SPINE Volume 19, Number 10, pp 1132–1137

Clinical Features of Patients with Pain Stemming from the Lumbar Zygapophysial Joints

Is the Lumbar Facet Syndrome a Clinical Entity?

Anthony C. Schwarzer, MB BS, FRACP,* Charles N. Aprill, MD,† Richard Derby, MD,‡ Joseph Fortin, DO,§ Garrett Kine, MD,‡ and Nikolai Bogduk, MD, PhD*

Study Design. This study is a prospective cross-sectional analytic study.

Objectives. The authors determined the prevalence and clinical features of patients with pain stemming from the lumbar zygapophysial joints.

Summary of Background Data. Previous studies have demonstrated a wide range of prevalence for zygapophysial joint pain and conflicting results with regard to clinical signs.

Methods. One hundred and seventy-six consecutive patients with chronic low back pain were investigated with a series of screening zygapophysial joint blocks using lignocaine and confirmatory blocks using bupivacaine.

Results. Forty-seven percent of patients had a definite or greater response to the screening injection at one or more levels but only 15% had a 50% or greater response to a confirmatory block. Response to zygapophysial joint injection was not associated with any single clinical feature or set of clinical features.

Conclusions. The zygapophysial joint is an important source of pain but the existence of a "facet syndrome" must be questioned. [Key words: back pain, zygapophysial joint, local anesthetics, prevalence, clinical signs]
Spine 1994;19:1132–1137

In some quarters the lumbar zygapophysial joints are believed to be an important source of low back pain. Belief in this notion was initially only conjectural. Goldthwait postulated that the lumbosacral zygapophysial joint might be a source of pain;[13] Ghormley declared that it could be and coined the term "facet syndrome,"[12] and Badgley endorsed the idea on the basis of pathomorphologic studies of the joint.[1] Rees[33] and subsequently Shealy[37] accepted the notion and developed techniques whereby the joint could allegedly be denervated to stop pain stemming from it.

Systematic studies began in 1976 when Mooney and Robertson[26] showed that back pain and referred pain to the lower limb could be induced experimentally in normal volunteers by stimulating the lumbar zygapophysial joints with injections of normal saline. This confirmed an earlier but less well documented observation by Hirsch,[15] and was later corroborated by McCall et al.[25] A later study by Marks[23] in patients with chronic low back pain demonstrated that local and referred pain could be provoked by injection of local anesthetic and corticosteroid into the zygapophysial joint or over the medial branch of the dorsal ramus. Kuslich et al probed zygapophysial joint capsules in patients undergoing lumbar decompression operations for herniated discs or spinal stenosis and found that pain could be induced in a small minority, although it was never of the same quality as the chronic low back pain from which the patients suffered.[18]

Convinced of the reality of lumbar zygapophysial joint pain as a clinical entity, many investigators developed and used techniques to diagnose it using intra-articular joint blocks and nerve blocks, and to treat it with intra-articular steroids[6,8,19–22,28] or radiofrequency denervation.[30,31] The cardinal pathology of painful, lumbar zygapophysial joints was portrayed as osteoarthrosis[4,7,20] or chondromalacia facetae,[9] whereas some investigators contended that occult fractures were an important cause of pain.[38]

This field, however, has remained controversial on several counts. The prevalence of lumbar zygapophysial joint pain is not known for certain: whether it is a common condition, an uncommon one, or even whether it exists at all. In selected samples the prevalence ranges between 16% and 94%[5,7,8,10,14,19–21,26–28,32,34,36] but

From the *Faculty of Medicine, The University of Newcastle, Newcastle, Australia, †Magnolia Diagnostics Inc., New Orleans, Louisiana, ‡Spinecare, Daly City, California, and §Diagnostic Conservative Management, New Orleans, Louisiana.
Supported by a scholarship (Dr. Schwarzer) from the New South Wales Department of Health and by the International Spinal Injection Society.
This work was performed at Diagnostic Conservative Management, New Orleans, Louisiana, and Spinecare, Daly City, California.
Accepted for publication November 2, 1993.

