MRI Analysis of the Lumbar Spine: Can It Predict Response to Diagnostic and Therapeutic Facet Procedures?

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Objectives: To determine the correlation between magnetic resonance imaging (MRI) pathology and the response to diagnostic facet medial branch block (MBB) and L5 dorsal ramus medial branch block and radiofrequency (RF) denervation of lumbar facet joints.

Methods: The medical records of 127 consecutive patients who underwent MBB for suspected zygapophysial joint pain were reviewed. The lumbar spine MRI of these patients was systematically graded by 2 musculoskeletal radiologists for loss of disc height, spinal stenosis, facet joint degeneration, and other forms of spinal pathology.

Results: Patients with central or foraminal spinal stenosis had statistically significant correlation with positive outcome of RF ($P = 0.02$), but not with MBB ($P = 0.08$). The presence of facet joint degeneration or hypertrophy was positively correlated with response to MBB (71% vs. 51%; $P = 0.04$), but not RF. Loss of disc height did not correlate with outcome of MBB ($P = 0.08$) and RF ($P = 0.29$). For other spinal pathology, no significant differences were noted for either the response to diagnostic blocks or the RF denervation. Younger patients were more likely to fail MBB ($P < 0.01$) but not RF denervation ($P = 0.38$).

Discussion: Whereas some relationships were noted between MRI findings and the response to lumbar facet joint interventions, many of these correlations tended to be weak. However, this study does suggest the possibility that patients with spinal stenosis, often considered an exclusion criterion for facet interventions, may respond to RF denervation of facet joints. Prospective studies are needed to confirm these observations.

Key Words: facet, MRI, RF denervation, spinal stenosis, zygapophysial joint

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Facet arthropathy is a common cause of chronic low back pain, accounting for between 10% to 15% of cases.[1] Numerous studies have shown that neither historical or physical examination findings,[2,3] nor radiologic zygapophysial joint (z-joint) pathology,[4–6] can reliably be used to diagnose a painful facet joint(s). It is thus widely accepted that an analgesic response to blockade of either the z-joints themselves, or more frequently the medial branches that innervate them, is the only valid method to diagnose facetogenic back pain.[1,7,8]

The relationship between the paired z-joints and intervertebral discs, which form the basic anatomic unit of the spine, is one of considerable complexity. In normal circumstances, the facet joints typically bear between 3% and 25% of the axial load.[1] Some, but not all, studies have shown that under pathologic conditions such as degenerative disc disease or facet hypertrophy, this burden increases considerably.[9,10] In a study by Fujiwara et al,[11] conducted in 14 patients with internal disc disruption, the authors found a strong correlation between the degree of disc and facet joint degeneration. No facet joint arthritis was observed in the absence of disc degeneration, and the most marked degenerative changes occurred at the spinal levels with advanced disc disease. This is consistent with a multitude of studies that show disc degeneration generally precedes, and may in fact accelerate, facet joint osteoarthritis.[12–15] Yet, in the sole clinical study that examined the association between lumbar facet joint and discogenic pain, Schwarzer et al,[16] found that only 3% of 92 patients with chronic axial low back had a positive discogram and concordant response to confirmatory lumbar facet blocks.

The relationship between spinal pathology and facet arthropathy is clinically relevant for 2 reasons. First, uncontrolled medial branch blocks are associated with a high false-positive rate, ranging between 25% and 40%.[2,3,17] As these patients are likely to have other causes of chronic axial LBP, among which internal disc disruption is probably the most common,[16] understanding the relationship between these 2 interrelated conditions can help clinicians more accurately identify the true pain generator(s). The second reason is that as several recent studies and guidelines have called into question the concept of lumbar facet joint RF denervation, clinicians are placing a greater emphasis on improving selection criteria.[6,18,19] However, no study to date has systematically examined the relationship between degenerative disc disease and related spinal pathology, and the response to diagnostic facet blocks and RF denervation. Our hypothesis was that increased spinal pathology and in particular decreased disc height might increase forces on lumbar facet joints leading to chronic pain originating from these joints. Therefore, the purpose of this study was to analyze the association between radiologic spinal pathology and the response to facet joint nerve blocks and RF denervation.

