.

PURPOSE: To identify significant components of a clinical examination that are associated with symptomatic lumbar discs, zygapophysial joints and SI joints.

STUDY DESIGN: A prospective, criterion-related concurrent validity study performed at a private radiology practice specializing in spinal diagnostics.

PATIENT SAMPLE: The sample consisted of 81 patients with chronic lumbopelvic pain referred for diagnostic injections.

OUTCOME MEASURES: Contingency tables were constructed for nine features of the clinical evaluation compared with the results of diagnostic injections. Statistical analysis included chi-squared test for independence, phi and odds ratios with confidence intervals.

METHOD: Patients received blinded clinical examinations by physical therapists, and diagnostic injections were used as the criterion standard.

RESULTS: Significant relationships were found between discogenic pain and centralization of pain during repeated movement testing, and pain when rising from sitting. Lumbar zygapophysial joint pain was associated with absence of pain when rising from sitting. Sacroiliac joint pain was related to three or more positive pain provocation tests, pain when rising from sitting, unilateral pain and absence of lumbar pain.

CONCLUSIONS: Significant correlations exist between clinical examination findings and symptomatic lumbar discs, zygapophysial and SI joints. The strongest relationships were seen between SI joint pain and three or more positive pain provocation tests, centralization of pain for symptomatic discs and absence of pain when rising from sitting for symptomatic lumbar zygapophysial joints. © 2003 Elsevier Inc. All rights reserved.

Keywords: Lumbar zygapophysial joint; Sacroiliac joint; Intervertebral disk; Physical examination; Low back pain; Intra-articular injections; Spinal injections; Diagnosis

Introduction

Patients with chronic low back pain desire answers about why they have pain [1,2]. Given the limitations of clinical examination [3–11], clinicians are often at a loss to provide answers with any degree of certainty. Imaging studies demonstrating neural compromise are likely to be clinically significant [12,13], but plain radiographs, computed tomography and magnetic resonance imaging are of limited value in identifying painful lumbar structures because they are often abnormal in asymptomatic subjects and may be unremarkable in patients with significant symptoms [12–17].

Progress has been made with clinical identification of subgroups within low back pain patient populations. Specific features of the clinical examination have been found to have...
ical evaluations were conducted and conclusions recorded for clinical evaluations. Informed consent was obtained, clinicians were blinded to previous radiology investigations, and the radiologist was blinded to results of the physical therapy. Two training sessions were held before the study to ensure consistency of methods and standardization of test procedures. Patients were scheduled for imaging studies and had prior unsuccessful therapeutic interventions. Fifty-five patients were part of a study specializing in spinal diagnostics. They were evaluated by physical therapists who were blinded to symptoms reported to be associated with zygapophysial joint pain. The composite of signs and symptoms identified by diagnostic injection. The null hypothesis was that lumbar disc, zygapophysial and SI joint pain can be established by specific spinal injection techniques. The criteria for a positive discogram include presence of abnormal morphology and provocation of similar or exact pain during injection. At least one adjacent disc must be negative to injection as a control. Substantial symptom relief after delivery of an anesthetic into lumbar zygapophysial or SI joints is the criterion for identifying symptomatic joints. The purpose of this study was to assess the significance of components of the history and clinical examination of patients with chronic pain associated with symptomatic lumbar discs, lumbar zygapophysial joints or SI joints identified by diagnostic injection. The null hypothesis was that there is no correlation between features of the clinical examination and the results of diagnostic injection.

**Patients and methods**

A total of 102 patients with chronic lumbar or lumbopelvic pain were referred to a private radiology practice specializing in spinal diagnostics. They were evaluated by visiting physical therapists. Each patient had previously undergone imaging studies and had prior unsuccessful therapeutic interventions. Fifty-five patients were part of a study examining the diagnostic power of clinical evaluation in predicting the presence or absence of symptomatic SI joints. Fifty-seven additional patients were evaluated to explore possible means of differentiating between painful SI and zygapophysial joints, and intervertebral discs. The same clinical evaluation was used throughout.

The clinical evaluation was carried out by physical therapists with credentials in the McKenzie method of spinal mechanical diagnosis and therapy. Two training sessions were held before the study to ensure consistency of methods and standardization of test procedures. Patients were scheduled for the clinical evaluation in an opportunistic fashion on days when one of the physical therapists would be in the clinic. The therapists were blinded to previous radiology investigations, and the radiologist was blinded to results of the physical therapist clinical evaluations. Informed consent was obtained, clinical evaluations were conducted and conclusions recorded before injections. Patients were not considered for the clinical evaluation if they were unwilling to participate, had clear signs of nerve root compression, were deemed too frail or were unable to tolerate the full clinical evaluation.

