

The Relationship Between Nonorganic Signs and Centralization of Symptoms in the Prediction of Return to Work for Patients With Low Back Pain

Background and Purpose. The purpose of this study was to assess the relationship between the nonorganic signs (Waddell scores) of patients with low back pain, their response to repetitive end-range lumbar spine test movements (centralization of symptoms), and the rate of return to work at a 6-month follow-up. **Subjects.** Patients were assessed at five locations of the Canadian Back Institute. A consecutive sample of 126 patients with low back pain, with or without referred leg pain, was selected and reviewed. **Methods.** Physical therapists assessed patients' responses to repetitive test movements (centralization), as described by McKenzie, and tested the patients for nonorganic signs (Waddell scores). Therapists completed a data sheet that classified patients as either those who centralize their symptoms or those who do not centralize their symptoms and recorded their Waddell scores. Although the patients were classified at assessment, they remained in treatment. All patients followed a structured Canadian Back Institute protocol of active exercise, regardless of centralization status or Waddell score. **Results.** The inability to centralize symptoms indicated a decreased likelihood of returning to work, regardless of the Waddell score. A high Waddell score predicted a poor chance of returning to work, regardless of the patients' ability to centralize symptoms. **Conclusion and Discussion.** A high Waddell score appears to be the best predictor of outcome, as indicated by return to work. [Karas R, McIntosh G, Hall H, et al. The relationship between nonorganic signs and centralization of symptoms in the prediction of return to work for patients with low back pain. *Phys Ther.* 1997;77:354-360.]

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Rob Karas

Greg McIntosh

Hamilton Hall

Lynda Wilson

Tony Melles

Since the introduction of Waddell's nonorganic signs¹ more than 15 years ago, physical examination has become an increasingly popular means of identifying illness behavior in patients with back pain. The centralization phenomenon, described by McKenzie in 1956,² is believed to represent a positive predictor in the management of mechanical back pain. The centralization of symptoms, however, in patients with indications of nonorganic pain presents a problem to clinicians in determining prognosis. Our study examined the relationship between these two common clinical evaluation tools and a functional outcome (return to work).

Repetitive end-range movements in the sagittal plane are used to assess the response of mechanical back pain. In many patients, centralization of symptoms is thought to indicate progression toward pain control. McKenzie² defined *centralization* as the phenomenon whereby radiating symptoms originating from the spine and referred distally are caused to move proximally toward the midline of the back. Donelson et al³ studied the response of low back symptoms to repeated end-range flexion and extension and concluded that the location of referred pain can change rapidly with repeated sagittal movements. Donelson et al⁴ also studied the influence of centralization on outcomes of return to function and relief of symptoms. They determined that patients who

centralized their symptoms had a higher incidence of good or excellent results than did patients who did not centralize their symptoms. Using methods similar to those of our study, Long⁵ examined whether centralization was associated with outcome following a work hardening program. Results showed that patients who centralized symptoms had a higher rate of return to work than did patients who did not centralize symptoms.

Waddell et al¹ identified five nonorganic signs, each identifiable by one or two tests. The tests assess a patient's pain behavior in response to certain maneuvers (Tab. 1). A patient with three or more positive nonorganic signs was said to have a clinical pattern of non-mechanical, pain-focused behavior.

Bradish et al⁶ studied the predictive value of nonorganic signs in returning patients who were receiving Workers' Compensation benefits to work and found no correlation between the presence of nonorganic signs and outcome. They concluded that nonorganic signs cannot be relied on as predictors of return to work within the first 6 months of an initial episode of low back pain. Werneke et al⁷ reported that behavioral signs decreased during treatment for those patients who returned to work. Treatment reduced the presence of nonorganic signs, but the signs had no predictive value. Based on this reduction in nonorganic findings, the authors pos-

R Karas, BSc PT, is Regional Director of Clinical Services—Eastern Ontario, Canadian Back Institute, Ottawa, Ontario, Canada.

G McIntosh, BHK, is Research Associate, Canadian Back Institute, 1200-330 Front St W, Toronto, Ontario, Canada M5V 3B7 (gmcintosh@cbi.ca). Address all correspondence to Mr McIntosh.