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PATIENTS AND METHODS

After permission was granted to conduct this study from the Internal Review Board at Massachusetts General Hospital, the medical records of 127 consecutive patients who underwent diagnostic lumbar facet medial branch blocks for suspected z-joint pain were reviewed. Six were excluded because of ambiguous records or missing data, leaving 121 patients eligible for inclusion.

Lumbar Medial Branch and L5 Dorsal Ramus Blocks

Selection criteria for diagnostic facet blocks were age ≥ 18 years, paraspinal tenderness, and chronic LBP > 3 months duration unresponsive to conservative therapy. Excluded from the study were patients with an untreated coagulopathy, the presence of focal neurologic signs and symptoms, and any unstable medical or psychiatric condition that might preclude an optimal response to treatment. Diagnostic medial branch block (MBB) was performed according to previously described techniques using an oblique angle for needle insertion.[6,7,20] The laterality and number of levels blocked performed varied according to symptoms. Patients with a positive response to the first block underwent confirmatory MBB at the discretion of the attending physician. Before the needle placement, the skin at each entry point was anesthetized by using a small amount of lidocaine (1%). Correct needle placement was confirmed in all cases by using antero-posterior fluoroscopic views. At each level, 0.5 mL of lidocaine 1% (or bupivacaine 0.5%) was injected. No patient received intravenous sedation.

Before the block, patients were instructed about the need to engage in their normal daily activities and maintain a written pain diary every 30 minutes for 8 hours. In addition to 0 to 10 numerical rating scale (NRS) pain scores, diaries were used to monitor postblock activities. The percent pain relief was calculated based on pain diaries. To control for the presence of other spinal pathology, $\geq 50\%$ pain relief during normal activities was used as the criterion for a positive response. To identify an "enriched" index group with a higher level of suspicion for facetogenic pain, patients who obtained $\geq 80\%$ concordant pain relief after 2 MBB carried out on different visits were subcategorized. The minimum duration of pain relief necessary for a block to be deemed positive was 1 hour for lidocaine and 3 hours for bupivacaine.

RF Denervation

RF denervation was performed as an ambulatory procedure using superficial local anesthesia. No intravenous sedation was used.[6,20–22] The C-arm image intensifier was positioned to confer an oblique, caudad-cephalad view. Twenty-two gauge SMK-C10 (Radionics, Burlington, MA) cannulas with 10-mm active tips were inserted parallel to the course of the nerve(s) until bone was contacted along the inferior lateral neck of superior articular process for all medial branch lesions, and at the junction of the ala and articular process of the sacrum for all L5 dorsal ramus lesions. For each lesion, correct placement was confirmed using electrostimulation at 50 Hz, with concordant sensation achieved at ≤ 0.5 V. Before lesioning, multifidus stimulation and the absence of leg contractions was verified with electrostimulation at 2 Hz. After satisfactory electrode placement, 0.5 mL of lidocaine 1% was injected to reduce thermal pain. The RF probe was then reinserted and a 90 second, 80°C lesion was made using an RF generator (Electrothermal 20S Spine System, Smith and Nephew, Andover, MA or Radionics RF Lesion Generator System, Model RFG-3C, Radionics, Valleylab, Boulder, CO).

Grading of Spinal Pathology

Lumbar spine pathology was graded by 2 musculoskeletal radiologists. They reviewed the MRIs independently and were blinded to the patient treatment and outcomes. Loss of disc height was graded for each disc on a 1 to 5 point scale designated as follows: 1 = absence of degenerative changes (normal disc height); 2 = 1% to 33% loss of disc height; 3 = 34% to 66% loss of disc height; 4 = 67% to 99% loss of disc height; 5 = 100% loss of disc height (ie, bone on bone). Diminution in height was then categorized as "mild", "moderate" or "severe" based on the cumulative score for all relevant levels. For 3-level facet blocks, a 0 to 5 cumulative score was coded as "mild", 6 to 10 as "moderate", and 11 to 15 as "severe". For 4-level facet blocks, 0 to 7 was coded as "mild," 8 to 14 as "moderate," and 15 to 20 as "severe."

