

# Does Needle Insertion Site Affect Diskography Results?

## A Retrospective Analysis

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**Study Design.** A retrospective clinical data analysis was performed.

**Objectives.** To determine the effect of needle insertion site on provocative diskography results, and to ascertain whether performing diskography ipsilaterally to a patient's reported pain leads to a higher rate of false-positives.

**Summary of Background Data.** In certain groups of patients, provocative diskography is associated with a significant false-positive rate, which can lead to misdiagnosis and inappropriate treatment. Although purported by some to be a cause of false-positive diskogram results, the effect of needle insertion site on diskography results has yet to be determined.

**Methods.** The charts of 127 patients who underwent diskography were evaluated to determine the relationship between the location of pain, needle insertion site, and diskography results.

**Results.** Performing diskography on the side ipsilateral to a patient's pain did not result in a higher incidence of positive diskogram results.

**Conclusion.** False-positive diskography results are unlikely to result from performing the procedure on the same side as a patient's reported pain. [Key words: diskography, low back pain, lumbar disc] *Spine* 2002;27:2279-2283

Because of the prevalence and widely ranging possible causes of chronic low back pain, its management is one of the most formidable challenges facing physicians. Recently, studies have shown that degenerative changes occurring in intervertebral discs are primary pain generators in a certain subset of patients.<sup>15</sup> A position statement issued by the North American Spine Society recommended provocative diskography as a safe and effective method for diagnosing discogenic pain.<sup>8</sup> Although techniques vary widely, the generally accepted criteria for a diagnosis of discogenic pain include radiologic abnormalities in a disc coupled with concordant pain at low to intermediate intradiscal pressures.<sup>5</sup> In patients with discogenic low back pain who have failed conservative ther-

apy, treatment options include surgery and intradiscal electrothermal annuloplasty and nucleotomy (IDET).

Invasive treatment of these patients, however, has yielded mixed results.<sup>13,18,20,21</sup> Furthermore, several studies have demonstrated that injecting contrast into a disc can generate pain in asymptomatic patients.<sup>2,4,9,11,19</sup> Although it has been reported<sup>14</sup> and seems logical that performing diagnostic diskography from the side ipsilateral to a patient's pain might result in a higher false-positive rate than entering the skin and disc from the contralateral side, the influence of needle insertion site has never been studied. This preliminary study was undertaken to determine the effect of needle insertion site (*i.e.*, ipsilateral or contralateral to a patient's symptoms) on diskography results, and to help ascertain whether performing diskography ipsilaterally to a patient's pain can lead to a higher incidence of false-positives.

### Materials and Methods

After permission was obtained from the Internal Review Board at Walter Reed Army Medical Center to conduct this study, the charts of 130 consecutive patients who had undergone diagnostic diskography from the right side at the Walter Reed Army Medical Center (WRAMC) Pain Management Clinic between 1999 and 2001 were retrospectively reviewed. Among these, three patients had required switching to a left-sided approach during the procedure because of inability to enter discs from the right. These patients were excluded from the study, leaving 127 study patients. As determined by the treatment algorithm for low back pain at the authors' institution, the large majority of study patients had failed other diagnostic and therapeutic procedures such as epidural steroid injections and medial branch blocks before diskography. All had evidence of degenerative disc disease, as observed on magnetic resonance imaging of their lumbar spine.

The patients were divided into four study groups, as determined by their recorded histories and the pain diagrams they had completed during their initial consultation and follow-up visits. The categories were as follows: midaxial low back pain (Group 1); low back pain extending predominantly into the right leg, hip, or groin (Group 2); low back pain extending predominantly into the left leg, hip, or groin (Group 3); low back pain radiating equally into both lower extremities (Group 4).

All the diskograms were performed from the patient's right side using a double-needle technique with an 18-gauge introducer and a 22-gauge diskography needle;<sup>8</sup> fluoroscopic visualization in the anteroposterior, oblique, and lateral views; and water-soluble contrast. Patients were blinded both to the timing of the injections and the disc being tested. Increasing the time interval between needle placement and contrast injection, injecting suspected control discs first, and reinjecting equivocal disks were some of the techniques used to help patients dis-

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**Table 1. Demographic Data of Patients Undergoing Diagnostic Diskography Broken Down by Symptoms**

Demographic Variables	Axial low back pain (n = 39)	Right-sided pain (n = 37)	Left-sided pain (n = 36)	Bilateral leg pain (n = 15)
Mean age (95% CI)	35.8 (33.0–38.6)	37.1 (34.1–40.0)	36.7 (33.3–40.2)	40.4 (33.5–47.2)
Sex				
Male	33 (85%)	23 (62%)	24 (67%)	9 (60%)
Female	6 (15%)	14 (38%)	12 (33%)	6 (40%)
Mean duration of low back pain (95% CI)	5.6 (4.0–7.2)	6.0 (3.2–8.8)	5.7 (3.5–7.9)	5.5 (2.9–8.1)
Previous back surgery (%)	6 (15%)	8 (22%)	5 (14%)	1 (7%)

count pain related to needle placement. Injection resistance, morphology of the disks, and pain response were noted by at least two different observers. A digital manometer was used to measure opening and peak intradiscal pressures.

