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Nonorganic Physical Signs in Low-Back Pain

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Nonorganic physical signs in low-back pain are described and standardized in 350 North American and British patients. These nonorganic signs are distinguishable from the standard clinical signs of physical pathology and correlate with other psychological data. By helping to separate the physical from the nonorganic they clarify the assessment of purely physical pathologic conditions. It is suggested also that the nonorganic signs can be used as a simple clinical screen to help identify patients who require more detailed psychological assessment. [Key words: low-back pain, nonorganic physical signs, physical pathology, psychosocial pathology]

LOW-BACK PAIN is a common problem, and the resulting disability frequently contains nonorganic, psychological, and social elements that are difficult for the busy clinician to assess. The physical signs described here provide a simple and rapid screen to help identify the few patients who require more detailed evaluation. Because patients are conscious and reacting during examination, most physical signs contain some nonorganic element; for example, Wing and co-workers[25] found that lumbar flexion correlated with neuroticism on psychological testing and straight leg raising correlated with experimental pain tolerance. Selected physical signs that appeared to have a *predominantly* nonorganic basis were described early in this century[5,6,12,16] following the introduction of the Compensation Acts and the development of medicolegal practice. Initially these signs were interpreted as evidence of "malingering," although with increasing psychological knowledge this appeared to be an oversimplification,[11] and the signs were in danger of being discredited and ignored. The present studies standardize a group of nonorganic physical signs and review their interpretation in the light of modern psychological knowledge. Their value is described in the routine clinical assessment of patients who have low-back pain.

This paper briefly describes the patients studied, describes the nonorganic signs and their development, scoring, and reliability, relates the nonorganic signs to the psychological findings, and finally considers the role of nonorganic signs in clinical practice.

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EXAMINATION TECHNIQUE

A standardized group of five types of physical signs was developed and used throughout the studies:

Tenderness
- Superficial
- Nonanatomic

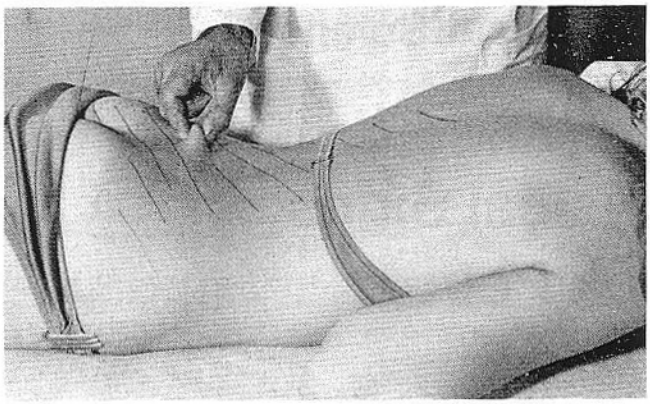

Fig 1. Nonorganic tenderness showing technique of testing superficial skin tenderness and the area **(shaded)** frequently involved in widespread nonanatomic tenderness.

Simulation
  Axial loading
  Rotation
Distraction
  Straight leg raising
Regional
  Weakness
  Sensory
Overreaction

Scoring

Any individual sign counts as a positive sign for that type; a finding of three or more of the five types is clinically significant. Isolated positive signs are ignored.

Tenderness

Tenderness related to physical disease is usually localized to a particular skeletal or neuromuscular structure. Nonorganic tenderness (Figure 1) may be either superficial or nonanatomic.

Superficial. The skin is tender to light pinch over a wide area of lumbar skin. A localized band in a posterior primary ramus distribution may be caused by nerve irritation and should be discounted.[9]

Nonanatomic. Deep tenderness is felt over a wide area, is not localized to one structure, and often extends to the thoracic spine, sacrum, or pelvis.

Simulation Tests

These give the patient the impression that a particular examination is being carried out when in fact it is not. Usually this is based on movement producing pain. On formal examination a particular movement causes the patient to report pain; that movement is then simulated without actually being performed. If pain is reported, a nonorganic influence is suggested. It is essential to minimize suggestion.

Axial Loading. Low-back pain is reported on vertical loading over the standing patient's skull by the examiner's hands (see Figure 2). Neck pain is common and should be discounted.

Rotation. Back pain is reported when shoulders and pelvis are passively rotated in the same plane as the patient stands relaxed with the feet together (see Figure 3). In the presence of root irritation, leg pain may be produced and should be discounted.

Distraction Tests

A positive physical finding is demonstrated in the routine manner; this finding is then checked while the patient's attention is distracted. The distraction must be nonpainful, nonemotional, and nonsurprising. In its simplest and most effective form this consists of indirect observation, ie, simply observing the patient throughout the period that he is in the examiner's presence, while he is unaware that he is being examined. During examination, parts of the body other than the particular part being overtly tested should be observed. Any finding that is consistently present is likely to be physically based. Findings that are present only on formal examination and disappear at other times may have a nonorganic component.

