

# The Influence of Psychologic Factors on Diskography in Patients With Chronic Axial Low Back Pain

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**ABSTRACT.** Derby R, Lee S-H, Chen Y, Kim B-J, Lee C-H, Hong Y-K, Lee J-E, Seo K-S. The influence of psychologic factors on diskography in patients with chronic axial low back pain. *Arch Phys Med Rehabil* 2008;89:1300-4.

**Objective:** To determine whether a patient's presenting psychometric scores affect the findings of a pressure and injection speed-controlled manometric lumbar diskography in patients with chronic low back pain (CLBP).

**Design:** A prospective, correlation-based, investigative study.

**Setting:** Free-standing ambulatory spine surgery center.

**Participants:** Two hundred sixty-three disks from 81 patients (54 men, 27 women).

**Intervention:** Diskography was performed using pressure and injection speed-controlled techniques. The patients were divided into psychometric subgroups (normal, at risk, abnormal) according to the Distress and Risk Assessment Method (DRAM).

**Main Outcome Measures:** The diskography findings on each psychometric DRAM subgroup were evaluated.

**Results:** Across the individual psychometric categories, the positive rates of diskography in the normal, at-risk, and abnormal subgroups were 75.0% (9/12), 59.5% (25/42), and 70.4% (19/27), respectively ( $P > .05$ ). The mean numeric rating scores of pain at 15 and 50psi above the opening pressure were similar in the 3 psychometric subgroups. There was no correlation between the diskography results and the psychometric subgroupings.

**Conclusions:** In patients with CLBP, there is no correlation between the presenting psychometric DRAM score and the findings from pressure and injection speed-controlled manometric lumbar diskography.

**Key Words:** Intervertebral disk; Low back pain; Psychometrics; Rehabilitation.

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**T**HE INTERVERTEBRAL DISK is considered to be a common source of chronic axial pain.<sup>1-3</sup> However, in the presence of 2 or more degenerated disks without significant disk herniations, confirming the diagnosis and identifying the symptomatic levels are challenging. While some clinicians contend that diskogenic pain can be diagnosed with a detailed history, physical examination, and imaging studies, this assumption is unproven. Wanting for a criterion standard diagnostic test, provocative disk stimulation is often used to confirm the diagnosis and identify symptomatic levels. The test, however, has liabilities. Foremost is the requirement that patients with chronic pain are asked to report on reproduction of pain during a stressful invasive test. Such a requirement will lead to a varying percentage of false-positive results. Whether one is able to contain the false-positive rate to an acceptable level is an ongoing debate.

One factor that might be expected to influence exaggerated reports of pain is the psychologic state of the patient. Previous studies support this contention and report that patients with abnormal psychometric test scores will overreport their level of pain during a diskography injection.<sup>4,5</sup> Because pain reported to be 6 or 7<sup>6</sup> or higher is a requirement for a positive response, patients presenting with abnormal psychometric findings are considered to be poor candidates for provocative disk stimulation.<sup>7</sup>

The purpose of this study was to confirm or refute the hypothesis that the score of a commonly used standardized psychologic test influences the rate of positive results.

## METHODS

### Patient Recruitment

The institutional review board of Quorum Review approved the study. All patients were informed of the nature of the study and the risks of diskography before consenting to the procedure. None of the participants received any remuneration for partaking in this study. The exclusion criteria were as follows: subjects and patients with allergies to contrast media, iodine, or cephalosporin antibiotics; inability to undergo MRI scanning because of ferromagnetic implants or severe claustrophobia; and inability to tolerate positioning for MRI or diskography.

Eighty-one patients with CLBP were recruited (54 men, 27 women; age range, 20–65y; mean age, 43±12y). Before the study, subjects and patients were instructed in the use of the

### List of Abbreviations

CLBP	chronic low back pain
CT	computed tomography
DRAM	Distress and Risk Assessment Method
MRI	magnetic resonance imaging
MSPQ	Modified Somatic Pain Questionnaire
NRS	numeric rating scale
ZSDS	Zung Self-Rated Depression Scale

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0-point to 10-point NRS for pain intensity responses. Those completing the NRS were instructed that 0 indicated no pain, 6 indicated bad pain, and 10 indicated the worst pain imaginable. The patients agreeing to continue in the study underwent pressure-controlled manometric diskography.<sup>8</sup> All patients were required to obtain or to provide an MRI scan of their lumbar spine that had been taken within the last 6 months.

