Eur Spine J (1999) 8 : 126–131

ORIGINAL ARTICLE

D. D. Ohnmeiss
H. Vanharanta
J. Ekholm

Relationship of pain drawings to invasive tests assessing intervertebral disc pathology

Received: 26 February 1998
Revised: 31 August 1998
Accepted: 26 October 1998

This work was presented in part at the Annual Meeting of the International Society for the Study of the Lumbar Spine, June 1998, Brussels

D. D. Ohnmeiss (✉)
Texas Back Institute Research Foundation,
6300 West Parker Road, Suite 100,
Plano, TX 75093, USA
Tel.: +1-972-608-3747
Fax: +1-972-608-3779
and Department of Rehabilitation Medicine,
Karolinska Institute, Stockholm, Sweden
and Texas Health Research Institute,
Plano, Texas

H. Vanharanta
Texas Back Institute Research Foundation,
Plano, Texas, USA,
and Department of Physical Medicine
and Rehabilitation, University of Oulu,
Oulu, Finland

J. Ekholm
Department of Rehabilitation Medicine,
Karolinska Institute, Stockholm, Sweden

Abstract It has been found that the pain patterns in pain drawings are related to the presence of herniated disc identified by myelography. The purpose of this study was to determine whether the pattern of pain in the drawings or the type of pain indicated (aching, burning, numbness, pins and needles, stabbing) was related to the presence of symptomatic disc pathology identified by CT/discography. In a subgroup of patients who underwent myelography, the relationship of the drawings to myelographic findings was also investigated. Pain drawings were completed by 187 patients with low back and/or radicular pain who were undergoing CT/discography. The drawings were scored in two ways, first by the system described by Ransford and secondly by visual inspection. They were classified as being indicative, or not, of disc pathology. The CT/discograms were classified as disrupted, or not, and the pain responses were recorded upon injection of each disc, based on the similarity of the pain provoked to clinical symptoms. Among the 133 patients with discogenic pain confirmed by discography, 110 (82.7%) had pain drawings that were classified as indicative. Among the 45 patients without discogenic pain, 29 (64.4%) had pain drawings classified as non-indicative. Patients with discogenic pain used more symbols indicating burning pain and aching pain than did non-discogenic pain patients. Our results confirmed those reported earlier by Udén, who found a relationship between the pattern of pain in the drawings and myelographic findings. Pain drawings may be helpful in the diagnosis of symptomatic disc pathology.

Key words Pain drawings · Low back pain · Discography · Myelography · Pain provocation · Lumbar disc

Introduction

The pattern of pain indicated in pain drawings has been found to be related to the presence or absence of disc herniation identified by myelography in patients with sciatic pain [28]. These results are not surprising, since myelography identifies disc pathology compressing the nerve roots or the thecal sac. Such compression may result in a patient indicating pain radiating into one or both of the lower extremities. Myelography is limited to only indirectly assessing discs by visualizing indentations in the column of contrast injected into the thecal sac and spreading around the nerve roots. However, discogenic pain can arise from non-bulging discs (no deformation of the outer annular wall) with internal ruptures [29]. As is true for other radiographic evaluations, myelographic images are sometimes abnormal in subjects with no symptoms [7]. Discography is a unique diagnostic tool in that it allows direct imaging of the internal architecture of the intervertebral disc. The combination of the image with pain provocation results has been reported to be superior to other diagnostic methods [8].

Previous studies have found that back pain patients tend to report pain of an aching sensation [9, 11, 13]. However, these studies did not address the question of whether particular pain types were associated with specific diagnostic groups within the back pain populations. The purpose of this study was to determine whether

1. *Pain patterns* indicated in pain drawings were related to the presence of symptomatic disc pathology identified by CT/discography
2. The *quality* of pain indicated by patients was related to symptomatic disc pathology, and
3. There was a relationship between pain drawings and myelographic images in a subgroup of patients who also underwent myelography

Materials and methods

Pain drawings were collected from 187 patients (118 males, 69 females; average age 37.2 years, range 18–62 years). Patients had back pain, with or without lower extremity pain, and had failed to gain adequate pain relief from conservative care, including active physical therapy. The drawings were completed the day of, but prior to, undergoing CT/discography for diagnostic purposes. Only drawings from patients undergoing discography at the three lowest lumbar discs were included in the study. The indications for discography were similar to those described by the North American Spine Society [6], which include

1. assessment of possible lateral disc herniations or recurrent disc herniation not identified by other imaging techniques,
2. assessment of discs prior to fusion to determine whether discs within the proposed fusion segment are symptomatic and whether adjacent discs can support a fusion,
3. assessment of minimally invasive surgical candidates to confirm a contained disc herniation, and
4. assessment of patients with persistent symptoms unresponsive to conservative care, in whom other diagnostic tests have failed to reveal pathology.