in larger, seemingly unselected samples, it is as low as 6%[5] or 8%.[16]

A major frustration has been that short of performing invasive diagnostic blocks, there are no reliable means by which lumbar zygapophysial joint pain might be diagnosed clinically. Jackson et al,[16] using a variety of unusual physical tests (ones not commonly employed in conventional practice), did not identify any clinical features indicative of lumbar zygapophysial joint pain. Studies addressing the pattern of referred pain from the lumbar spine have been unable to distinguish pain from different levels.[23,25]

Fundamental to the diagnosis of lumbar zygapophysial joint pain is the use of diagnostic blocks. Radiologically controlled blocks of the joints constitute the only available criterion standard against which any clinical or radiographic test for zygapophysial joint pain might be correlated. Single diagnostic blocks, however, are a poor standard. One study that evaluated single, uncontrolled, diagnostic blocks has shown that they are associated with a false-positive rate of 38%.[35] Another study to evaluate the effect of a placebo injection showed that the placebo rate was 32%.[36] Therefore, to formulate a reliable diagnosis, diagnostic blocks in any patient must at least be accompanied by a control observation.

One suitable control is the extra-articular injection of a small volume of normal saline.[36] A convenient alternative, advocated in the pain literature, is the use of a series of two local anesthetic blocks.[2] Lignocaine, which has a rapid onset and a short duration of action, can be used as a screening block. Patients who respond to this block can then undergo a confirmatory block using a local anesthetic with a different half-life such as bupivacaine. A patient with genuine zygapophysial joint pain should obtain relief after initial injection of lignocaine but should obtain the same relief on a subsequent occasion if bupivacaine was used.

A confirmatory block using bupivacaine should be able to screen out false-positive responders to single-block lignocaine. Regardless of the response to a first block with lignocaine, the patient who does not obtain the same relief from a second block with bupivacaine should not be considered to have zygapophysial joint pain.

This study explores these various issues. The prevalence of lumbar zygapophysial joint pain was sought in a consecutive series of patients with chronic low back pain. Double diagnostic blocks were used to establish the diagnosis. Concurrently the clinical features of all patients were recorded to determine any differences between responders and non-responders to diagnostic blocks.

This study differs from that of Jackson et al[16] in that the physical examination used techniques that are representative of those performed in conventional practice. They did not require special equipment or unusual positions as in the Jackson study. Moreover, by using double diagnostic blocks, this study addressed patients with a more convincing diagnosis of lumbar zygapophysial joint pain, lack of which was a problem identified by Jackson et al.[16]

■ Patients and Methods

The study population consisted of 176 consecutive patients with low back pain seen between April 1992 and October 1992. They were seen at either a radiology practice in New Orleans specializing in spinal pain or at a specialist spine center in San Francisco. The patients were drawn from the metropolitan area of New Orleans or San Francisco but there were also some interurban and interstate referrals. All had been referred by neurosurgeons, orthopedic surgeons, and physiatrists because noninvasive investigations had been nondiagnostic and, in the opinion of the referring physician, the patients' pain was severe enough to warrant invasive investigations. Patients younger than age 18 or older than age 80 and those who had undergone lumbar surgery or who exhibited neurologic signs were excluded.

There were 106 men and 70 women whose median age was 38.4 years (interquartile range, 31.2 to 46.1) and whose median duration of back pain was 16.5 months (interquartile range, 9.0 to 33.0). The cause of back pain was work related in 52%, and motor vehicle accidents in 20%. Pain of other causes accounted for the remaining 28% of patients. Worker's compensation or third-party insurance coverage was present in 75%. Pain was unilateral in 62%, central in 9%, and bilateral in 29%.