### Psychometric Test

Before diskography was performed, subjects and patients completed a back pain history and psychometric screening questionnaire, which included a standard pain diagram. The psychometric screening consisted of a modified ZSDS score<sup>9,10</sup> and an MSPQ score.<sup>9,11,12</sup> Patients were divided into 4 groups according to the psychometric test findings, using the DRAM scores: *normal* was defined as a ZSDS score less than 17; *at-risk* was defined as a ZSDS score between 17 and 33 and an MSPQ score of less than 12; *distressed depressive* was defined as a ZSDS score greater than 33; and *distressed somatic* was defined as a ZSDS score between 17 and 33 and an MSPQ score greater than 12. These modified ZSDS and MSPQ scores were then combined, and the correlation between the psychometric scores and the diskography parameters was examined.

### The Pressure and Injection Speed-Controlled Manometric Diskography Technique

Diskography was performed by 1 of 3 diskographers, who had between 5 and 25 years experience with the procedure, in a surgical suite under aseptic conditions. Intravenous antibiotics (2g of cephalosporin) were administered 20 minutes before the procedure. All patients were premedicated with .025mg/kg of midazolam before the procedure. Throughout the procedure, the patients were monitored with pulse oximetry and a blood pressure cuff. Supplemental oxygen was administered through a nasal cannula.

Nonionic contrast medium mixed with 6mg/mL of cephalosporin was injected into each disk at a rate of .05mL/s using a controlled injection syringe with digital pressure readout.<sup>a</sup>

At the time of the disk injection, each patient was awake, alert, and able to respond to instructions or questions. They were asked to report the nature and location of any pain that had been evoked during the procedure, and to rate its intensity on a 0 to 10 NRS for pain.

The pressures were monitored throughout each injection. The opening pressure was recorded when the contrast medium was first observed to enter the disk. At each subsequent injection of 0.5mL contrast medium, the pressure of the injection, the location of the contrast medium, and any pain response were recorded. The injection was continued until one of the following endpoints had been reached: an intradiskal pressure of 80 to 100psi above the opening pressure, or a total of 3.5mL contrast medium had been injected. In some cases, the final pressure of the injection exceeded 100psi because of a rapid increase in pressure during the final few seconds of the injection.

When each injection was terminated, anteroposterior and lateral spot films were obtained to record the distribution of the contrast medium. When all the levels in each patient had been tested, CT was performed on all those levels. The participants tolerated the procedure well, and there were no complications.

### Diskography Parameters

Subjects were scored using a standard 0-point to 10-point NRS. The diskography parameters were compared with the psychometric scores after excluding the nonpainful disks. The

pressure (in psi) associated with a given pain response was noted. The pressure and injected volume at which the pain was first evoked and the NRS values at 15, 30, and 50psi above the opening pressure and the maximal NRS during more than 50psi of intradiskal stimulation were recorded.

### Pain Behaviors

All patients were videotaped throughout the procedure to corroborate the pain response or its absence. Three examiners subsequently reviewed the videotape of each procedure and scored it for the pain behavior using the modified Wong-Baker Faces Pain Rating Scale.<sup>13</sup> The agreed score was entered when all 3 examiners agreed on their rating. When the examiners disagreed, the videotape was viewed again until a consensus score had been achieved. Each of these instruments rated the pain behavior on a 0 to 4 scale, on which 0 indicated no pain behavior and 4 indicated maximum pain behavior. The facial expressions were evaluated as follows: 0 was *does not hurt*, 1 was *hurts slightly* (grimace observed), 2 was *hurts even more* (intensity mild and intermittent), 3 was *hurts quite a lot* (intensity moderate), and 4 was *hurts the worst* (tearing). According to the 0 to 4 rating scale of the facial expression, the vocal expression was also rated on a 5-point scale: 0 was *does not hurt, calm, no vocal sound*; 1 was *hurts slightly, groans briefly*; 2 was *hurts even more, intensity mild and intermittent, moan*; 3 was *hurts quite a lot, intensity moderate, long-lasting moaning*; and 4 was *hurts the worst, intensity quite pronounced, screaming or shouting*.