Pain drawings were evaluated in two ways. They were scored based on the system described by Ransford et al. [18]. In this system, points are assigned for pain in sporadic patterns, indicating pain outside the outline of the body, and incorporating extra words or symbols to describe pain or calling attention to its severity. Based on this system, the drawings were classified as normal (score of 2 or less) or abnormal (score greater than 2). The drawings were also classified by overall visual assessment, similar to what has been described by other authors [2, 28]. In this study, the drawing was classified as indicative or non-indicative of symptomatic disc pathology. If the pain was primarily in a radicular pattern from the back into one or both of the lower extremities, the drawing was classified as indicative (Fig. 1 A). The drawing was classified as non-indicative if pain was indicated in a widespread sporadic pattern or if the patient used extraneous marks inside or outside the body to indicate pain or other sensations or pain was primarily in the low back/buttocks region with no radicular pattern (Fig. 1 B). The drawings were rescored by the same evaluator 2 months after the first scoring, based on both the Ransford system and the indicativeness scoring, and the repeatability of the classification determined.

Other data recorded from the drawings were the number of each type of symbol used (different symbols were to be used to indicate aching, burning, pins and needles, numbness, and stabbing), and pain location (low back and/or buttocks only, radiating into thigh but not below the knee, or radicular pain passing below the knee).

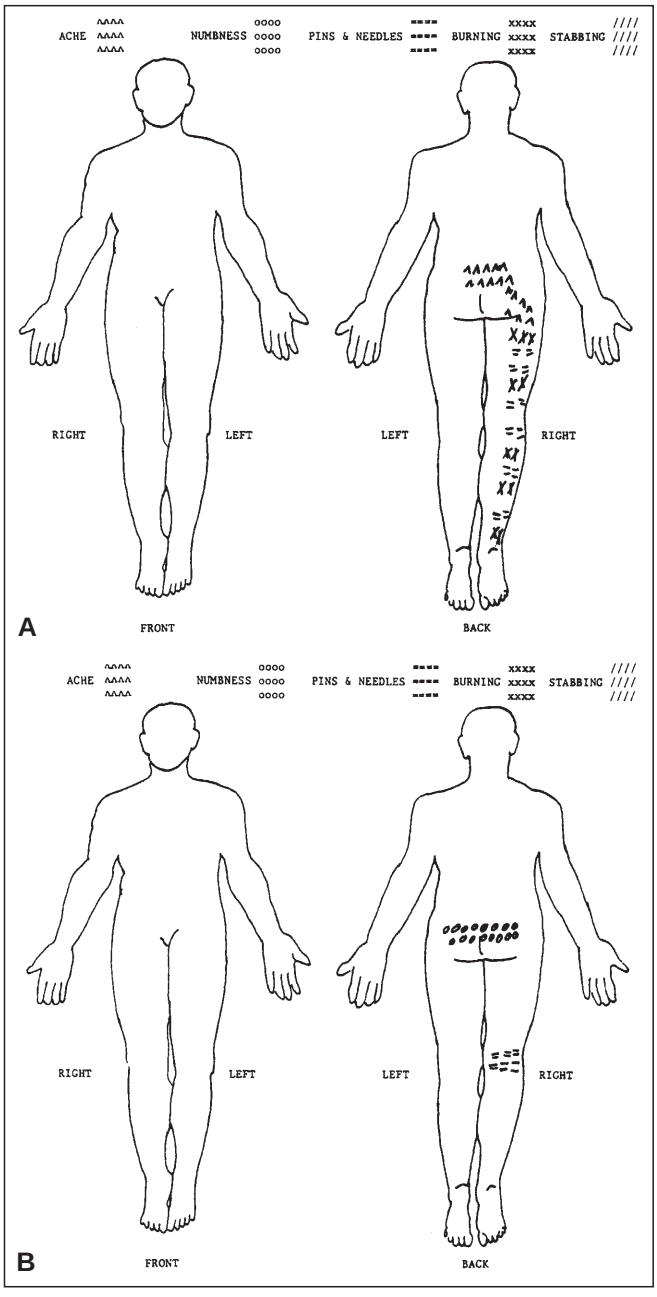

Fig. 1 **A** Pain drawing scored as indicative of disc pathology and rated normal based on the Ransford score. Note the clear radicular pattern from the low back into the posterior aspect of the right leg. **B** Pain drawing classified as non-indicative of a disc pathology. Although lower extremity pain is present, it is not contiguous with the lumbar pain