The nature of the study and the potential hazards of the procedures to be undertaken were explained to all patients, all of whom consented to participate. A standard questionnaire and form were completed on each patient and included information on history, physical examination, and the results of all procedures. The following historical features were obtained from each patient: date of onset of back pain, mechanism of injury and whether this was related to an accident at work or a motor vehicle accident; site of back pain (left, right, bilateral, or central), and pattern of referred pain. Other questions related to their pain and the answers were graded as yes, no, or indeterminate. Each subject was asked whether the pain was aggravated or improved by sitting, standing, or walking.

A standard physical examination was also performed to determine whether the following movements aggravated the pain: forward flexion, extension, rotation of the trunk to the right and left, rotation to the left with right extension, and rotation to the right with left extension, and whether straight leg raising in the supine position aggravated either their back pain or their leg pain.

Patients were examined primarily by one examiner but three others also performed examinations on some patients. To test interobserver reliability, 20 patients were selected randomly and examined by both the principal investigator and one of four other examiners. Therefore a mean of five patients was examined by each observer. Each observer was blinded as to the findings of the principal investigator.

Zygapophysial joints were investigated with diagnostic blocks using lignocaine and bupivacaine on separate occasions. Blocks with lignocaine were done before but on the same occasion as other investigations required in the course of

the patient's management, such as discography. Confirmatory blocks with bupivacaine were performed on a subsequent occasion, usually 2 weeks after the first set of blocks.

The zygapophysial joint blocks were performed on the ipsilateral side in patients whose pain was unilateral, or bilaterally in patients with bilateral pain or central pain. Blocks were initiated at the segmental level of maximal pain and spinal tenderness, which was determined by fluoroscopy. If L5–S1 was the site of maximal tenderness, the procedures were carried out at this level followed by joints at L4–L5 and then L3–L4. If L4–L5 was the site of maximal tenderness, L4–L5 was injected first followed by L5–S1 and then L3–L4. If L3–L4 was the site of maximal tenderness, the order of injections was L3–L4, L4–L5, and L5–S1. If the site of maximal tenderness was the posterior superior iliac spine or over the sacroiliac joint, the L5–S1 joint was injected first followed by L4–L5 and then the sacroiliac joint.

The zygapophysial joints were anesthetized using either blocks of the medial branches of the dorsal ramus or intra-articular injections depending on the preference of the proceduralist. Both procedures anesthetize the zygapophysial joint and are equivalent in efficacy.[3,24,29] When spondylolysis was suspected radiographically, medial branch blocks were performed to avoid excessive spread of local anesthetic, which might occur if the block was intra-articular. The procedures were performed with the patient lying on a fluoroscopy table in an oblique/prone position. The skin overlying the joint was prepared using an iodine-based antiseptic solution, and the area was draped. The skin overlying the joint was infiltrated with 1% lignocaine using a short 23-gauge needle. Using standard techniques[3] under intermittent fluoroscopic guidance, a 20-, 22-, or 25-gauge 3½-inch spinal needle was used to gain access either to the cavity of the target joint or to the medial branches that innervated the joint (Figures 1, 2).

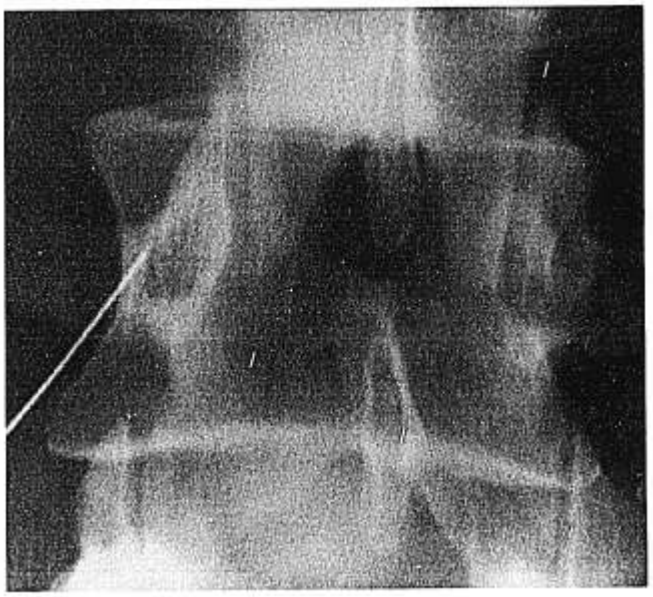

Figure 2. Postero-anterior view of a needle in position for a left L3 medial branch block.