### Positive Diskogram Criteria

The magnetic resonance images of each disk tested were graded for their signal intensity using a I to V scale for disk degeneration.<sup>14</sup> The CT diskograms were graded for the presence and extent of radial fissures as 0, 1, 2, 3, 4, and 5 according to the Dallas Diskogram Scale.<sup>15</sup> Four criteria have been previously used to determine the presence of positive disk on diskography: (1) an abnormal disk (Dallas scale grade  $\geq 3$ ), (2) NRS pain response of 6 or more out of 10, (3) at a pressure level 50psi or less, pain described by the patient as familiar, and (4) a negative control disk.<sup>16</sup> In contrast with the criteria of Walsh et al,<sup>17</sup> we did not require 2 or more pain behaviors documented by videotape to establish a positive level.

The prediskography and postdiskography pain scores were used to compare and confirm the concordant assessments made during the injection.

### Data Analysis

All statistical analyses were performed with SPSS/PC+ software.<sup>b</sup> When comparing positive diskography rates with psychometric groups, the chi-square test was used. Partial correlation coefficients were analyzed for relation parameters of diskography with summation of psychometric scores.

## RESULTS

### Sample Characteristics

Two hundred sixty-three disks were recruited from 81 patients with CLBP. Thirty-seven disks in 12 patients not at risk (normal) and 139 disks in 42 at-risk patients were evaluated with a psychometric test. In 27 patients who showed abnormal psychometric findings, 22 for distressed depressive and 5 for distressed somatic findings were analyzed. The duration of pain was  $47.21 \pm 64.61$  months.

**Table 1: The Rate of Positive Disks of Each Psychometric Subgroup at Various Pressures**

Pressures	Normal (%)	At Risk (%)	Abnormal (%), (DD/DS), n
NRS at 15psi	19	14	20 (21/14)
NRS at 30psi	27	23	31 (34/14)
NRS at 50psi	41	31	33 (37/14)

Abbreviations: DD, distressed-depressive; DS, distressed-somatic.

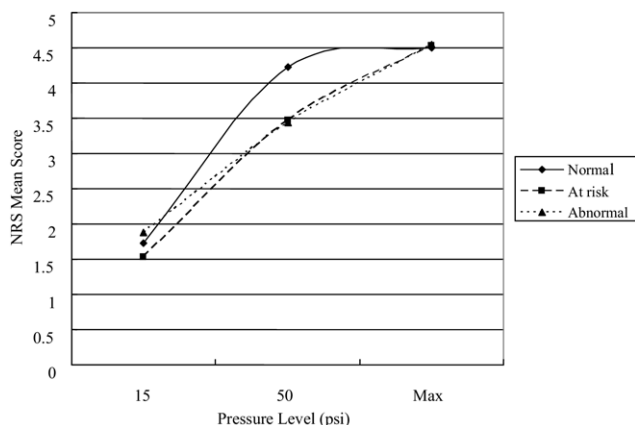
**Comparison of Psychometric and Diskographic Findings**

**Positive rates in psychometric groups.** The positive rates of diskography per person in the normal, at-risk, distressed depressive, and distressed somatic findings on the psychometric test were 75.0% (9/12 patients), 59.5% (25/42 patients), 77.3% (17/22 patients), and 40.0% (2/5 patients), respectively. These differences were not statistically significant ( $P > .05$ ). The positive rates of diskography per examined disk in the normal, at-risk, distressed depressive, and distressed somatic findings on the psychometric test were 37.8% (14/37 disks), 30.9% (43/139 disks), 36.9% (27/73 disks), and 28.5% (4/14 disks), respectively. These differences were not statistically significant ( $P > .05$ ).

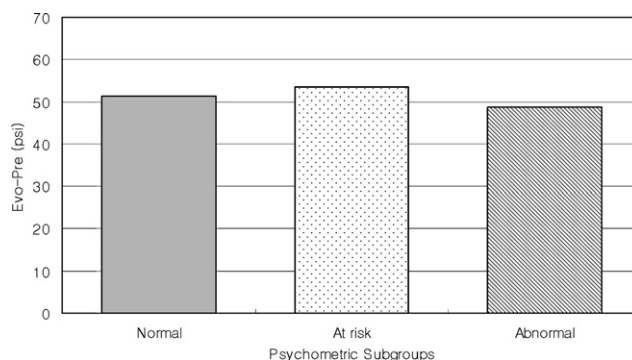
**Pain severity and positive rates with pressure during diskography.** The mean NRS scores at 50psi above opening pressure were  $3.99 \pm 3.87$  for the normal group,  $4.40 \pm 3.92$  for the at-risk group, and  $4.34 \pm 3.87$  for the abnormal psychometric groups. There were no significant NRS score or positive rate differences among psychometric groups at 15, 30, and 50psi above opening pressure (table 1, fig 1).