CT/discography was performed by radiologists highly experienced with the procedure and following a standardized protocol [19]. During the procedure, which was performed under sterile conditions, the patient was only mildly sedated. Needles were placed into the nucleus of each disc, using biplanar fluoroscopic imaging to guide proper placement. After all needles were placed, radiographic contrast was injected into the nucleus of each disc to

be evaluated. The pain provoked upon injection of each disc was recorded, as described by Sachs et al. [20], as (1) painless, (2) pain was provoked but was dissimilar to clinical pain, or (3) pain was provoked that was similar to or (4) the exact reproduction of the patient's clinical symptoms. The similar and exact reproduction categories were combined and considered to be clinically painful.

The CT/discograms were scored using the Dallas discogram description(DDD) [20]. The axial CT/discographic images were classified as disrupted (DDD grade 2 or 3) or non-disrupted (DDD grade 0 or 1). This was done based on the work of Moneta et al. [16], who found that clinical pain provocation was related to annular disruption grades 2 and 3, in which the intermediate or outer annular fibers are disrupted. Grade 1 disruption was not related to clinical pain provocation. In the current study, a patient was considered to have discogenic pain only if one or more studied discs was abnormal on the image and clinical pain was provoked upon its injection.

A subgroup of 72 patients had also undergone myelography, and the relationship of the drawings to myelographic findings was investigated. The myelograms were classified as demonstrating a disc abnormality if there was abnormal filling of the nerve roots or compression of the thecal sac in the lower lumbar region.

Data analysis

Intra-evaluator repeatability was assessed by calculating the kappa values for the two sets of scores for the drawings. For descriptive purposes, the percentage of cases in which the scores agreed is also provided. Categorical data were analyzed using Chi-square analyses. The mean number of symbols used by patients to indicate various sensations were compared using *t*-tests for the discogenic and non-discogenic pain groups identified by CT/discography.

Table 1 Relationship of pain drawings to symptomatic disc pathology identified by CT/discography

Pain drawing	CT/discography results			
	Discogenic pain		Non-discogenic pain	
	N	%	*N*	%
Indicative	116	82.3	18	39.1
Nonindicative	25	17.7	28	60.9
Total	141		46	

Significant relationship ($P < 0.001$, Chi-square)
Overall agreement 77.0% (144/187)

Table 2 Percentage of patients reporting the various pain types with respect to the presence/absence of symptomatic disc pathology

Pain type	Symptomatic disc pathology (*N* = 141)		No symptomatic disc pathology (*N* = 46)		
	N	%	*N*	%	
Aching	110	78.0	36	78.3	$P > 0.85$
Pins & needles	46	32.6	8	17.4	$P < 0.05$
Numbness	70	49.6	19	41.3	$P > 0.30$
Burning	67	47.5	10	21.7	$P < 0.01$
Stabbing	72	51.1	25	54.3	$P > 0.65$

Results

Scoring repeatability

The Ransford scoring was in perfect agreement in 83.2% of the drawings, with a kappa value of 0.77. When collapsing the drawings into normal/abnormal categories, the classification agreed in 92.3%, with a kappa of 0.92. When rescoring the drawings with respect to the predictiveness of discogenic pathology, the classification was the same in 90.4% of the drawings, and the kappa was 0.85.

Relationship of drawings to discogenic pathology

Table 1 presents the percentage of drawings classified as indicative and the presence/absence of symptomatic discogenic pathology. There was a significant relationship between the drawings and CT/discographic findings ($P < 0.01$, Chi-square). The overall agreement of drawings with the presence/absence of discogenic pathology as determined by CT/discography was 77.0%; the sensitivity was 82.3% and the specificity 60.9%.