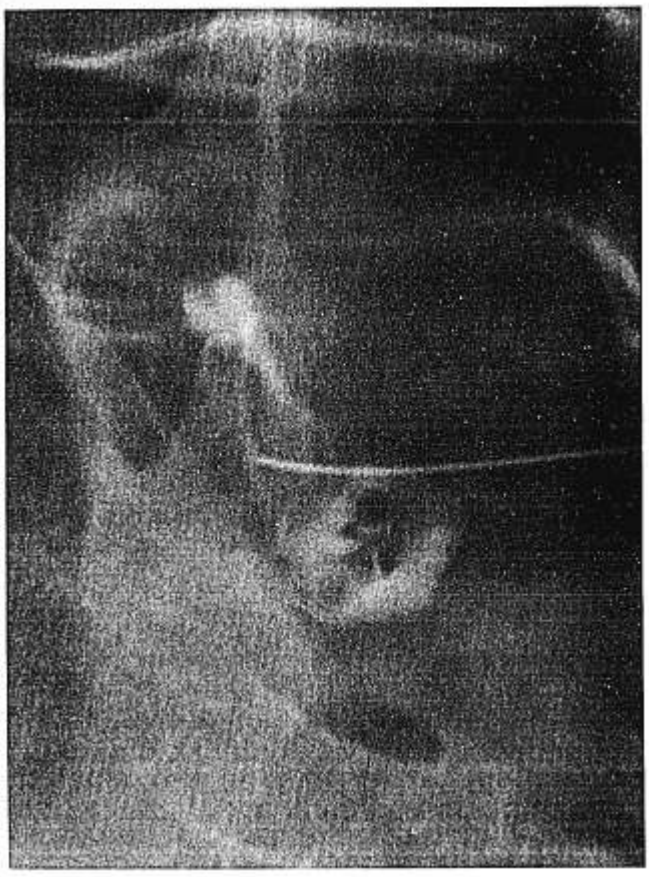

Figure 1. Arthrogram of a left L5–S1 zygapophysial joint in an oblique projection. Contrast medium outlines the joint cavity and fills the superior and inferior recesses.

When intra-articular blocks were performed, 0.2 to 0.3 mL of non-ionic contrast medium was used to confirm intra-articular placement of the needle, and the joint was anesthetized with 0.5 mL of 2% lignocaine. When medial branch blocks were performed each nerve was infiltrated with 0.5 mL of 2% lignocaine.

Ten minutes after the blocks with lignocaine, the patient was examined, and was asked to walk around and perform previously painful movements. Responses to the blocks were graded as "worse," "no change," "partial," "definite," and "complete." A partial response constituted a minor improvement in pain consistent with fluctuations in pain to which the patient was accustomed. A definite response was defined as a substantial and unexpected loss of pain in the symptomatic area. A complete response was defined as total relief of pain. If patients had less than a complete response the next segmental level was investigated and a similar assessment of response was performed, to a maximum of three levels. If a patient obtained a definite or complete response at one or more segmental levels from the screening procedures with lignocaine, he or she was asked to return 2 weeks later to undergo a confirmatory block.