H Hall, MD, FRCSC, is Medical Director, Canadian Back Institute, Toronto, Ontario, Canada M5V 3B7.

L Wilson, BSc, is Research Associate, Canadian Back Institute, Toronto, Ontario, Canada M5V 3B7.

T Melles, BSc PT, is Executive Director, Canadian Back Institute, Toronto, Ontario, Canada M5V 3B7.

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Table 1.
Waddell's Nonorganic Signs¹

Test	Signs
Tenderness	Superficial—the patient's skin is tender to light pinch over a wide area of lumbar skin Nonanatomic—deep tenderness felt over a wide area, not localized to one structure
Simulation tests	Axial loading—light vertical loading over patient's skull in the standing position causes typical lumbar pain Acetabular rotation—back pain is reported when the pelvis and shoulders are passively rotated in the same plane as the patient stands; this is considered to be a positive test if pain is reported within the first 30 degrees
Distraction tests	Straight-leg-raise discrepancy—marked improvement of straight leg raising on distraction as compared with formal testing Double leg raise—when both legs are raised after straight leg raising, the organic response would be a greater degree of double leg raising; patients with a nonorganic component demonstrate less double leg raise as compared with the single leg raise
Regional disturbances	Weakness—cogwheeling or giving way of many muscle groups that cannot be explained on a neurological basis Sensory disturbance—diminished sensation fitting a "stocking" rather than a dermatomal pattern
Overreaction	Disproportionate verbalization, facial expression, muscle tension and tremor, collapsing, or sweating

tulated that some patients with chronic low back pain exhibiting abnormal illness behavior could benefit from work-oriented physical reconditioning in a supportive environment.

Patients who centralize their symptoms often have histories and physical findings indicative of recognizable pain patterns. Most patients with positive nonorganic findings have inappropriate, yet predictable, responses to treatment. Combining the mechanical assessment and the nonorganic tests should increase the predictive value over that of each pattern considered separately in the evaluation of rates of return to work. Our experience with both the recognition of patterns of back pain that allow centralization and the application of Waddell's nonorganic signs made the combination of these two approaches a practical goal.

The purpose of this research was to assess the relationship between the nonorganic signs (Waddell scores) of patients with low back pain, the patients' response to repetitive end-range lumbar spine test movements (centralization of symptoms), and the rate of return to work. We examined whether centralization, the presence of positive nonorganic signs, or a combination of both, was the best predictor of a successful outcome. Our hypothesis was that a low Waddell score (ie, 0, 1, or 2 out of 5) is the best predictor of return to work. Of particular interest were the groups with discordant findings: patients with high Waddell scores who centralized their symptoms and patients with low Waddell scores who did not experience a central shift in the symptom location. Return to work was chosen as the functional outcome measure because of its documented importance among physicians, payers, patients, and therapists.⁸

Method

We examined 171 consecutive patients who had low back pain (duration=14 days to 2 years), with or without referred leg pain. Patients were assessed and treated at five locations of the Canadian Back Institute (CBI). The CBI clinic in Ottawa (Ontario) was the primary data-collection site, with participation from CBI clinics in North York, Scarborough, and Niagara Falls (Ontario) and Halifax (Nova Scotia). Data were collected between August 1992 and June 1994. Patients gave written informed consent prior to their first visits, but the assessment and treatment were not affected by inclusion in the study; thus, human subjects review was not obtained.

Exclusionary criteria were (1) previous back surgery, (2) systemic disease, (3) positive straight leg raise at less than 60 degrees, (4) positive well leg lift⁹ (a straight leg lift of the unaffected leg causing typical pain in the affected leg), (5) positive crossover sign (a straight leg lift of the affected leg causing typical pain in the unaffected leg), (6) signs of neurological impairment (muscle weakness, absent reflexes, positive plantar response, saddle anesthesia), (7) a concurrent episode of neck pain, and (8) lack of pain at the time of assessment. Patients included in the study were referred to CBI for routine assessment and treatment by insurance company and Workers' Compensation Board adjudicators, rehabilitation specialists, general practitioners, and surgeons.