Straight Leg Raising. Straight leg raising (SLR) is the most useful distraction test. The patient whose back pain has a nonorganic component shows marked improvement in straight leg raising on distraction as compared with formal testing. There are several variations based on sitting (Figure 4). This is commonly known as the "flip test."

Regional Disturbances

Regional disturbances[23] involve a widespread region of neighboring parts such as the leg below the knee, the entire leg, or a quarter or half the body. The essential feature is divergence from accepted neuroanatomy.

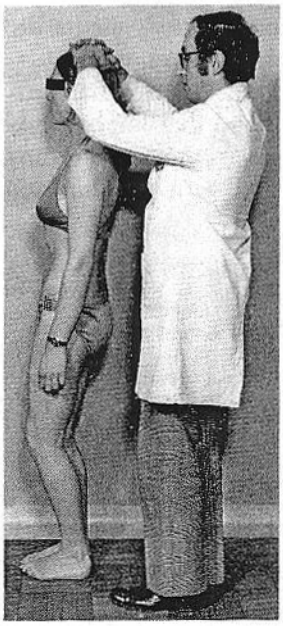

Fig 2. Axial loading: back pain on vertical loading on the standing patient's head.

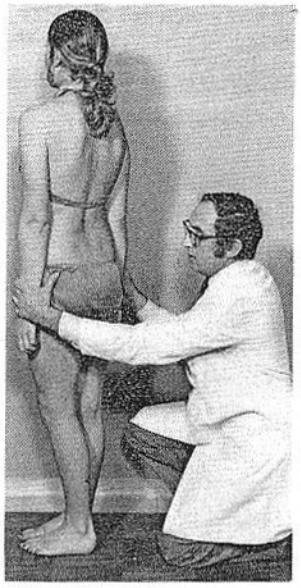

Fig 3. Simulated rotation: back pain when shoulders and pelvis are passively rotated in the same plane.

Weakness. Weakness is demonstrated on formal testing by a partial cogwheel "giving way" of many muscle groups that cannot be explained on a localized neurologic basis.

Sensory. Sensory disturbances (Figure 5) include diminished sensation to light touch, pinprick, and sometimes other modalities fitting a "stocking" rather than a dermatomal pattern. "Giving way" and sensory changes commonly affect the same area, and there may be associated nonanatomic regional tenderness. Care must be taken, particularly in patients who have spinal stenosis or who have had repeated spinal surgery, not to mistake multiple root involvement for a regional disturbance.

Overreaction

Overreaction during examination may take the form of disproportionate verbalization, facial expression, muscle tension and tremor, collapsing, or sweating (Figure 6). The response to procedures such as venipuncture or myelography provides additional information. Judgments should, however, be made with caution, minimizing the examiner's own emotional reaction; there are considerable cultural variations, and it is very easy to introduce observer bias or to provoke this type of response unconsciously.

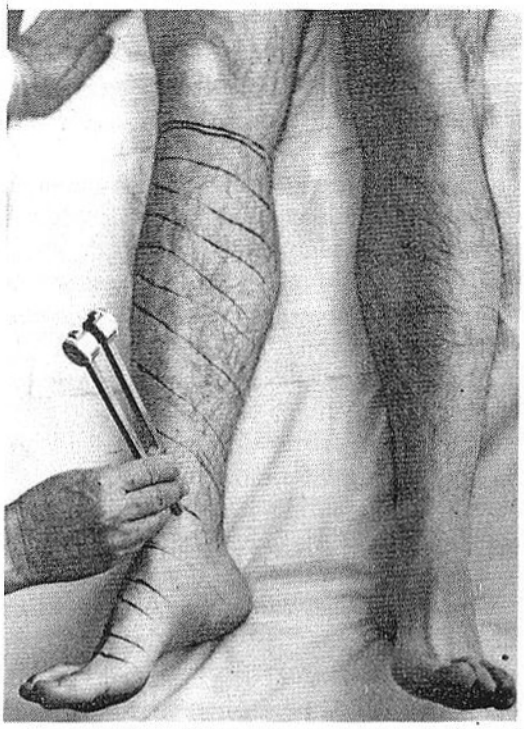

Fig 5. Nonanatomic sensory alteration in a "stocking" distribution affecting light touch, pinprick, and sometimes other modalities.

MATERIALS AND METHODS

Patients were studied in two centers, located in Toronto, Canada, and Glasgow, Great Britain (Table 1). The studies are numbered in chronologic order.