Confirmatory blocks using bupivacaine 0.5% instead of lignocaine were performed at the segmental level at which the greatest relief had been obtained after the previous injection of lignocaine. After anesthetization of the putatively symptomatic joint, each patient was given a series of visual analog scales to complete after discharge over the ensuing 8 hours. Patients were instructed not to rest and were encouraged to

Table 1. Relationship Between Clinical Features and the Results of Double, Diagnostic Blocks of the Lumbar Zygapophysial Joints

Historical and Examination Features	*P* Value
Pain made worse by sitting	0.55
Pain made worse by standing	0.63
Pain made worse by walking	0.97
Pain relieved by sitting	0.40
Pain relieved by standing	0.03
Pain relieved by walking	0.26
Pain increased by forward flexion	0.96
Pain increased by extension	0.99
Pain increased by right rotation	0.62
Pain increased by left rotation	0.38
Pain increased by right rotation & left extension	0.07
Pain increased by left rotation & right extension	0.99
Left SLR makes back pain worse	0.33
Left SLR makes leg pain worse	0.43
Right SLR makes back pain worse	0.14
Right SLR makes leg pain worse	0.21

SLR = straight leg raising test (patients excluded from this analysis are 12 patients who did not undergo confirmatory blocks).

carry out their daily activities. Ratings were performed at ½ hour, 1 hour, and then hourly. Relief of more than 50% of pain that was sustained for 3 hours or more was accepted as a positive response. Any other response was considered negative.

A response of 50% relief or greater was adopted to allow for conditions in which the patient suffered pain from more than one source, such as discogenic pain as well as zygapophysial joint pain. A response of at least 50% could be inferred to indicate that the joint anesthetized was a significant but not the sole source of pain. Without this provision, patients with multiple sources of pain including a zygapophysial joint would have remained undetected.

All data was recorded on a database using Epi Info (Version 5. April 1990, Public Domain Software for Epidemiology and Disease Surveillance, Centers for Disease Control, Atlanta, GA). The Data Analysis component of Epi Info was used for frequencies and contingency tables. All other analyses were performed using SPIDA (Statistical Package for Interactive Data Analysis, Version 6, 1992 Statistical Computing Laboratory Pty Ltd, Macquarie University, NSW, Australia). The chi-squared statistic was used to determine the relationship between discrete variables. Interobserver reliability was determined using McNamar's test of symmetry and the Kappa statistic. For prevalence estimates, the 95% confidence intervals were determined.[11]

Regression analysis is a statistical tool for evaluating the relationship of one or more independent variables to a single continuous variable.[17] To determine the clinical features of zygapophysial joint pain, logistic regression was used to find a model that would relate a combination of clinical features to outcome of zygapophysial joint injections.

■ Results

With respect to screening blocks with lignocaine, 70 patients (40%) underwent medial branch blocks, 79 (45%) had intra-articular blocks, and 27 (15%) underwent both. Eighty-three patients (47%) reported definite or greater responses to the lignocaine blocks at one or more levels.

Confirmatory blocks with bupivacaine were performed in 71 patients. They were not undertaken in the remaining 12 patients either because they did not have pain at the time they returned for investigations or because they lived too far away and were unable to attend. Twenty-six patients or 15% reported a 50% or greater improvement in their pain (95% CI 10–20%).

Of the 26 patients who had positive responses, 18 had unilateral pain and 8 had bilateral pain. No patients with central pain responded to the confirmatory blocks. The level that was most frequently symptomatic was L5–S1 (15) followed by L4–L5 (6), L3–L4 (3), and L2–L3 (1). In one patient with a lumbarized sacral segment, there was a positive response at L5–L6. Of the patients with greater than 50% relief of pain, there were 7 (4% of the original sample) who obtained absolutely complete relief of their pain with both blocks.

There was no statistically significant difference between the examination findings of the principal investigator and the other investigators. The Kappa scores for comparisons between observers range between 0.69 and 1.00.

There was no statistically significant association between response to blocks and any single feature on history or physical examination (Table 1). Separate analyses were performed for patients with left-sided pain and right-sided pain (Table 2) and for all patients irrespective of the side of their pain. Chi-squared tests did not reveal any clinical feature as a useful predictor. In particular, rotation of the lumbar spine and rotation combined with extension were poor discriminators of zygapophysial joint pain; referral of pain below the knee was not any more common or less common in patients with or without zygapophysial joint pain (Tables 3, 4).