**Pressure of initial pain response.** The mean pressures initially evoking any pain were  $51.38 \pm 24.20$ psi for the normal group,  $53.65 \pm 7.12$ psi for the at-risk group, and  $48.74 \pm 11.45$ psi for the abnormal psychometric groups (fig 2). There were no significant differences in the pressures that evoked pain among psychometric groups.

**Volume of initial pain response.** The mean injected contrast media volume at which pain was initially evoked was  $2.21 \pm 1.46$ mL in the normal group,  $2.41 \pm 1.41$ mL in the at-risk group, and  $2.19 \pm 0.56$ mL in the abnormal psychometric groups (fig 3). There were no significant differences in the volumes that evoked pain among psychometric groups.



**Fig 1. Mean NRS curves of psychometric subgroups according to pressure level during diskography.**



**Fig 2. Pressure of initial pain response (Evo-Pre) in each psychometric subgroup during diskography.**

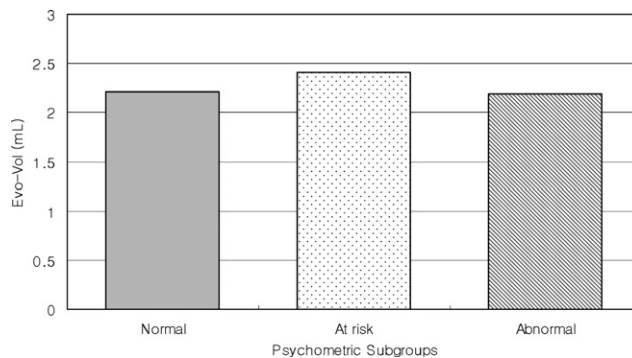
**Pain behaviors during diskography.** The facial and verbal behaviors were scaled during diskography and with video analysis after procedure. The mean pain behavior scores did not differ among psychometric groups (fig 4).

**Correlation between diskographic findings and psychometric scores.** The correlation between MSPQ and facial scores was .139; between MSPQ and verbal scores, it was .148 (table 2). However, these correlations were negligible. Mean pain scores or pressure and volume of initial pain response did not show a significant correlation with psychometric scores.

**DISCUSSION**

Main<sup>9</sup> developed the MSPQ specifically for patients with CLBP. The MSPQ measures the heightened somatic awareness or anxiety and has been evaluated and validated extensively.<sup>12</sup> Main and Waddell<sup>18</sup> also modified and developed the modified ZSDS, which is a widely used self-rating depression scale.<sup>10,19</sup> Scores on these 2 scales can also be combined to give a measure of psychologic distress, which has been shown to be a reliable predictor of how patients will respond to treatment.<sup>20,21</sup> This combined modified ZSDS and MSPQ psychometric test was the primary metric tool used in this study.

Carragee et al<sup>5</sup> reported a false-positive rate of 83% in the somatization disorder group in diskogram studies of patients without CLBP symptoms and found that a positive disk injection strongly correlated with elevated MSPQ and modified ZSDS scores. Block et al<sup>4</sup> also reported that patients with elevated scores on the hypochondriasis, hysteria, and depression scales tend to overestimate their pain during diskographic injections. These pioneering studies were the first to suggest



**Fig 3. Volume of initial pain response (Evo-Vol) in each psychometric subgroup during diskography.**

that psychologic factors have some influence on the diskography findings, as demonstrated by the abnormal results on psychometric tests, and may serve to generate a higher than normal number of false-positive results.

Carragee et al<sup>5</sup> culled data from several groups of subjects without a history or a minimal history of CLBP who volunteered to undergo provocative disk injections to evaluate the false-positive potential for then prevailing uncontrolled manual injection diskographic technique. Because the volunteers in our comparable study<sup>22</sup> all had normal psychologic profiles, we culled our data from a group of patients undergoing diskography using the same precise pressure-controlled technique used in the asymptomatic volunteer group. In the patient group, we were evaluating the statistical similarity in positive, indeterminate, and negative results between patients and asymptomatic volunteers. We can therefore only state that the number of positive responses showed no correlation with the MSPQ and modified ZSDS scores, which does not necessarily contradict the study by Carragee,<sup>5</sup> which states that there is a direct correlation between elevated MSPQ and modified ZSDS scores and the number of false-positive responses in asymptomatic patients.