Canadian compensation patients were studied at the Workmen's Compensation Board of Ontario (WCB). The Canadian patients (Studies 1 and 2) were mainly men, almost all of whom had histories of chronic pain and work loss over many months (often years) and a high incidence of previous failed treatment. Study 1 was

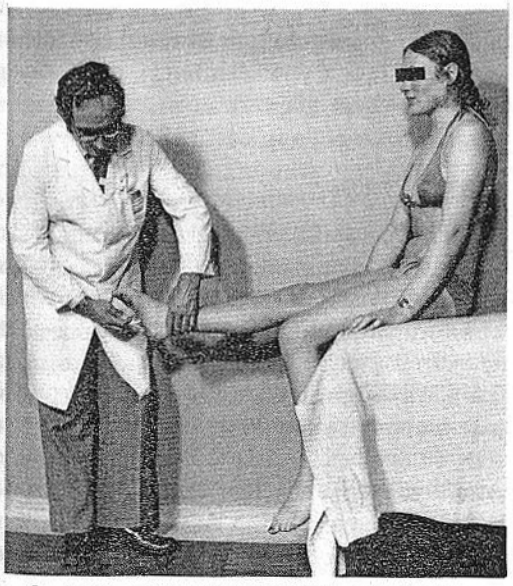

Fig 4. Straight leg raising improving with distraction, as when testing the plantar reflex in the sitting position.

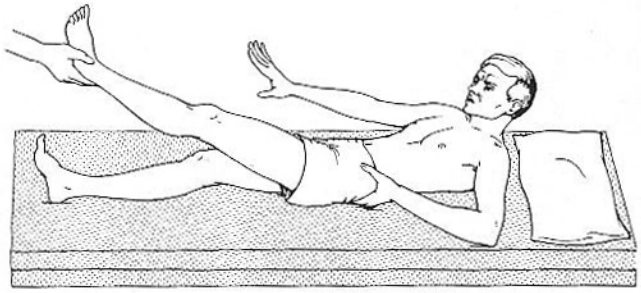

Fig 6. Overreaction to examination: disproportionate verbalization, facial expression, muscle tension and tremor, collapsing or sweating.

Table 1. Patients Studied and Incidence of Nonorganic Physical Signs

	Studies*				
	1	2	3	4	5
Number of patients	84	50	100	70	50
Percent male	80	86	48	50	50
Age (yr) (mean ± SD)	42 ± 8	38 ± 11	45 ± 17	40 ± 12	47 ± 15
Percent who had previous surgery	100	43	0	47	0
Tenderness					
Superficial (%)	43	46	4	17	0
Nonanatomic (%)	50	42	12	31	0
Simulation					
Axial loading (%)	45	38	12	27	0
Rotation (%)		30	9	17	0
Distraction (straight leg raising) (%)	26	22	3	16	0
Regional					
Weakness (%)	41	32	11	29	0
Sensory (%)	41	44	3	14	0
Overreaction (%)	10	30	13	33	0
3 out of 5 positive (%)	33	50	12	33	0

* Study 1: WCB, multiple operations; Study 2: WCB, problem admissions; Study 3: UK, new referrals; Study 4: UK, second referral, problem backs; Study 5: UK, normal subjects.

of WCB patients who had 60% poor results at follow-up 17 months after repeat back surgery.[22] Study 2 consisted of patients admitted to the Back Assessment and Rehabilitation Clinic of the WCB, usually for finalization of prolonged disability claims.

Study 3 consisted of British patients with previously untreated back pain who were referred by family physicians to a routine hospital orthopaedic clinic. Patients with "problem backs" who were secondarily referred from other specialists to a special British Back Clinic (Study 4) were in many respects similar to the problem patients in the Canadian Back Assessment and Rehabilitation Clinic (Study 2). There was a similar pattern of prolonged pain and disability, failed treatment, previous surgery, and psychosocial reactions and problems, although the patients were not institutionalized as a group. Only 12% of all British patients referred to an orthopaedic surgeon had a history of medicolegal proceedings about their back injury (Studies 3 and 4). Normal subjects (Study 5) who had neither lost time from work nor had previous medical consultations for back pain were British patients with hand injuries who were attending a hospital outpatient clinic. Brief questioning disclosed that none had a psychiatric history, neurotic symptoms, or relevant previous medical history of illness behavior.