When combinations of clinical features were assessed by logistic regression, a model could not be formulated

Table 2. Relationship Between Clinical Features and Results of Double, Diagnostic Blocks of the Lumbar Zygapophysial Joints

Examination Features	*P* Value*	*P* Value†
Pain increased by right rotation	0.10	0.58
Pain increased by left rotation	0.16	0.81
Pain increased by right rotation & left extension	0.19	0.61
Pain increased by left rotation & right extension	0.48	0.40
Left SLR makes back pain worse	0.47	0.93
Left SLR makes leg pain worse	0.28	0.33
Right SLR makes back pain worse	0.73	0.22
Right SLR makes leg pain worse	‡	0.40

* Left-sided pain.
† Right-sided pain.
‡ Insufficient cells for analysis. SLR = straight leg raising test.

that could discriminate patients who responded to blocks from those who did not.

These results prevail even if complete relief of pain is adopted as the criterion for zygapophysial joint pain. Even the 4% of patients who exhibited this degree of relief could not be distinguished clinically.

■ Discussion

The criteria adopted for the diagnosis of lumbar zygapophysial joint pain in this study are more stringent than those that have been applied in any previous study. This study is the first to assess the prevalence of zygapophysial joint pain using double blocks. The value of the second block is that it significantly improves the specificity of this diagnostic test, thereby making any prevalence estimate more reliable. The specificity of single uncontrolled blocks is 62%, providing a false-positive rate of 38%.[35]

While improving the reliability of this diagnostic test, double blocks are time-consuming, and to give maximal information, patients must be evaluated carefully after each segmental level is blocked, which includes an evaluation of those activities of daily living that would normally bring on the pain. Some 15 to 20 minutes must be allowed for this evaluation after each lignocaine block. Such an assessment has two important effects. First, it reduces the rate of false-positive responses, and second, it enables the symptomatic level to be isolated accurately.

One limitation of the present study was that we were unable to compare the duration of effect of lignocaine and bupivacaine. This was because the study was conducted opportunistically in the course of normal practice. In spine medicine, patients are often referred for multiple investigations, including discography and selective nerve root blocks, at the one visit. This does not allow the use of pain diaries after screening blocks with lignocaine. However, we were able to document responses to the confirmatory block by the use of serial visual analog scales. This ensured that positive responses were sustained for periods consistent with the expected duration of action of the local anesthetic used. This concordance constituted further evidence that the patients' responses were not falsely positive.

Under these conditions, this study found that a diagnosis of zygapophysial joint pain could be made in 15% of patients on the basis of double, diagnostic blocks, but there are no clinical features that could distinguish those patients who responded and those who did not respond to diagnostic blocks.

Table 3. Relationship Between Pain Referral Pattern and Presence of Zygapophysial Joint Pain

Pain Location	Left-sided Pain	Right-sided Pain
Groin	0.49	0.22
Buttock	0.86	0.69
Thigh	0.41	0.37
Calf	0.85	0.75
Foot	0.10	0.66

Analysis performed for left-sided pain and for right-sided pain.

Table 4. Prevalence of Pain Referral Patterns in Patients With and Without Zygapophysial Joint Pain

Area of Pain Referral	Pain Positive	Pain Negative
Left groin	4/26 (15%)	15/138 (11%)
Right groin	1/26 (3%)	23/138 (17%)
Left buttock	11/26 (42%)	54/138 (39%)
Right buttock	10/26 (15%)	58/138 (42%)
Left thigh	10/26 (38%)	49/138 (36%)
Right thigh	10/26 (38%)	59/138 (43%)
Left calf	7/26 (27%)	34/138 (25%)
Right calf	4/26 (15%)	45/138 (33%)
Left foot	8/26 (31%)	23/138 (17%)
Right foot	2/26 (8%)	28/138 (20%)

Patients excluded from this analysis were 12 patients who were unable to undertake confirmatory blocks using bupivacaine.