Physical therapists instructed patients to perform repetitive test movements, as described by McKenzie,² at initial assessment and then during a second assessment the following day. Nonorganic signs testing, as described by Waddell et al,¹ was completed on the first day.

Following the second assessment, the therapists completed a data sheet that classified patients as either those with centralization of symptoms or those without centralization of symptoms and recorded their Waddell scores. Using a scoring system described by Chan et al,¹⁰ patients were given either a low (0, 1, or 2 out of 5) or a high (3, 4, or 5 out of 5) Waddell score. Our operational definition of centralization was that either there were symptoms that moved proximally or the pain decreased when the subject moved in one direction (flexion or extension).

Every therapist involved in the study, at minimum, had participated in the McKenzie Institute level A course, had CBI level 1 certification, and had clinical competence in the technique of repetitive end-range testing. Therapists also had extensive experience in nonorganic signs testing. Prior to the study, one of the authors (RK) provided each of the other seven participating physical therapists with a specific review of nonorganic signs testing.

The double straight leg raise,¹¹ a variation of the routine straight leg test, was added to the distraction section of the test. The test requires the examiner to lift one and then both of a patient's legs. Both of the patient's knees remain extended. Due to restricted excursion of the contralateral sciatic nerve, a patient with an organic lesion producing sciatica will allow less elevation with a single leg lift. A patient who is focused on pain exhibits the opposite finding. Because lifting one leg produces pain, the patient reasons that raising both legs will hurt twice as much and so allows only half of the elevation.

Patients who have a poor memory or who are inaccurate in their descriptions may hinder the therapist's ability to evaluate their condition. To improve the reliability of nonorganic testing, we had two clinicians evaluate each patient for nonorganic signs, as suggested by Vallfors.¹² The second examiner was blinded to the results of the first examiner. Only when both therapists indicated the presence of three or more positive nonorganic signs was the patient categorized as having a high Waddell score. Because of the logistics of the clinical setting, it was feasible for only one of the two physical therapists to perform mechanical testing for centralization.

Although the patients were classified by the end of the second assessment day, they remained in treatment. All patients followed a structured CBI protocol of active exercise, regardless of centralization status or Waddell score. The protocol involved treating patients daily for 1 to 3 hours per day to a maximum of 30 days. Treatment progressed through three stages of recovery: (1) pain control—2 to 10 days of treatment emphasizing back education and exercises in the patients' direction of

Table 2.

Frequency of Centralization of Symptoms in Patients With Low Back Pain by Waddell Score (N=126)

	Centralization	No Centralization
High Waddell score ^a	13	9
Low Waddell score ^b	79	25

^a 3, 4, or 5 out of 5 positive signs.

^b 0, 1, or 2 out of 5 positive signs.

preference (flexion or extension), (2) recovery of movement—2 to 10 days of treatment emphasizing exercises opposite to the patients' direction of preference, and (3) physical conditioning—up to 4 weeks of cardiovascular training via a stationary bicycle, a stair-climbing or walking program, and progressive isotonic strengthening of the trunk and extremity muscles using free-weight or machine training. The number of treatment hours per day, the number of days in each stage, and the total treatment time were adapted to the needs of each patient. Home exercise programs were given to all patients at the time of discharge.

A research assistant who was unaware of the results of the patients' clinical examinations conducted structured 6-month follow-up telephone interviews to determine return-to-work status. Patients were classified as working if they returned to work in any capacity, either full or modified duty and either full-time or part-time. Patients who returned to work with a new employer or in a new job were also classified as working. The 6-month follow-up contact rate was 83.6% (143/171) of the patients. Patients who were not working at the time of assessment because their jobs had been terminated (n=12) and patients who were homemakers, students, or retirees (n=5) were excluded from outcome calculations because return to work could not be quantified for those patients without employment. The final sample used for outcome calculation was 126 patients with an average age of 39.4 years (SD=11.4, range=21-70). Men comprised 65.5% of the sample.

Data Analysis

Chi-square analysis was used to test for statistical significance ($P<.05$) in the return-to-work rates of patients who centralized symptoms and patients who did not centralize symptoms. Fisher's Exact test was utilized for return-to-work rate comparisons of high versus low Waddell scores. Logistic regression was used to confirm the probabilities of return to work. Analysis of variance and Bonferroni *post hoc* analysis was used to examine the return-to-work rates of the four categories of patients.