All patients had a full medical history and physical examination including the nonorganic signs and neurologic assessment. Up-to-date roentgenograms were obtained. All medical records were reviewed, particularly previous roentgenograms and details of any spinal operations. In Studies 3 and 4, additional clinical data were recorded on inappropriate descriptions of symptoms, general somatic and neurotic symptoms,[19] previous medical history of illness behavior,[3,7,21] disability,[25] and medicolegal and compensation factors. The patients filled in a pain drawing.[20] The observer estimated overall numerical scores for total disability, relative organic and nonorganic disability, and psychological suitability for surgery. Patients in Study 1 and some patients in Studies 3 and 4 completed a Minnesota Multiphasic Personality Inventory (MMPI), a standard American psychological questionnaire.[8]

In Study 1, correlations between individual nonorganic signs and with the MMPI were analyzed by computer using Pearsonian correlation coefficients and confirmed by corrected χ^2 analysis. Studies 3 and 4 were jointly analyzed by computer, comparing the nonorganic signs with other symptomatic and clinical data. Initial correlations were again shown by Pearsonian correlation coefficients. Regression analysis was then followed by principal component analysis using Cattell's Scree Test, and four main factors were submitted to varimax orthogonal rotation. Throughout this paper, Pearsonian correlation coefficients are generally given in parentheses, where a coefficient of 0.30 is approximately equivalent to $P = 0.001$.

STANDARDIZATION

At an early stage (Studies 1 and 2) a number of signs were discontinued as unsuitable (Table 2). Analysis of Studies 3 and 4 allowed further simplification with minimal loss of sensitivity (Table 2). This produced the final standardized group of eight signs (see Examination Technique). Although it is possible to substitute other signs, this combination was found to be the most comprehensive, clinically useful, and easily learned.

The initial selection of signs from Studies 1 and 2 showed widespread correlation between the five types of tests and also between tests of each type. This was confirmed in Studies 3 and 4, in which the correlation coefficients between individual nonorganic physical signs

Table 2. Signs Tested and Not Included

	Reason for not including				
Sign	*Observer bias*	*Lower reproducibility*	*Less stability*	*Overlapping better tests*	*Little additional value and confusing to learn*
Patient's manner	+	+	+		
Contradictory clinical evidence	+	+	+		
Knee flexion during straight leg raising		+	+	+	
Opposite leg lifting during straight leg raising		+	+	+	
Strength of grip		+	+	+	
Thumb extension (EPL)		+	+	+	
Orbicularis strength		+	+	+	
Pretibial tenderness		+	+	+	
Middorsal tenderness		+		+	
Simulated bowstring		+			
Distraction spinal movement		+			
Distraction tenderness		+	+		
Discrepant weakness		+	+		
Lumbar sensory changes		+		+	
Simulated straight leg raising					+
Distraction weakness					+

were all greater than 0.25 and most were in the range of 0.35 to 0.55. Principal component analysis in Studies 3 and 4 grouped all the nonorganic signs together. Macnab[17] suggested that the regional type of pain and motor and sensory disturbances[23] could be distinguished from the "magnification" pattern with simulation and distraction signs and overreaction; in the present studies it was not possible to separate the patterns in this way. The nonorganic physical signs described here form a highly interrelated, homogeneous group.

Reliability was shown by two observers (GW and EK) independently examining 50 consecutive patients (Study 2). The order of examiners was random. The patients were first examined on the day of admission and were reexamined on a different day within one week. The first examiner's findings were not available to the second examiner. The reproducibility of more than 80% (Table 3) is rather higher than that generally reported for other techniques of medical examination and considerably higher than most psychological assessment.[4,13,14] This may be partly because the two examiners had a very similar approach and had worked closely together for more than six months.

Stability of the signs with time was shown by the same observer examining 50 consecutive patients (Study 2) on admission and discharge. Thirty-three were examined by EK, 17 by GW. The average time between examinations was 23 days, and the original findings were not available at reexamination. Despite prolonged inpatient assessment and intimate contact with staff and other problem back patients, the signs remained unchanged in 85% of patients (Table 3). After such detailed assessment it is likely that the final overall judgment would be more accurate, but this stability suggests an acceptable accuracy to the briefer initial examination.

No nonorganic signs were observed in 50 normal subjects (Table 2, Study 5, examined by RMV), confirming the specific relation of nonorganic signs to back pain.

In all studies there was a clear biphasic distribution in the number of nonorganic signs observed in individual patients (Figure 7). Patients tended to show one or no signs, or else a constellation of signs from three or more of the five types: tenderness, simulation tests, distraction tests, regional signs, and overreaction to examination. This "3 out of 5" was the most useful total score of multiple nonorganic signs. All the individual signs correlated with this total score (correlation coefficients 0.50–0.79, Studies 3 and 4). Multiple nonorganic signs showed a higher reproducibility between examiners and stability with time (Table 3) than did some individual signs. Multiple nonorganic signs correlated with other clinical nonorganic data (Studies 3 and 4) and with the MMPI (Study 1), while isolated signs often did not. Multiple nonorganic signs also agreed most closely with a surgeon's rating of overall psychological unsuitability for surgery (0.73, Studies 3 and 4). Finally, isolated false positive signs may occur in many organic conditions, eg, regional sensory disturbance in ischemia or widespread tenderness in osteoporosis. For these reasons, isolated nonorganic signs should be ignored and significance attached only to multiple positive signs from three or more of the five types. In further discussion, multiple nonorganic signs will imply the occurrence of three or more of the five types.