The evaluation included patient history, determination of symptom location, aggravating and relieving factors and performance of repeated end-range movements and positions to assess changes in symptom behavior. Centralization, peripheralization or other change in pain status was specifically noted, as was any obvious change in spinal mobility with repeated movement testing. The term “centralization” refers to a retreat of referred symptoms from the periphery toward the midline of the spine. “Peripheralization” refers to progression of symptoms moving from the spine toward the periphery.

The SI joint was examined using pain provocation tests, including distraction, compression, sacral thrust, thigh thrust and Gaenslen’s test (pelvic torsion), as described by Laslett and Williams.

**Injection procedures**

All patients were referred for evaluation employing one or more injection procedures. Lumbar discography, lumbar zygapophysial joint arthrography/injection or SI joint arthrography/injection were performed when specifically requested by the referring physician or if deemed indicated by the radiologist. Considerations included patient consent and ability to tolerate the procedures. Discography was performed employing a standard technique. Using an extradural approach, small-gauge needles were directed into the nucleus of the discs. Contrast material was then slowly injected in a controlled fashion. Spot films in two planes were obtained to demonstrate the enhanced nucleus and any annular or end plate abnormalities. Discometric (pressure/volume) data were also collected during the injection, as was the patient’s response to disc stimulation. Local anesthetic was instilled into painful discs, and anesthetic response was recorded before discharge. The injection was deemed positive when it provoked similar or exact pain, when imaging demonstrated abnormal morphology and at least one adjacent disc was negative upon injection.

SI and lumbar zygapophysial joint injections were performed employing standard techniques. Small-gauge spinal needles were directed into the joint space with fluoroscopic guidance. Contrast material was slowly instilled to confirm needle placement in the joint and to assess capsular integrity. The SI and/or lumbar zygapophysial joint injection was considered positive if the slow injection of solution provoked familiar pain of moderate intensity and instillation of a small volume of anesthetic (less than 1.5 cc) resulted in 80% or greater relief of the primary pain based on 10-point verbal analogue scale. Pain ratings were recorded before and 30 to 60 minutes after the injection. Injections were considered indeterminate when there was a concordant pain response but insufficient pain relief. Such indeterminate responses were considered negative for analysis. Where circumstances dictated, the study of several components was...
accomplished on the same day. SI and zygapophysial joint injections were completed first. Discography was performed in a second session after evaluating response to the initial procedures. The radiologist documented the procedures performed, radiographic findings and pain and analgesic response to injection.

Statistical analysis

Post hoc review of the clinical evaluation of raw data suggested that pain stemming from the three sources differed in regard to pain location and response to mechanical stresses. Nine specific characteristics of the clinical assessment were selected for statistical analysis. These were midline lumbar pain, asymmetrical pain, unilateral pain, bilateral pain; change in lumbar range of motion, centralization or peripheralization with repeated movement testing; pain when rising from sitting and presence of three or more positive SI joint pain provocation tests.

Data were analyzed using SPSS statistical software [36]. Two-by two contingency tables were constructed, and the chi-squared test of independence was used as a screening test to identify significant associations among the characteristics as compared with the results of diagnostic injections ($\alpha = .05$). The phi coefficient, which is an index of association analogous to Pearson’s correlation coefficient ($r$), was also obtained [37]. The phi coefficient is used to demonstrate a relationship analogous to Pearson’s correlation coefficient ($r$), and ranges from values of $-1$ to $+1$; $-1$ indicates a perfect inverse relationship, 0 relates to no association, and $+1$ indicates a perfect positive correlation between the two variables. Phi is calculated by dividing the square root of chi-squared by the number of subjects in the sample. Phi-squared indicates the strength of the effect size. The effect size is an estimate used to quantify the degree to which the results deviate from null expectations.

For those characteristics showing a significant correlation, odds ratios with 95% confidence intervals were obtained to assess the strength of the correlation between the variables. An odds ratio of one indicates no relationship between the diagnostic injection and clinical examination characteristic; two indicates a weak relationship; over four a fairly strong relationship; over eight a very strong relationship with three or more positive SI joint pain provocation tests (Table 2).