Results

Centralization of symptoms occurred among 73.0% (92/126) of all patients in this study. Low Waddell scores

Table 3.

Bonferroni *Post Hoc* Analysis of the Percentage of Patients With Low Back Pain Who Returned to Work by Centralization of Symptoms and Waddell Score (N=126)^a

	Centralization	No Centralization
High Waddell score ^b	30.8% ^d	66.6%
Low Waddell score ^c	82.3% ^{d,e}	52.0% ^d

^a $P < .05$, analysis of variance.

^b 3, 4, or 5 out of 5 positive signs.

^c 0, 1, or 2 out of 5 positive signs.

^d Significant difference for rate of return to work between patients with high Waddell scores who centralized their symptoms and patients with low Waddell scores who centralized their symptoms.

^e Significant difference for rate of return to work between patients with high Waddell scores who centralized their symptoms and patients with high Waddell scores who did not centralize their symptoms.

were found among 82.5% (104/126) of the patients. Table 2 displays the frequency of centralization status by Waddell score.

Analysis by centralization status revealed that patients who centralized symptoms (n=92) returned to work more frequently than did patients who did not centralize symptoms (n=34) ($\chi^2=4.31$, $P=.038$). Among the patients who centralized symptoms, the Fisher's Exact test revealed that more patients who had low Waddell scores (n=104) returned to work than patients who had high Waddell scores (n=22) ($P=.0003$). Logistic regression confirmed that for patients who centralized symptoms, the probability of returning to work increased with a low Waddell score ($P=.0005$). Fisher's Exact test showed that for patients who did not centralize symptoms, the Waddell score did not have a significant effect on the return to work.

Analyzing the data with primary reference to Waddell score demonstrated that patients with low scores (n=104) returned to work more often than did patients with high scores (n=22) ($\chi^2=7.53$, $P=.006$). Among patients with low Waddell scores, those who centralized symptoms (n=79) had a higher return-to-work rate than did those who did not centralize symptoms (n=25) ($\chi^2=9.29$, $P=.002$). Logistic regression confirmed that the probability of return to work increased with centralization ($P=.0034$). For patients with high Waddell scores, the Fisher's Exact test revealed no difference in return-to-work rate between those who centralized symptoms (n=13) and those who did not centralize symptoms (n=9) ($P=.192$). The analysis of variance revealed that there was a difference in return-to-work status among the four groups ($F=7.24$, $P=.0002$). Bonferroni *post hoc* analysis determined where the difference lay (Tab. 3).

Logistic regression showed a complex relationship between the probability of return to work and centralization status and Waddell score. Return-to-work out-

come depended on the interaction between centralization and Waddell score ($P=.0037$).

Discussion

Teaching patients with low back pain how to centralize their pain and achieve pain control is a reasonable goal. Donelson et al⁴ stated that pain control should occur rapidly, within 48 hours of pain onset in a patient with acute mechanical pain. One technique for evaluating a patient's status is to test for the presence of nonorganic signs. Centralization would seem to be especially worthwhile for patients with low Waddell scores because the probability of return to work increases. Our results showed that among patients with low Waddell scores, those who centralized their symptoms had a higher return-to-work rate than did those who did not centralize their symptoms.

Many clinicians believe that patients who centralize their symptoms and have low Waddell scores will do well with mechanical treatment, whereas patients who do not centralize their symptoms and have high Waddell scores will fail to improve. Our results confirm this belief. The possibility of a behavioral component needs to be established early in the treatment program to identify possible barriers to rehabilitation^{13,14} and set effective goals. Research is needed to further investigate the outcomes of patients who do not centralize their symptoms and have high Waddell scores.

Our analysis of those patients who centralized their symptoms revealed that their scores on the Waddell signs were related to their outcomes. This finding is further evidence in support of nonorganic signs testing, even when centralization is achieved. Any patient with a high Waddell score, regardless of success with centralization, may require a treatment approach that recognizes and helps resolve possible behavioral issues.