The proportion of patients indicating each of the various pain types is presented in Table 2 for patients with and for those without symptomatic disc pathology. A significantly greater proportion of patients with discogenic pain reported burning pain as well as pins and needles than did patients with no discogenic pain. Aching pain was very common in both groups. Patients with discogenic pain used significantly more symbols indicating burning pain and aching pain than did patients without discogenic pain (burning 5.9 vs 1.9, $P < 0.01$; aching 18.3 vs 12.4, $P < 0.05$, *t*-test). The two groups did not differ based on the total number of symbols used in the drawings (46.7 vs 38.1, $P > 0.30$). There was no relationship between the number of different symbol types used and the presence/absence of disc pathology ($P > 0.25$, median test).

There was no correlation between age or symptom duration and the total number of symbols used or the number of any particular type of symbol used ($r < 0.15$).

The only gender-related factor was that females used a greater total number of symbols than males (54.8 vs 38.6, $P < 0.05$). However, females did not tend to use a greater number of any particular type of symbol, or a greater number of different types of symbols.

Relationship of drawings to myelographic findings

A subgroup of 72 patients (45 males, 27 females; average age 37.0 years) underwent myelography as well as CT/discography. As seen in Table 3, there was a significant

Table 3 Relationship of pain drawings to disc abnormality identified by myelography

Pain drawing	Myelography results			
	Abnormal		Normal	
	N	%	*N*	%
Indicative	40	83.3	12	50.0
Nonindicative	8	16.7	12	50.0
Total	48		24	

Significant relationship ($P < 0.005$, Chi-square)
Sensitivity 83.3%, specificity 50.0% and overall agreement 72.2% (52/72)

Table 4 The relationship of the Ransford pain drawings scores to the indicativeness classification (indicative or non-indicative of symptomatic disc pathology), symptomatic disc pathology, and disc pathology identified by myelography

	Ransford Classification	
	Normal ($N = 144$)	Abnormal ($N = 43$)
Classification		
Indicative	74.3%	62.8%
Non-indicative	25.7%	37.2% $P > 0.14$
Symptomatic disc pathology (CT/discography)		
Discogenic pain	75.0%	76.7%
Nondiscogenic pain	25.0%	23.3% $P > 0.75$
Abnormal disc (myelography)	($N = 55$)	($N = 17$)
Abnormal disc	69.1%	58.8%
Normal disc	30.9%	41.2% $P > 0.40$

relationship between the drawings and the myelographic findings.

Results using Ransford scoring system

The drawings were also scored using the system described by Ransford et al. [18]. The scores from this method were not significantly related to the indicativeness scoring, the presence of symptomatic disc pathology as identified by discography, or the presence of herniated disc identified by myelography (Table 4).

Discussion

The repeatability of both the Ransford and the indicativeness scoring systems was quite high, as has been reported by other authors [2, 27]. In the subgroup of patients who underwent myelography, our results were very similar to those of Udén and Landin [28]. Both studies found a significant relationship between the drawings and the presence of a disc herniation identified by myelography. This may be due to the fact that myelography best identifies compression of the thecal sac and nerve roots, which are frequently associated with radicular pain. Such radicular symptoms are easily identified in pain drawings. The drawings were also significantly related to the presence of symptomatic disc pathology as identified by CT/discography. A patient was considered to have discogenic pain only if at least one disc demonstrated rupture into, or through, the outer layers of the annulus, and clinical pain was provoked during its injection. The pain provocation component of the study is helpful in determining which disc(s) is related to the patient's clinical symptoms. The previous study with myelography related the drawings to radiographic findings. The addition of the pain provocation component further supports the use of the drawings as a helpful adjunct in evaluating patients with back and/or radicular pain.

Previous studies have reported that when back pain patients are given a lengthy list of adjectives and instructed to select those that describe the type of pain they are experiencing, aching pain was frequently selected [9, 11, 13]. In our study, only five pain descriptors were suggested for use, but aching was the most frequently used symbol in both the discogenic and non-discogenic pain groups. The type of pain that best differentiated between the two groups was burning pain, which was more often indicated by discogenic pain patients.

There was no relationship between pain type and symptom duration. Ljunggren reported differences in pain descriptors used by acute and chronic pain patients [12]. In our study, all patients were considered to be chronic, with some having suffered symptoms for several years. However, we did not differentiate between truly continuous pain and frequent recurrent episodes. Results may be different for these two groups.