Whether the results of Carragee<sup>5</sup> or Block et al<sup>4</sup> would have differed had they used a more precise provoking stimulus is speculation. As in our study, Carragee<sup>5</sup> used the criteria reported by Walsh et al<sup>17</sup> to establish positive injections, and Carragee<sup>5</sup> used manual injections of contrast through 3-mL syringes with no obvious method for controlling the dye injection speed. Only 1 set of pressure readings was reported and presumed to be the static pressures. Typically, manual injection of 0.5mL is accomplished in less than 2 seconds, and high-dynamic pressures may occur. These high-dynamic pressures will increase the number of false-positive results.<sup>22,23</sup>

By contrast, we carefully controlled the speed of contrast medium by using a device designed to inject fluid and record pressures simultaneously. We injected 0.5mL contrast medium over 8 to 10 seconds using a screw device that delivered 0.5mL per revolution. Both dynamic and static pressures were recorded, and we attempted to keep the dynamic pressure within 10 to 20psi of the static pressures. We made every effort to check and compensate for extraneous pain provoked by needle insertions, manipulation of needle during injection, and pain caused by proximity of the diskogram needle to the exiting dorsal root ganglion. One would expect and in fact we did find a lower false-positive rate in our asymptomatic volunteers<sup>22</sup>

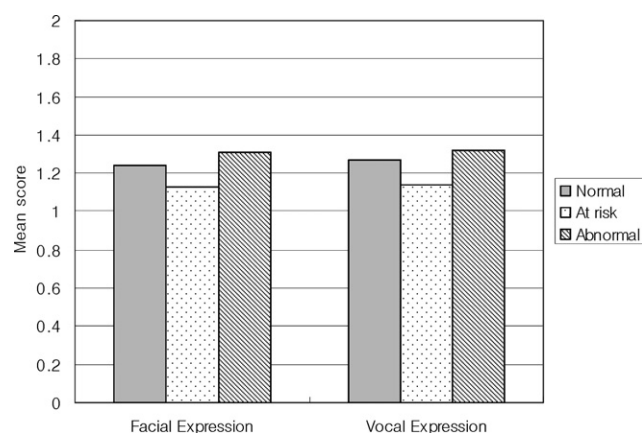


Fig 4. Mean pain behavior score in each psychometric subgroup during diskography.

Table 2: Correlation Coefficients Between Diskographic Findings and Psychometric Scores

Measures	MSPQ	ZSDS
NRS at 15psi	.077	.042
NRS at 50psi	.021	-.012
Maximal NRS	.060	.045
Evo-Pre	-.049	-.051
Evo-Vol	-.023	-.010
Facial expression	.139*	.053
Vocal expression	.148*	.053

Abbreviations: Evo-Pre, pressure at which pain was first evoked; Evo-Vol, injected volume at which pain was first evoked; maximal NRS, maximal pain response during the diskography.

\*Significant at the 0.1 level.

than Carragee.<sup>5</sup> It is probable that our false-positive rate in symptomatic patients would likewise be lower. Even so, we do not know whether a lower number of false-positive results in volunteers in the study by Carragee<sup>5</sup> would negate the correlation between MSPQ and modified ZSDS scores and a positive response.

Study Limitations

The primary limitation of our study was that only the MSPQ and modified ZSDS were used to evaluate the psychometric profiles. Because pain sensitivity can vary depending on other psychiatric states not measured by the MSPQ and modified ZSDS, it is possible that a more extensive or different set of instruments might have detected or modified a correlation. Nevertheless, our study indicates that the use of a more precise method of provoking a stimulus may limit the confounding influences of psychometric factors.

CONCLUSIONS

There was no significant correlation between the psychometric of MSPQ and modified ZSDS scores and the findings of diskography at 15, 50, and maximal pressure above opening pressure during controlled manometric disk stimulation in patients with axial CLBP. Therefore, using a more precise method of provoking a stimulus may limit the confounding influences of some psychometric factors on the lumbar diskography.

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#### Suppliers

- a. Intellisystem; Merit Medical Systems, 1600 Merit Pkwy S, Jordan, UT 84095.
- b. SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.