The study group comprised 81 individuals (49 women and 32 men) ranging in age from 18 to 79 years (mean, 40.8 years; SD, 12.1 years). Time from onset of symptoms to evaluation ranged from 2 to 156 months (median, 18 months; mean, 26 months; SD, 28 months). Forty-three percent were off work because of their symptoms. Ninety-eight percent of the study group included buttock pain on their preprocedure pain drawing. Table 1 shows the distribution of the dominant pain location for the 81 patients. Fifty-four percent reported buttock pain as the dominant pain.

A total of 104 injection procedures were performed on the 81 patients. Thirty patients had only negative responses to one or more injection procedures. A pain generator was positively identified in 51 patients. The number of patients and results of the diagnostic injections are shown in Table 2.

There was a significant association between a positive SI joint injection and four of the nine characteristics (Table 3). A negative relationship was found between presence of midline lumbar pain and positive SI joint injection. Patients having SI joint pain rarely had pain at or above the level of the L5 spinous process. In contrast, 80% of those with discogenic pain reported midline lumbar pain. Positive relationships were noted for unilateral pain (p = .05), pain produced or increased when rising from sitting (p = .02), and presence of three or more positive SI joint pain provocation tests (p < .001). As indicated by the odds ratios, there was a fairly strong relationship between positive SI joint injection and unilateral pain and a very strong relationship with three or more pain provocation tests. Presence of three or more positive SI joint pain provocation tests was found to have a phi coefficient of .6 when compared with the results of SI joint diagnostic injection. Squaring this value gives an effect size of 36%. All patients with positive SI joint injections had pain when rising from sitting, precluding the calculation of an odds ratio, because there were no patients with a positive SI joint injection who did not have pain when rising from sitting.

Both centralization of pain and pain when rising from sitting were significantly associated with a positive discogram (Table 4). All patients with positive discograms reported pain when rising from sitting, precluding calculation of an odds ratio. Seven of 15 patients with positive discograms (47%) reported centralization of pain during the repeated movement portion of the clinical examination. The odds of centralization occurring for patients having
positive discograms were 2.13 (95% CI 1.28, 3.52). This represents a weak but positive relationship between the two variables. Patients with negative discograms did not report centralization of pain during repeated movement testing.

To further assess the value of centralization, the 2×2 contingency tables for each of the three pain generators (Tables 5, 6 and 7) were evaluated to establish the sensitivity and specificity of this clinical sign. When compared with the results of discography, centralization was found to have a low sensitivity of 0.47 (95% CI 0.25, 0.70), but a high specificity of 1.00 (95% CI 0.7, 1.00). All patients whose pain centralized had positive discography. Comparison of centralization to the results of diagnostic zygaphysial joint injection yielded a sensitivity of 0.0 (95% CI 0.0, 0.22) and specificity of 0.89 (95% CI 0.57, 0.98). None of the patients with positive zygaphysial joint injections reported centralization of pain. Comparison of centralization with SI joint injections gave a sensitivity of 0.09 (95% CI 0.03, 0.28) and specificity of 0.79 (95% CI 0.63, 0.90).

Given that all patients with a positive injection into either the SI joint or a lumbar disc reported provocation of pain when rising from sitting, it is interesting to note that the lack of pain provocation when rising from sitting was the one significant characteristic associated with patients with positive zygaphysial injections (Table 8). There was a strong correlation between not having pain provoked when rising from sitting for patients with positive zygaphysial injections. This characteristic had an effect size of 36%.

Discussion

The results of this study allow rejection of the null hypothesis that there would be no significant associations between the clinical evaluation and diagnostic injections. Significant associations were seen for each of the three pain generators investigated by diagnostic injection.

With regards to pain location, 80% of those with painful discs had midline lumbar pain. The presence of midline lumbar pain tends to exclude the SI joint as a potential pain generator. While this study found no correlation between midline lumbar pain and zygaphysial joints, a previous study found that patients with confirmed zygaphysial joint pain did not have midline pain [3]. The small number of symptomatic zygaphysial joints in the sample provides insufficient statistical power to support or reject the previously cited negative relationship between midline pain and these joints.

The one characteristic that was significantly associated with lumbar zygaphysial joint pain was lack of provocation of pain when rising from sitting. This contrasts to significant correlations between pain provoked on rising from sitting for patients who had positive disc or SI joint injections. Patients reporting midline lumbar pain and pain when rising from sitting are more likely to have discogenic pain.

While only a weak correlation was observed between centralization and discogenic pain, it is of note that patients with zygaphysial joint pain did not report the centralization phenomenon. When centralization is observed, a painful facet joint is less likely to be the pain generator.