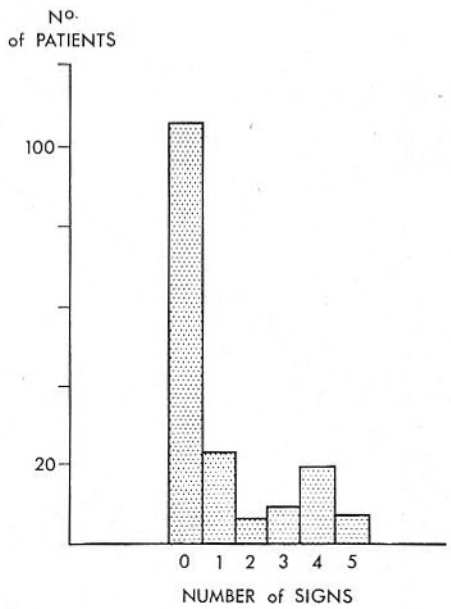

Fig 7. The number of nonorganic signs observed in individual patients (tenderness, simulation tests, distraction tests, regional signs, and overreaction).

Table 3. Reproducibility and Stability*

	Reproducibility (% agreement)	Stability (%)		
		No change	Positive to negative	Negative to positive
Tenderness				
Superficial	80	86	4	10
Nonanatomic	80	84	4	12
Simulation				
Axial loading	78	78	6	16
Rotation	78	84	2	14
Distraction (straight leg raising)	86	90	4	6
Regional				
Weakness	84	78	8	14
Sensory	86	84	8	8
Overreaction	82	76	14	10
3 out of 5 positive	86	86	4	10

* Study 2, 50 patients

INTERPRETATION

Nonorganic signs were separable from and independent of the standard physical findings of organic pathologic conditions (Studies 3 and 4). The presenting symptoms of back pain, referred leg pain, or root pain, the relation of pain to time and activity, local physical and radiologic findings of spinal abnormality, and objective evidence of nerve root irritation or compression all showed no correlation with the nonorganic signs. Nonorganic signs were *less* common in patients who had clear-cut pathologic conditions of the spine such as deformity, fracture, congenital anomaly, or underlying bone pathology. The only correlation was with marked limitation of lumbar flexion (less than 3 cm by the skin marking technique of Macrae and Wright[18]). Of 100 consecutive patients, 20 had marked limitation of lumbar flexion; of these 20, 12 had clearly identifiable lumbar pathology or mechanical derangements and no nonorganic features. Of the remaining eight patients with ill-defined physical pathology, seven had clear nonorganic findings. This supports the finding of Wing and co-workers[25] that lumbar flexion may be limited by physical causes in the back, by nonorganic factors, or by both. Most physical signs may be similarly influenced by either organic pathology or nonorganic factors, eg, localized physical or widespread nonorganic tenderness, limited straight leg raising persisting or improving with

Table 4. Correlation Between Nonorganic Signs and Minnesota Multiphasic Personality Inventory (MMPI)*

	MMPI scale†		
	Hs	D	Hy
Tenderness	0.22		0.29
Simulation	0.20	0.23	0.20
Distraction		0.29	0.23
Regional	0.19		0.22
Overreaction		0.18	

* Study 1, 84 patients; Pearsonian correlation coefficients confirmed by corrected χ^2 analysis

† Hs = hypochondriasis, D = depression, Hy = hysteria

Table 5. Relation Between Nonorganic Physical Signs and Other Clinical Nonorganic Data*

	Correlation coefficient with nonorganic signs
Inappropriate symptoms	0.50
General somatic and neurotic symptoms	0.54
Disability behavior	0.31
Pain drawing	0.27
Surgeon's score (% nonorganic)	0.69
Psychological unsuitability for surgery	0.73

* Studies 3 and 4, 170 patients

distraction, pattern of motor weakness, or sensory changes of a dermatomal or regional pattern. Provided the patterns are clearly recognized, the nonorganic physical signs described here appear to be completely independent of the conventional symptoms and signs of pathologic conditions of the spine.

Nonorganic signs were unrelated to age, sex, or type of work (Studies 2, 3, and 4). There was no major difference between comparable groups of British and North American patients (see Study 4, Studies 1 and 2, Table 2). One observer (GW) participated throughout all studies, and the minor differences in the incidence of superficial tenderness, regional sensory changes, and overreaction can be largely attributed to initially learning and progressively refining the examining techniques. Contrary to general clinical impression, in problem back patients these nonorganic signs occur just as commonly and in the same patterns in Britain as in North America.