Inclusion criteria for a diagnosis of discogenic pain were based on the discographic diagnostic categories outlined by Derby et al.<sup>5</sup> All the patients classified as having discogenic pain had at least one disc with a grossly abnormal radiologic appearance on MRI and diskography, and concordant pain of at least 6/10 at less than 50 psi above the opening pressure when contrast media was injected into the abnormal disc(s). Patients also were required to have at least one normal control disc. Patients who failed to meet these criteria were classified as having negative diskogram results. In addition to the physicians who performed the procedures, at least one independent reviewer well-versed in these procedures interpreted all the diskograms. In the event of a discrepancy in the interpretation, a second independent reviewer was consulted to determine the proper classification.

Because all the diskograms were performed from the right side, the experimental hypothesis tested was whether patients with right-sided (*i.e.*, ipsilateral) pain were more likely to have positive diskogram results than those with symmetrical or left-sided symptoms (*i.e.*, the latter group in whom the skin and disc were entered from the side contralateral to their pain). This test was accomplished in two ways. First, the percentage of patients in each group with a diagnosis of discogenic pain was determined, which required at least one abnormal disc. Second, the percentage of positive diskogram results in each group was calculated. This was done by dividing the total number of diskograms performed by the number of positive disks. Calculations were made for the study population as a whole ( $n = 127$ ), and for patients with ( $n = 20$ ) and those without ( $n = 107$ ) prior back surgery separately. All the data were analyzed by the use of  $\chi^2$  tests.

## ■ Results

Among the 127 diskography patients in the four study groups, 39 (31%) had axial low back pain; 36 (28%) had predominantly left-sided low back pain; 37 (29%) had mostly right-side symptoms; and 15 (12%) had pain radiating into both legs. The mean age of the patients was 36.9 years (95% CI, 35.3–38.6 years), and the mean duration of low back pain was 5.7 years (95% CI, 4.6–6.9 years). In terms of gender, 70% ( $n = 89$ ) of the study subjects were men, which is in concordance with the overall patient population of the Walter Reed Army Medical Center. Approximately 16% of the study patients ( $n = 20$ ) had undergone prior back surgery. The breakdown of demographic data is presented in Table 1.

Of the 127 study patients, 83 had at least one positive diskogram, yielding an overall discogenic pain prevalence of 65%. These patients underwent a total of 366 diskograms (average, 2.9 per patient), with positive results for 120, yielding a positive rate of 33%. Provocative diskography performed from the patient's right side gave positive results in 67% of the patients with midaxial low back pain, 69% of the patients with predominantly left-sided pain, 60% of the patients with right-sided pain, and 67% of the patients whose pain extended to both legs. The 39 patients with axial low back pain underwent a total of 120 diskograms, 42 (35%) of which yielded positive results. There were 96 diskograms performed in the 36 patients with left-sided pain, with positive results for 33 (34%). In the 37 patients with right-sided symptoms, 110 diskograms were performed, 32 (29%) of which yielded positive results. Among the 15 patients with pain in both legs, 13 of 40 diskograms (33%) gave positive results.

To detect differences between groups for both the percentage of individuals with discogenic pain and the overall percentage of positive diskogram results,  $\chi^2$  analyses were used. No statistically significant differences were noted among the four groups for either of these variables. Likewise, when the patients were divided into two groups representing right-sided pain and all other pain (the other three subsets), no significant differences between the groups were observed. These results are presented in Table 2.

When the data for the patients who had undergone prior back surgery was compared with the data for those who had not, the results were as follows. The proportion of patients with discogenic pain in both the failed back group (13 of 20) and the nonsurgical group (70 of 107) was 65%. Of the 302 diskograms performed among the nonfailed back patients, 97 (32%) had positive results, whereas 23 of 64 diskograms performed among the patients with prior back surgery (36%) yielded positive results. Among the nonsurgical patients, 22 of 33 patients with axial back pain (67%), 17 of 29 patients with right-sided symptoms (59%), 22 of 31 patients with left-side pain (71%), and 9 of 14 patients with bilateral symptoms (64%) had positive diskography results.