The category "alignment deformity" consisted of scoliosis, kyphosis, lordosis, and spondylolisthesis. Scoliosis, kyphosis and lordosis were classically defined as any abnormal curvature of the lumbar spine having a structural (ie, nonfunctional) basis. Spondylolisthesis was categorized as "positive" if there were any anterior or posterior slippage of one vertebral body in relation to an adjacent vertebra. An annular tear was defined as a focal hyperintensity of the annulus on a T2-weight spin-echo image, or a gadolinium-enhanced T1 spin-echo image, without a focal protrusion or extrusion.[23] The designation of a disc as "bulging", "protruding", or "herniated" was based on the classification scheme introduced by Jensen et al.[24] Bulging was predefined as a circumferential extension of the discs beyond the endplates. A disc was considered "protruded" if there was focal or asymmetric extension beyond the endplates, with the base of the protrusion being broader than any other dimension. A herniated (and extruded) disc was defined as a focal protrusion past the endplates, either without the connection to the parent disc, or with the base of the protrusion narrower than the diameter of the protruded part. For practical reasons, "herniated" and "extruded" discs were categorized together.

Facet joint pathology was classified as "degenerated", "hypertrophied", or "both" based on validated grading systems for facet joint osteoarthritis.[25,26] The designation of a joint as "degenerated" required either narrowing of the facet joint space to < 2 mm,[27] or the presence of osteophytes, subarticular bone erosion, or subchondral cysts. Classification as "hypertrophied" required radiologic evidence of hypertrophy of the articular processes.

In the absence of a standardized grading system, the degree of spinal stenosis is typically rated as "none", "mild", "moderate", or "severe" by radiologists. For the purposes of data analysis, the latter 3 depictions were categorized as "positive", whereas normal or near-normal spinal canal dimensions were classified as "negative". Central spinal stenosis was considered to be present with narrowing of the spinal canal to a diameter of < 12 mm; foraminal stenosis was defined as a significant decrease in the size of the foramen secondary to either hypertrophied z-joints or intervertebral disc pathology. Categorization was carried out solely based on radiologic imaging, without regard for patient symptomatology.

Outcome Measures

All post-MBB and post-RF denervation pain scores were measured using 0 to 10 NRS pain scales. An MBB was considered positive if it resulted in ≥50% pain relief concordant with the duration of action of local anesthetic. A successful RF treatment was defined as a ≥50% average reduction in preprocedure NRS pain score that persisted for at least 3 months after the procedure. In addition to treatment outcome and spinal pathology, the other demographic and clinical variables recorded for analysis were age, sex, duration of pain, opioid usage, location of symptoms, previous spine surgery, and the number of treatment levels.

Statistical Analysis

Statistical analyses were performed using Prism Graph version 5 (GraphPad Software, San Diego, CA). The distribution of categorical variables in each group was compared using the Fisher exact test for parametric data. Categorical data are reported by number of patients. Contingency tables were organized in six 2×2 blocks to evaluate the influence of loss of disc height, disc protrusion(s), annular tears, spinal stenosis, alignment abnormalities, and radiologic facet pathology had on the response to diagnostic MBB and RF denervation outcomes. A Student *t* test was used to compute the significance of age (continuous variables) in patients who underwent negative MBB and those who had positive MBB. An 1-way analysis of variance test was used to compute the significance of age among patients who underwent negative MBB, those who had positive RF, and those who had negative RF. A Fisher exact test was used to calculate the significance of sex in the above 3 groups. A "*P*" value of <0.05 was considered statistically significant.

RESULTS

One hundred and twenty-seven patients were identified who underwent facet interventions between 2002 and 2005, among whom 119 met all inclusion criteria. The 2 reasons for exclusion were inadequate outcome data and ambiguous results from the diagnostic blocks. The mean age of the study participants was 52.9 (standard deviation 16.5), with 52% of the patients being male.

Forty-two patients obtained a negative response to diagnostic MBB, predefined as less than 50% pain relief. Among the 77 patients who had a positive block(s), 28 obtained a positive result from RF denervation, 32 experienced a negative outcome, and 17 either obtained long-term pain relief from MBB, failed to undergo RF denervation, or did not have clearly recorded outcome from RF lesioning. No significant differences were noted when the response to MBB or RF denervation was stratified by sex, but younger patients were more likely to have a negative MBB ($P<0.01$) (Tables 1–3).