For those patients who did not centralize their symptoms, a low Waddell score was not related to the return-to-work rate. Failure to centralize or abolish pain rapidly indicates a lack of response to mechanical treatment and presages a poor result. Centralization in patients with high Waddell scores had no relationship to return to work. We agree with Chan et al¹⁰ that high Waddell scores in conjunction with a positive history and the other aberrant physical findings may override any physical or mechanical advancements gained by the patient.

The rate of return to work for the patients who centralized their symptoms and had low Waddell scores was 51.5% higher than for patients who centralized their symptoms and had high Waddell scores. With low Waddell scores, the rate of return to work was 30.3% higher for patients who centralized their symptoms than for

patients who did not centralize their symptoms. This discrepancy suggests that a patient's Waddell score may be a better predictor of return to work than the ability to centralize symptoms.

Our analysis of nonorganic signs, irrespective of centralization, does not concur with the findings of Bradish et al,⁶ who found that Waddell scores were not predictive of outcome (ie, return to work). Patients with low Waddell scores in our study had a higher rate of return to work than did patients with high Waddell scores. Our findings regarding centralization, irrespective of nonorganic signs, are similar to the findings of previous research.^{4,5} Patients who centralized their symptoms had a higher rate of return to work than did patients who did not centralize their symptoms.

The predictive value of both centralization and nonorganic signs for return to work should be interpreted with caution. A high Waddell score is indicative only of symptom magnification or possible illness behavior. It does not signify malingering.¹⁵ We agree with Hayes et al¹⁶ that malingering is not a medical or psychological diagnosis; it is a judgment. Outcome may be influenced by factors other than physical recovery or excessive pain focus. Motivation, job availability and satisfaction, economic or cultural necessity, the level of sickness, or injury compensation may override physical function and pain perception in the patient's decision.^{13,14,17}

We chose the McKenzie protocol because of its association with centralization.^{5,18-21} The technique is compatible with the existing CBI treatment protocols. We believe that the clinicians were competent both in the McKenzie method of repeated movement testing and in recognizing the occurrence of centralization. Similar to the study by Riddle and Rothstein,²² who observed no better test results with more experience or training, the amount of therapist experience likely had little impact on the results. There may have been limitations in categorizing patients. A double-blind assessment protocol similar to what we accomplished with Waddell testing may have helped overcome this problem; unfortunately, the use of such a protocol was logistically impossible. The Waddell tests are part of the standard CBI initial patient assessment. Their inclusion in this study required little additional instruction for a staff who already held a high level of proficiency in nonorganic testing.

The presence of Waddell signs was not evaluated at discharge. Further research is needed to examine the change in Waddell scores from assessment to discharge and correlate each score to outcome. This research may provide more insight into how the behavioral state of the patient at discharge affects return to work.

Conclusion

As the cost of managing low back pain escalates, any predictor of outcome is advantageous. Patients whose outcome is predicted as poor at assessment will require special management or redirection to more appropriate therapy. Our results suggest that patients who do not centralize their symptoms within two treatments and have high Waddell scores are unlikely to respond to mechanical therapy. The Waddell score appears to be the better predictor of a failed outcome.

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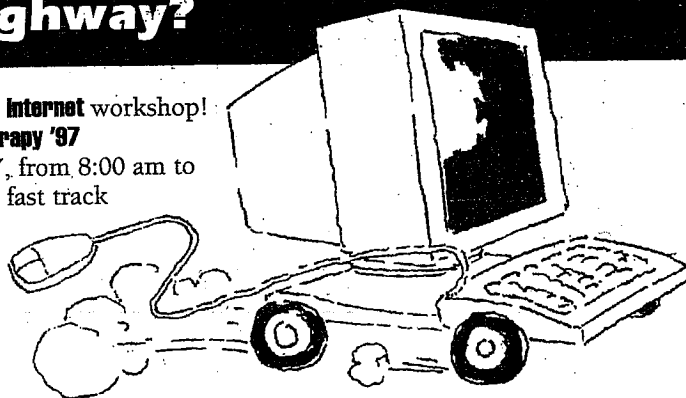
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