The prevalence of lumbar zygapophysial joint pain established in this study is less than that reported by others who adopted greater than 50% relief of pain as the diagnostic criterion.[5] This difference can be accounted for by the use of double, diagnostic blocks which, because of their greater specificity, may reduce the prevalence by more than half.[35] Similarly, if complete relief of all pain is used as the diagnostic criterion, previous studies have reported prevalence rates of 8%[16] and 6%[5] whereas the prevalence of this degree of relief in this study was 4%.

This study did not disprove the null hypothesis that there are no clinical features that reliably discriminate between patients with pain of zygapophysial origin and pain of other causes. No combination of historical or examination features could be used to predict pain of zygapophysial joint origin. This result confirms those of Jackson et al[16] and Revel et al,[34] but is dissonant with those of Fairbank et al[10] and Helbig and Lee.[14] However, these latter two groups relied only on single blocks, and it is not clear the extent to which their observations may have been confounded by false-positive responses. Moreover, the clinical features found by these investigators to be associated with zygapophysial joint pain were addressed expressly in this study and were found not to be associated.

One definitive observation stemming from this study is that no patients with central pain responded to diagnostic blocks of the zygapophysial joints. We can recommend, therefore, that in patients with central lumbar pain, zygapophysial joint blocks are unlikely to be diagnostic.

Otherwise, the results of this study echo previous concerns. Although the zygapophysial joint may be a source of pain in a substantial minority of patients, we were unable to demonstrate a "facet syndrome" clinically.