It has been reported that pain drawings are good predictors of treatment outcome in back pain populations [5, 14, 15, 21, 24]. This relationship may be attributable to two or more factors. Pain drawings have been reported to be related to MMPI scores [17], which are predictive of treatment outcome in low back populations [21–23, 26]. Secondly, the results of the current study suggest part of the relationship between pain drawings and treatment outcome may be due to the fact that the drawings are related to symptomatic discogenic pathology identified by discography, which has been related to favorable surgical outcome [3, 25]. Also, it is interesting to note that both elevated MMPI scores, hysteria and hypochondriasis, as well as pain drawings with high Ransford scores, have been found to be related to patients reporting pain during the discographic injection of lumbar discs [1, 17].

The Ransford classification was not related to discogenic pain identified by CT/discography. This was primarily attributable to patients who had both an abnormal pain drawing and symptomatic disc pathology identified

by CT/discography. This occurrence may arise from one of several sources. First, patients with abnormal pain drawings have been found to report pain at a greater number of disc levels during discographic injection [17], and thus such patients may be more likely to be classified as having discogenic pain. Secondly, simply because a patient has a pain drawing classified as abnormal – something often thought to be associated with psychological problems – does not rule out the existence of symptomatic disc pathology. When addressing the relationship of pain expression to organic pathology, it is important to keep in mind that pain arising from an organic source and psychological problems are not mutually exclusive, nor does the lack of pathology identified by diagnostic imaging evaluations necessarily imply psychological problems [10].

It should be noted that the current study was performed in a very select group of patients. It included only those undergoing CT/discography for diagnostic purposes. Generally, this test is reserved for patients who have failed to gain sufficient relief from conservative care, have been evaluated by non-invasive radiographic examinations, and who are being evaluated as candidates for spine surgery. Often, a disc problem is suspected. However, as demonstrated in this study, even when the three lowest lumbar discs were injected, 26.3% of the patients did not have symptomatic disc pathology at any of the studied levels. Nonetheless, this study population is very select and thus the applicability of our results to more general back pain populations remains to be investigated.

Conclusions

This study concurred with previous reports that the Ransford and indicativeness (Udén) scoring methods have a high level of intra-evaluator repeatability [2, 27]. The study also confirmed Udén's findings that the pattern of pain indicated in drawings is significantly related to myelographic findings [27]. The drawings were also significantly related to the presence of symptomatic disc pathology identified by CT/discography. This is important because CT/discography results were classified based not only on image, but also clinical pain provocation. The provocation portion of the examination can be used to help determine whether the imaged abnormalities are related to the patient's clinical symptoms. Although aching pain was the most prevalent in entire study group, patients with discogenic pain used significantly more symbols indicating aching sensation. Pain of a burning sensation was indicated more frequently in the discogenic pain group. Pain drawings appear to be a helpful diagnostic tool for identifying lumbar discogenic pain.

Acknowledgements This work was funded in part by grants and contributions from the Presbyterian Hospital of Plano, Plano, Texas. The authors thank the Texas Back Institute, Plano, Texas, for providing access to data for this study.

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REVIEWER'S COMMENT

This study confirms that the anatomical pattern of pain on a pain drawing corresponds reasonably well to reproduction of pain on discography and the diagnosis of a prolapsed disc on myelography. That is quite separate from the issue of psychological distress as measured by the Ransford score. It is important to emphasise that the underlying physical pathology and the patient's psychological state are quite separate issues. An individual patient may have both a discrete physical pathology and also varying degrees of emotional reaction. Physical pathology and psychological distress are not mutually exclusive but are different aspects of the illness. So the pain drawing, as any other aspect of the patient's clinical presentation, may provide information *both* about the patient's physical problem and about their psychological state.

G. Waddell
Orthopaedic Surgeon,
6 Heatherbrae, Bishopbriggs, Glasgow G64 2TA, UK

The findings about the adjectives that patients use to describe their pain are much more tentative, and descriptions of aching and burning are only weakly related to a particular diagnosis. I would caution against attempts to diagnose pathology from such descriptions of the pain. That is likely to be unreliable and misleading.

We must remember that the pain drawing is only a screening test. It only gives the first crude hint of the anatomical pattern of the pain and the patient's reaction to the pain. Diagnosis of underlying pathology still depends on a detailed clinical history and examination, supplemented if necessary by appropriate investigations. Most patients with a high Ransford score on the pain drawing are distressed but up to 50% of distressed patients do not display this on a pain drawing, so there are many false negatives. We must remain alert to other signals of distress and illness behaviour. In conclusion, the pain drawing is a useful first step but it is no substitute for a thorough clinical assessment.