The incidence of nonorganic signs is shown in Table 2. None occurred in normal subjects (Study 5). Multiple nonorganic signs were seen in approximately one of ten patients with previously untreated back pain referred by family physicians to a routine hospital orthopaedic clinic (Study 3). The incidence was much higher—one of three or more—in problem patients referred by other surgeons to special clinics. Although unrelated to the duration of symptoms or whether symptoms were acute, recurring, or chronic, multiple nonorganic signs did correlate with work loss (0.30, Studies 3 and 4). In Study 1, 24% of patients showed multiple nonorganic signs after two operations, 33% after three operations, and 43% after four operations. This relation was not maintained in Studies 3 and 4, and regression analysis suggested that it was not a direct relation; previous surgery accounted for less than 1% of the variance in nonorganic signs. After repeated surgery (Study 1), multiple nonorganic signs correlated more closely (0.30) with a poor result of surgery than with surgery *per se* and also correlated with failure to return to work. Similarly, in Studies 3 and 4, multiple nonorganic signs were partly related to failure of treatment (0.19), disability (0.30), and secondary referral as a "problem back" patient (0.26). These statistics suggest that multiple nonorganic signs are more common in "problem patients" and are associated with

Table 6. Principal Component Analysis of the Relations of Demographic, Clinical, and Psychological Data With Factor Loadings*

Factor 1—Nonorganic findings (17%)†		Factor 2—Illness behavior (10%)†		Factor 3—Disability (9%)†		Factor 4—Sex-related (5%)†	
Data	Factor loading	Data	Factor loading	Data	Factor loading	Data	Factor loading
All nonorganic signs	0.50–0.71	Many inappropriate symptoms	0.55	Source of referral	0.61	Sex	−0.67
Multiple nonorganic signs	0.85	Neurotic symptoms	0.55	Major presenting symptom	0.45	Type of work	−0.70
Limited lumbar flexion	0.35	Previous medical history	0.59	Previous surgery	0.62	Age	0.46
Neurotic symptoms	0.46	Pain behavior	0.38	Work loss	0.69	Duration of symptoms	0.36
Inappropriate symptoms	0.41	Chronicity	0.39	Chronicity	0.32	Limited lumbar flexion	0.46
Observer scores		Observer scores		Limited lumbar flexion	0.38		
Percent nonorganic	0.62	Percent nonorganic	0.59	Disability role	0.52	Pain score	0.41
Psychological unsuitability for surgery	0.62	Psychological unsuitability for surgery	0.56	Observer score total disability	0.60	Medicolegal	−0.43

* Studies 3 and 4, 170 patients
† Percent of common variance

failed treatment. However, without long-term follow-up studies the cause-and-effect relation is not clear.

In Study 1 the nonorganic signs showed a low but consistent correlation with the "neurotic triad" scores of the MMPI (Table 4), which represent a nonspecific general measure of psychological distress. The correlation with the hypochondriasis (Hs) score was confirmed in British patients who had neither compensation factors nor previous surgery (MMPI in 36 patients in Studies 3 and 4; correlation coefficient 0.35). Preliminary analysis of the Eysenck Personality Questionnaire in a supplementary study of 74 similar British patients has not shown any relation. In Studies 3 and 4 there was widespread correlation between multiple nonorganic signs and most of the other clinical nonorganic data (Table 5). From the total demographic, clinical, and nonorganic data describing these 170 patients, principal component analysis distinguished four major factors (Table 6). This is a statistical technique of clustering a number of individual items of information to identify underlying common characteristics. The first and largest factor comprised all the nonorganic signs with additional loading of several psychological symptoms. The second factor comprised mainly symptoms of illness behavior, some of which appeared to have a clear psychological component. The third factor comprised disability and work-related aspects. The fourth and smallest factor comprised sex-related characteristics. This analysis confirms that the nonorganic physical signs are only indirectly related to disability and demographic factors but are more closely related to other nonorganic data. Continuing studies are attempting to relate the nonorganic signs to quantitative clinical analysis of nonorganic symptoms and disability and to more specific psychometric analysis of illness behavior.

The present studies found nonorganic signs to be equally common in medicolegal cases, compensation patients, and in other problem patients in whom neither factor was identified. The exact incidence appeared to depend mainly on patient selection and referral patterns. In Studies 3 and 4 there was only moderate correlation between nonorganic signs and medicolegal factors (0.22), and regression analysis showed that medicolegal factors accounted for less than 1% of the variance in nonorganic signs. It appears that nonorganic signs are not limited to, nor specific to, medicolegal and compensation situations. The nonorganic signs did not correlate with the MMPI validity scores of F and K (84 patients in Study 1, 36 patients in Studies 3 and 4). These validity scores are generally thought[8] to detect unreliable answers, attempts to give socially acceptable answers, and deliberate exaggeration ($F > 15$, $K < 8$, $F - K > 9$, "saw-tooth" profile). Only 12% of compensation patients (Study 1) showed any such features, and there was an equal incidence of the opposite tendencies. None of the aforementioned MMPI characteristics, individually or collectively, was significantly more