In a breakdown by total number of diskograms, positive results were seen for 34 of 103 diskograms in the nonsurgical group with axial back pain (33%), 22 of 81 diskograms in the nonsurgical group with right-sided

**Table 2. Relationship Between Pain Complaints and Diskography Results**

Diskography outcome	Axial low back pain (n = 39)	Right-sided pain (n = 37)	Left-sided pain (n = 36)	Bilateral leg pain (n = 15)
Total number of diskograms performed n = 366	120	110	96	40
Total number of positive diskograms <sup>+</sup> n = 120 (%)	42 (35%)	32 (29%)	33 (34%)	13 (33%)
Number of patients with diskogenic pain <sup>**</sup> n = 83 (%)	26 (67%)	22 (60%)	25 (69%)	10 (67%)

All diskographies were performed from the patient's right side.

<sup>+</sup>  $P = 0.79$  for differences between all 4 groups; and  $P = 0.32$  for differences between patients with right-sided pain and those with nonright-sided pain (other 3 groups).

<sup>\*\*</sup>  $P = 0.83$  for differences between all 4 groups; and  $P = 0.37$  for differences between patients with right sided pain and those with nonright-sided pain (other 3 groups).

pain (27%), 29 of 82 diskograms in the nonsurgical group with left-sided pain (35%), and 12 of 36 diskograms in the bilateral group (33%). According to  $\chi^2$  analyses, there were no statistical differences between patients who had undergone prior back surgery and those who had not for both the percentage of patients with a diagnosis of discogenic pain and the overall percentage of positive diskogram results. Similarly, when the nonsurgical and failed back patients were separated into two groups, no significant differences were found between the site of the patients' reported pain and diskography results.

## Discussion

The main finding of this study is that entering the skin and disc on the side ipsilateral to the patient's pain during diskography does not affect the percentage of positive diskogram results, and therefore is unlikely to affect the false-positive rate. At the authors' institution, diskograms are performed from the patient's right side for logistical reasons. The C-arm is equipped only with the standard 115° contralateral rotation feature, as opposed to the more expensive 145° rotation option, so diskography performed from the patient's left side requires either rotation of the patient or extensive manipulation of the C-arm intensifier.

Previous studies have demonstrated that the rate of false-positive diskography results can be high, ranging from 10% to 83%, depending on the population.<sup>4</sup> Findings by Carragee et al<sup>3</sup> suggest that previous back surgery may play a contributing role in this phenomenon. However, in the current study found no significant differences in the percentage of positive diskogram results or the overall incidence of discogenic pain between the patients who had undergone prior back surgery and those who had not. Other risk factors for false-positive diskogram results may include psychopathology and a history of chronic pain.<sup>4</sup> One cause sometimes implicated in false-positive diskography results is performing the procedure at or adjacent to a painful area. Although it has been asserted that diskograms should be performed from the side contralateral to the patient's reported pain,<sup>14</sup> this issue has yet to be addressed in the literature.<sup>7,8,16</sup>

The primary reason why inserting a needle on the side ipsilateral to a patient's pain might lead to a higher incidence of false-positive diskogram results is that it could

stimulate nondiscogenic pain that interferes with a patient's ability to discern pain adequately on disc injection. Some potential false pain generators include myofascial pain, facet-mediated pain, ligamentous injury, and disc disruption leading to hypersensitive, proximal tissues. In an electromyographic study using pigs, Indahl et al<sup>10</sup> demonstrated that there might be interactive responses between injured and diseased spinal structures such as disks, facet joints, and paraspinal musculature. The implication of this study for the current investigation is that stimulation of one structure in the spinal region might provoke pain in a sensitized adjacent structure.

Another potential problem is that contacting a nerve root on the way into the disc can complicate interpretation of the diskogram. Although the pain that results from hitting a nerve root is both qualitatively and quantitatively different from that arising from the intervertebral disc and other false pain generators, it is possible that the residual pain that remains may interfere with a patient's ability to assess injection-induced discomfort. This may be more likely to occur in patients who have concomitant radicular symptoms, or who do not fully understand the instructions.

In 1933, Foerster<sup>6</sup> demonstrated that L2 is the dermatome corresponding to the low back. More recently, Nakamura et al<sup>12</sup> showed that the primary afferent pathway of lumbar discogenic pain is *via* the L2 spinal nerve root, presumably through sympathetic afferents from the sinuvertebral nerves. In the Nakamura<sup>12</sup> study, the authors noted several patients who experienced bilateral pain relief when the L2 nerve root was blocked on one side. This indicates that at least in some cases, intervertebral disks contain significant crossover sensory innervation. As such, a lateral annular tear could possibly be perceived as pain emanating from the contralateral side. The current results and those of Nakamura et al<sup>12</sup> are consistent with the findings of Slipman et al,<sup>17</sup> who showed that there is no correlation between the side of annular tears and the side of patients' reported pain.