This study supports the findings of Donelson et al. [23] regarding the value of centralization in identifying symptomatic discs. The sensitivity and specificity of centralization can be calculated from their data to be 0.94 (95% CI 0.82, 0.99) and 0.52 (95% CI 0.34, 0.69), respectively. Nearly half of the centralizers had negative discograms. In contrast to the Donelson et al. study, all patients in the present study receiving discography and reporting centralization had positive discograms. The two patients reporting centralization who did not undergo discography did have positive SI joint injections. Because these two patients did not receive discography, it is unknown if the discs of these patients contributed to their complaints of pain.

In the present study, patients with unilateral pain below the level of the L5 spinous process, no lumbar pain and pain

| Table 2 | Diagnostic injection data |
|---------------------------------------------|
| Discogram & Lumbar facet & Sacroiliac |
| Positive injection & 15 & 14 & 22 |
| Negative injection & 9 & 9 & 35 |
| Totals & 24 & 23 & 57 |

| Table 3 | Significant clinical examination findings for sacroiliac joint pain |
|---------------------------------------------|
| Midline pain & 3.9 & .05 & −0.3 |
| Pain rising from sitting & 5.3 & .02 & 0.3 |
| ≥3 SIJ PPT/s & 22.2 & .001 & 0.6 |
| Unilateral pain & 3.7 & .05 & 0.3 |

| Table 4 | Significant clinical examination findings for lumbar discogenic pain |
|---------------------------------------------|
| Chi squared & p Value & Phi |
| Centralization & 5.9 & .025 & 0.5 |
| Pain rising from sitting & 5.7 & .017 & 0.5 |

| Table 5 | Contingency table comparing centralization of pain to the results of discography |
|---------------------------------------------|
| Positive discogram & Negative discogram |
| Centralizers & 7 & 0 |
| Noncentralizers & 8 & 9 |

CI=confidence interval; PPTs=pain provocation tests; SIJ=sacroiliac joint.
Centralizers 2 7
Noncentralizers 20 27

results of diagnostic zygapophysial joint (z-joint) injections

Contingency table comparing centralization of pain with the results of diagnostic zygapophysial joint (z-joint) injections

<table>
<thead>
<tr>
<th></th>
<th>Positive z-joint</th>
<th>Negative z-joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noncentralizers</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Centralizers</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

when rising from sitting were more likely to have a painful SI joint. The use of SI joint pain provocation tests aids significantly in clarifying the clinical picture. Presence of a SI joint source of pain as identified by diagnostic injection is 28 times more likely when there are three or more positive SI joint pain provocation tests.

A limitation of this study is that the comparisons are based on single diagnostic injections. This is not an issue for those receiving discography, because internal controls are used to minimize false-positive responses. However, there is a 32% false-positive rate associated with single lumbar zygapophysial injections [40]. A false-positive rate for SI joint injections has not been reported. A false-positive rate of 7.7% may be calculated from one study [4] or 47% in another [6]. Replication of this study using double (confirmatory) diagnostic blocks is warranted to better clarify the degree of significance of these clinical characteristics.

Given the limitations of a routine orthopedic examination and radiographic findings in identifying sources of back pain, this paper provides preliminary evidence that pain location, historical factors and examination findings facilitate better clinical classification of patients with low back pain. Individuals with symptomatic lumbar discs, zygapophysial joints or SI joints constitute at least 68% of all patients with chronic low back pain [41]. The use of readily available clinical findings to identify possible SI joint, facet or discogenic sources of pain may enable more precise use of diagnostic procedures and therapeutic interventions.

**Conclusion**

Significant associations were noted between SI joint pain provocation tests, pain when rising from sitting, unilateral pain and lack of midline lumbar pain and SI joint pain. Centralization of pain and pain when rising from sitting were correlated with discogenic pain. No provocation of pain when rising from sitting was associated with zygapophysial joint pain. Consideration of specific pain location, historical factors and examination findings can allow for better clinical classification of patients with low back pain.

Table 7
Contingency table comparing centralization of pain with the results of diagnostic sacroiliac joint injections

<table>
<thead>
<tr>
<th></th>
<th>Positive SI joint</th>
<th>Negative SI joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noncentralizer</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Centralizer</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

SI=sacroiliac.

Table 8
Significant clinical examination finding for lumbar facet pain

<table>
<thead>
<tr>
<th></th>
<th>Chi squared (1, N=23)</th>
<th>p Value</th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain rising from sitting</td>
<td>7.1</td>
<td>.008</td>
<td>−0.6    0.08 (0.01, 0.59)</td>
</tr>
</tbody>
</table>

CI=confidence interval.

References