Table 7. False Positive Nonorganic Signs in Patients With Acute Pathologic Conditions of the Spine and Severe Disability*

Patient	Sex	Age (yr)	Pathologic condition	Nonorganic findings
1	F	46	L2–3 tuberculosis	2 of 5 nonorganic signs Neurotic and social symptoms Previous medical history
2	M	69	Recurrent disc prolapse	Nonorganic signs
3	M	61	Multiple myeloma	Nonorganic signs
4	F	70	L2–3 infection	Nonorganic signs
5	M	69	Disc prolapse	Impossible to assess or examine

* Studies 3 and 4, 170 consecutive patients

frequent in patients who had multiple nonorganic signs. Similarly, there was no correlation between the nonorganic signs and the validity score L of the Eysenck Personality Questionnaire (supplementary study on 74 British patients who had neither compensation factors nor previous surgery).

Supplementary British studies double-checked possible causes of diagnostic difficulty or false positive findings. Nonorganic findings were easily distinguished from four partial cord lesions, three cauda equina lesions, and two lumbosacral plexus injuries. Regional pain, nonorganic tenderness, and positive simulation and distraction signs do not occur in these organic lesions. Regional weakness and nonorganic sensory signs conform to body image divisions of knee, groin, or waist rather than to neurologic levels. The nonorganic presentation of coarse and partial cogwheel "giving way" found during formal testing of voluntary power is clearly different from the consistently increased muscle tone, tremor, and fine cogwheel spasticity on passively testing an upper motor neuron lesion or the regular, smooth weakness of a lower motor neuron lesion. Clonus, brisk tendon reflexes, and positive Babinski reflexes do not occur in a regional disturbance. Most important, associated psychological symptoms and social features are usually present to confirm nonorganic physical signs. Six patients with proven disseminated sclerosis at various stages did not show multiple nonorganic signs. Fifteen patients with gross scoliosis or kyphosis and/or demonstrable instability and 12 patients with wedge fractures similarly had no nonorganic signs. Of six patients with spinal infection and eight with spinal tumors, two showed multiple nonorganic signs (Table 7, Patients 3 and 4).

It is safer to assume that all patients complaining of back pain have a physical source of pain in their back. Equally, all patients with pain show some emotional and behavioral reaction. Physical pathology and nonorganic reactions are discrete and yet frequently interacting dimensions; they are not alternative diagnoses but should each be assessed separately. Rarely, patients who have both serious pathologic conditions of the spine and major nonorganic features set a diagnostic trap (Table 7, Patient 1). The main exception and danger to the nonorganic physical signs is the occurrence of multiple false positives in elderly patients who have difficulty standing because of acute pain (Table 7). Nonorganic signs, in the absence of other nonorganic symptoms, history, and behavior, must not prevent the physical assessment and investigation of such patients.

DISCUSSION

Regression analysis of multiple nonorganic signs and of a surgeon's decisions showed that overreaction was the single most important nonorganic physical sign. Unfortunately, this is also the sign most influenced by the subjective impressions of the observer. Further studies aim to refine and define overreaction more objectively. It would also be useful if a test could be devised to distinguish physical and nonorganic limitation of lumbar flexion.

Final proof of the validity of these signs depends on their value in predicting the outcome of treatment. McCulloch,[15] basing his assessment largely on nonorganic physical signs, found them to be of major value in predicting the result of chemonucleolysis for prolapsed lumbar intervertebral disc: no significant psychogenic component, 74% success, psychogenic component, 11% success. This is supported by the reported prognostic value of the hypochondriasis (Hs) and hysteria (Hy) scores of the MMPI in chemonucleolysis,[24] physiotherapy,[2] and rehabilitation.[1] Current prospective trials are assessing the prognostic value of the nonorganic signs in both conservative treatment and surgery. Preliminary analysis of the early results of salvage surgery in the lumbar spine suggests a substantially higher rate of good initial results in patients who have no significant psychosocial problems. The nonorganic signs appear to help in the identification of patients likely to have a poor result from surgery.

All reviews of the failures of spinal surgery emphasize the importance of psychosocial factors and their assessment.[22] It has been shown clearly that most physical findings may be influenced by both physical pathology and nonorganic factors. Recognition of these nonorganic signs greatly clarifies the clinical assessment of the standard signs of physical pathology. It is suggested also that nonorganic physical signs should form part of a routine preoperative screen. In the absence of clear indications for surgery this may give sufficient cause not to embark on elaborate and risky preoperative investigations which become progressively more compelling and harder to stop. Even with a proven and treatable physical lesion, multiple nonorganic signs help to identify those patients requiring formal psychosocial assessment before surgery for relief of pain. Finally, the nonorganic signs may add one facet to such detailed psychosocial assessment. It must, however, be emphasized that they form only one facet and should not be

overinterpreted as a substitute for a complete clinical, nonorganic, or psychological profile.