References

1. Badgley CE. The articular facets in relation to low-back pain and sciatic radiation. J Bone Joint Surg 1941;23:481–496.
2. Boas RA, Cousins MJ. Diagnostic neural blockade. In: Cousins MJ, Bridenbaugh PO, editors. Neural Blockade in Clinical Anaesthesia and Management of Pain, 2nd edition. Philadelphia: J. B. Lippincott, 1988:885–898.
3. Bogduk N, Aprill C, Derby R. Lumbar zygapophysial joint pain: diagnostic blocks and therapy. In: Wilson D, editor. Interventional Radiology for the Skeletal System. Kent: Edward Arnold, (in press).
4. Bough B, Thakore J, Davies M, Dowling F. Degeneration of the lumbar facet joints. Arthrography and pathology. J Bone Joint Surg (Br) 1990;72:275–276.
5. Carette S, Marcoux S, Truchon R, et al. A controlled trial of corticosteroid injections into facet joints for chronic low back pain. N Engl J Med 1991;325:1002–1007.
6. Carrera GF. Lumbar facet joint injection in low back pain and sciatica: Description of technique. Radiology 1980;137: 661–664.
7. Carrera GF. Lumbar facet joint injection in low back pain and sciatica: Preliminary results. Radiology 1980;137:665–667.
8. Destouet JM, Gilula LA, Murphy WA, Monsees B. Lumbar facet joint injection: Indication, technique, clinical correlation, and preliminary results. Radiology 1982;145:321–325.
9. Eisenstein SM, Parry CR. The lumbar facet arthrosis syndrome-clinical presentation and articular surface changes. J Bone Joint Surg (Br) 1987;69:3–7.
10. Fairbank JCT, Park WM, McCall IW, O'Brien JP. Apophyseal injection of local anesthetic as a diagnostic aid in primary low-back pain syndromes. Spine 1981;6:598–605.
11. Fletcher RH, Fletcher SW, Wagner EH. Clinical Epidemiology: The Essentials. Baltimore: Williams & Wilkins, 1988: 42–75.
12. Ghormley RK. Low back pain with special reference to the articular facets, with presentation of an operative procedure. JAMA 1933;101:1773–1777.
13. Goldthwait JE. The lumbosacral articulation: An explanation of many cases of "lumbago", "sciatica" and paraplegia. Boston Med Surg J 1911;164:365–372.
14. Helbig T, Lee CK. The lumbar facet syndrome. Spine 1988;13:61–64.
15. Hirsch C, Ingelmark B, Miller M. The anatomical basis for low back pain. Acta Orthop Scand 1963;33:1–17.
16. Jackson RP, Jacobs RR, Montesano PX. Facet joint injection in low-back pain-A prospective statistical study. Spine 1988;13:966–971.
17. Kleinbaum DG, Kupper LL, Muller KE. Applied Regression Analysis and Other Multivariate Methods, 2nd Edition. Boston: PWS-Kent Publishing Company, 1988:36–40.
18. Kuslich SD, Ulstrom CL, Michael CJ. The tissue origin of low back pain and sciatica: A report of pain response to tissue stimulation during operations on the lumbar spine using local anesthesia. Orthop Clin North Am 1993;22:181–187.
19. Lau LS, Littlejohn GO, Miller MH. Clinical evaluation of intra-articular injections for lumbar facet joint pain. Med J Aust 1985;143:563–565.
20. Lewinnek GE, Warfield CA. Facet joint degeneration as a cause of low back pain. Clin Orthop 1986;213:216–222.
21. Lippitt AB. The facet joint and its role in spine pain. Mangement with facet joint injections. Spine 1984;9:746–750.
22. Lynch MC, Taylor JF. Facet joint injection for low back pain. A clinical study. J Bone Joint Surg (Br) 1986;68:138–141.
23. Marks R. Distribution of pain provoked from lumbar facet joints and related structures during diagnostic spinal infiltration. Pain 1989;39:37–40.
24. Marks RC, Houston T, Thulbourne T. Facet joint injection and facet nerve block: a randomised comparison in 86 patients with chronic low back pain. Pain 1992;49:325–328.
25. McCall IW, Park WM, O'Brien JP. Induced pain referral from posterior lumbar elements in normal subjects. Spine 1979;4:441–446.
26. Mooney V, Robertson J. The facet syndrome. Clin Orthop 1976;115:149–156.
27. Moran R, O'Connell D, Walsh MG. The diagnostic value of facet joint injections. Spine 1988;13:1407–1410.
28. Murtagh FR. Computered tomography and fluoroscopy guided anesthesia and steroid injection in facet syndrome. Spine 1988;13:686–689.
29. Nash TP. Facet joints: intra-articular steroids or nerve block? The Pain Clinic 1990;3:77–82.
30. Ogsbury JS, Simon RH, Lehman RAW. Facet "denervation" in the treatment of low back syndrome. Pain 1977;3: 257–263.
31. Rashbaum RF. Radiofrequency facet denervation. A treatment alternative in refractory low back pain with or without leg pain. Orthop Clin North Am 1983;14:569–575.
32. Raymond J, Dumas J. Intraarticular facet block: diagnostic test or therapeutic procedure? Radiology 1984;151:333–336.
33. Rees WES. Multiple bilateral subcutaneous rhizolysis of segmental nerves in the treatment of the intervertebral disc syndrome. Ann Gen Pract 1971;16:126–127.
34. Revel ME, Listrat VM, Chevalier XJ, et al. Facet joint block for low back pain: identifying predictors of a good response. Arch Phys Med Rehabil 1992;73:824–828.
35. Schwarzer AC, Aprill CN, Derby R, Fortin J, Kine A, Bogduk M. The false-positive rate of uncontrolled diagnostic blocks of the lumbar zygapophysial joints. Pain (in press).
36. Schwarzer AC, Wang S, Laurent R, McNaught P, Brooks PM. The role of the zygapophysial joint in chronic low back pain. Aust NZ J Med 1992;22:185(abstract).
37. Shealy CN. Facet denervation in the management of back pain. Clin Orthop 1976;115:157–164.
38. Twomey LT, Taylor JR, Taylor MM. Unsuspected damage to lumbar zygapophyseal (facet) joints after motor-vehicle accidents. Med J Aust 1989;151:210–217.

Address reprint requests to

Anthony Schwarzer, MD
Faculty of Medicine
The University of Newcastle
University Drive
Callaghan
New South Wales 2308, Australia