The likely explanation as to why needle insertion site does not affect diskography results lies in the anatomy of the disks and the science of diskography. The underlying assumption of diskography is that in normal discs, annular lamellae share the load borne during routine activities. As a radial fissure develops, fewer lamellae remain

to share this load. Therefore, while the overall stress on the disc remains the same, the relative stress on the remaining fibers increases. At some point, the mechanical threshold required to produce nociception is met, and the disc becomes painful. The disc may then become chemically sensitized.<sup>1</sup> The principle behind diskography is that the pressure the contrast exerts on the remaining lamellae mechanically stimulates these painful fibers.<sup>1</sup> As such, pain associated with needle placement should be discounted before contrast injection.

At the authors' institution, patients are asked to rate their baseline pain only after all diskography needles have been correctly placed. This reduces the confounding factor of procedure-induced pain, and ensures that testing is assessing only evoked pain resulting from the pressure increase associated with contrast spread to pain-eliciting structures. With this in mind, it seems logical to conclude that the site of needle entry has minimal influence over the pain induced by provocative diskography. If it did, the entire premise of the procedure would be moot.

In conclusion, this study demonstrates that the side of needle insertion in diskography does not affect the rate of false-positive results. This may be attributable to cross-over innervation of the disks, but it is more likely that pain during diskography stems from mechanical stimulation of a degenerated, sensitized annulus, and not from irritation of other pain generators.

### ■ Key Points

- Lumbar diskography may be associated with a high false-positive rate in certain subsets of patients. The influence that the needle insertion site has on this rate has yet to be determined.
- It has been written, and often is said, that diskograms should be performed from the side contralateral to the patient's reported pain. Presumably, this is to reduce the incidence of false-positive results.
- The data from this study indicate that the side from which diskography is performed has no effect on diskography results.

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## Point of View

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In the study by Cohen and colleagues, diskography, performed mainly on active duty servicemen, was done exclusively from the right side. The authors looked at the rate of positive injections as a function of whether the patient's usual pain was right, left, or center. The authors were interested in whether injecting from the painful side "leads to a higher rate of false-positives." It has long been held that needle insertion during diskography should be performed on the side with the least pain. The thinking has been that the irritation of needle insertion may simulate a concordant pain response unrelated to the injection and pressurization of the disc. This careful study seems to show that it really does not matter which side is approached. The rate of positive response is the same whether the painful side is poked or not.

To address the authors' question, however, what does this tell us about the rate of false-positive disc injections in the authors' subject pool? These patients all had confirmed disc degeneration on MRI, all had long-term pain (mean, >5 years), and all were considering invasive treatment. Our previous work would suggest that even persons who have disc degeneration with little or no low back pain may frequently have serious pain with disc injection.<sup>1-5</sup> Now in the study by Cohen and colleagues, how can it be confirmed that the "positive disc" is in fact the primary cause of a patient's low back pain illness? Which are the true-positive and which are the false-positive discs?

Among the "positive" disc injections in the cohort studied by Cohen and colleagues, we do not know how many patients had relief of their symptoms with removal of the "offending" disc. In the absence of a gold standard for a true-positive injection, this remains our only confirming measure. But how often do we have that clear feedback. Much more commonly, the outcome is an improvement of pain scores from 7/10 to 4/10, a fall in

Oswestry from the 50's to the 30's, and persistent, significant activity restriction. In other words, the patient who was completely miserable became only mainly miserable. Was that a "true positive" discogram or a misdiagnosis of the patient's illness?

In fact, a clear diagnosis cannot be made with certainty after provocative diskography. We can hope to lower the risk of a false-positive injection by using this test cautiously in persons with a high risk of spurious painful injections. This high-risk group probably includes patients with serious emotional distress or multiple unexplained somatic complaints; patients with distracting, chaotic, or overwhelming secondary gain issues; patients with collapsing or nonexistent social reserves; patients with multiple concurrent local pathology in the spine or pelvis; or patients with clear central pain amplifiers. However, even when all these are eliminated, how certain are we that even complete removal of the suspected disc will cure the illness? Perhaps there is a 70% or 80% chance of a cure at best. If that is our optimistic outcomes expectation, we probably are admitting at least a 20% to 30% false-positive rate, whether one side or the other is stuck with the diskography needle. The work of Cohen and colleagues shows that inserting the needle on the side opposite that of the patient's usual pain probably is an ineffective strategy for further lowering the false-positive injection rate.

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