The standardized group of nonorganic physical signs described here is easily learned and can be incorporated unobtrusively to add less than one minute to the routine physical examination. This should be paralleled by certain specific items of history. Compensation factors reduce the success rate of any form of treatment for back pain and sciatica by approximately one third.[22] Recent stressful life events such as family crises or marital or employment problems may illuminate the current exacerbation.[10] Systemic inquiry about disability[25] and general somatic and neurotic symptoms[19] may reveal unusual patterns of pain expression, excessive concern with health, and unrealistic expectations of treatment. The history of operations, illness behavior, and response to previous treatments should be elucidated in the routine medical history.[3,7,21] The minutes thus spent to "operate on a patient, not a spine" may save years of coping with the human wreckage caused by ill-considered surgery on the lumbar discs.

CONCLUSIONS

1. A group of nonorganic physical signs in low-back pain are described and standardized.
2. These nonorganic signs are independent of and separable from the standard clinical signs of physical pathology.
3. Recognition of nonorganic signs clarifies clinical assessment of the standard signs of physical pathology.
4. The nonorganic signs correlate with other clinical nonorganic assessment.
5. Nonorganic signs should form part of a routine preoperative screen to help identify patients who require detailed psychosocial assessment.

REFERENCES

1. Beals RK, Hickman NW: Industrial injuries of the back and extremities. J Bone Joint Surg 54A:1593–1611, 1972
2. Bergquist-Ullman M, Larsson U: Acute low back pain in industry. Acta Orthop Scand (Suppl) 170, 1977
3. Blumer D: Psychiatric considerations in pain. Chap 18. The Spine. Edited by RH Rothman, FA Simeone. Philadelphia, WB Saunders Company, 1975
4. Cochrane AL, Chapman PJ, Oldham PD: Observers' errors in taking medical histories. Lancet 1:1007–1009, 1951
5. Collie J: Malingering and feigned sickness. New York, Paul B. Boeber, 1913
6. Collie J: Fraud in medico-legal practice. London, Edward Arnold Company, 1932
7. Engel GL: Psychogenic pain and the pain-prone patient. Am J Med 26:899–909, 1959
8. Graham JR: The MMPI: A Practical Guide. New York, Oxford University Press, 1977
9. Gunn CC, Milbrandt WE: Early and subtle signs in low-back sprain. Spine 3:267–281, 1978
10. Holmes TH, Rahe RH: The social readjustments rating scale. J Psychosom Res 11:213–218, 1967
11. Huddleston JH: Accidents, neuroses and compensation. Baltimore, Williams and Wilkins Company, 1932
12. Jones AB, Llewellyn LJ: Malingering or the simulation of disease. London, William Heinemann, 1917
13. Kilpatrick GS: Observer error in medicine. J Med Educ 38:38–43, 1963
14. Kreitman N, Sainsbury P, Morrissey J, Towers J, Scrivener J: The reliability of psychiatric assessment: An analysis. J Ment Sci 107:887–908, 1961
15. McCulloch JA: Chemonucleolysis. J Bone Joint Surg 59B:45–52, 1977
16. McKendrick A: Malingering and Its Detection. Edinburgh, E & S Livingstone, 1912
17. Macnab I: Backache. Baltimore, Williams and Wilkins Company, 1977
18. Macrae IF, Wright V: Measurement of back movement. Ann Rheum Dis 28:584–589, 1969
19. Mayer-Gross W, Slater E, Roth M: Clinical Psychiatry. Third edition. London, Bailliere, Tindall and Cassell, 1969
20. Ransford AO, Cairns D, Mooney V: The pain drawing as an aid to the psychologic evaluation of patients with low-back pain. Spine 1:127–134, 1976
21. Szasz TS: The painful person. J Lancet 88:18–22, 1968
22. Waddell G, Kummel EG, McCulloch JA, et al: Failed lumbar disc surgery and repeat surgery following industrial injuries. J Bone Joint Surg 61A:201–207, 1979
23. Walters A: Psychogenic regional pain alias hysterical pain. Brain 84:1–18, 1961
24. Wiltse LL, Rocchio PD: Pre-operative psychological tests as predictions of success of chemonucleolysis in the treatment of the low-back syndrome. J Bone Joint Surg 57A:478–483, 1975
25. Wing PC, Wilfling FJ, Kokan PJ: Comprehensive analysis of disability following lumbar intervertebral fusion. (In preparation)

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