Sixty of the 77 patients with a positive initial MBB underwent confirmatory blocks. Among the 77 patients who had at least 1 positive MBB, 31% (n = 24) experienced ≥80% pain relief following both blocks, forming the "high index" group. In this enriched subset of patients, 8 of 17(47%) obtained a positive response to RF denervation, which was equivalent to the percentage of patients in the overall cohort who experienced a successful facet rhizotomy outcome; $P=1.00$).

TABLE 1. Results of Facet Interventions Stratified by Demographic and Clinical Data

	Negative Medial Branch Block (n = 42)	Positive Radiofrequency Denervation (n = 28)	Negative Radiofrequency Denervation (n = 32)	*P*
Age (years) (SD)	48.5 (15.7)	59.3 (16)	55.8 (14.4)	0.03
Sex				0.82
Male	22 (42%)	15 (28%)	16 (30%)	
Female	20 (41%)	13 (27%)	16 (33%)	

Fifty-one percent of patients were identified as having some form of spinal stenosis. Patients with spinal stenosis showed statistically significant correlation with positive outcome of RF denervation (58% vs. 21% without stenosis, $P=0.02$). However, those same patients were neither more likely experience a positive response to MBB (73% vs. 58% without stenosis, $P=0.08$), nor a confirmatory MBB (20% vs. 26%, $P=1.00$).

With regard to disc pathology, slightly more patients with moderate or severe loss of disc height experienced a positive diagnostic MBB than those with no or mild degeneration (70% vs. 58%), although this difference failed to reach statistical significance ($P=0.25$) with same applying to confirmatory MBB (28% vs. 16%, $P=0.08$). Similar results were found in patients who underwent RF denervation (51% vs. 34%, $P=0.29$). For the presence of alignment deformities (ie, kyphosis, exaggerated lordosis, or spondylolisthesis), annular tears, and disc protrusions, no significant differences were noted between either response to diagnostic z-joint blocks and RF denervation.

Statistically significant differences were found between radiologic facet joint pathology and the response to diagnostic blocks, but not denervation outcomes. Collectively, patients with either z-joint degeneration or hypertrophy were more likely to obtain significant relief after diagnostic MBB than those with morphologically normal facet joints [71% (57/80) vs. 51%, $P=0.04$]. However, these relationship was neither noted among patients in the enriched "high-index group", nor were patients with radiologic evidence of facet joint degeneration any more likely to experience a positive outcome than those without imaging pathology.

DISCUSSION

One of the major obstacles facing physicians is the lack of adequate diagnostic tests geared to identify potential pain generator(s) in patients with low back pain. This can result in misdiagnosis and unnecessary visits to physicians of various specialties, which in turn can lead to increased patient suffering, worsening disability, missed work-days, and increased utilization of expensive medical resources.

The lumbar z-joints are a common source of low back pain,[2] but it can be extremely difficult to diagnose painful facet joints using historical, physical examination, and radiologic imaging findings.[4–6] In this study, we postulated that degenerative pathologic changes in adjacent structures might produce increased strain on the facet joints, thereby rendering them nociceptive. We sought to test this

TABLE 2. Results of Facet Interventions Stratified by Spinal Pathology*

	Negative Diagnostic Medial Branch Block (n = 42)*	Positive Response to at Least a Single Medial Branch Block (n = 77)*†	*P*‡	High-index Facetogenic Pain Group (n = 24)*§	*P*∥
Loss of disc height¶			0.25		0.08
None or mild	22 (42%)	31 (58%)		7 (16%)	
Moderate	17 (27%)	36 (63%)		13 (27%)	
Severe	3 (23%)	10 (77%)		4 (33%)	
Disc Protrusion/hernation			0.66		1.00
0-1 Disc	12 (40%)	18 (60%)		7 (24%)	
≥ 2 Discs	30 (34%)	57 (66%)		16 (22%)	
Annular tear			0.79		0.53
No	34 (34%)	66 (66%)		18 (21%)	
Yes	7 (39%)	11 (61%)		6 (35%)	
Stenosis			0.08		1.00
None	24 (42%)	33 (58%)		14 (26%)	
Central	1 (8%)	12 (92%)		2 (18%)	
Foraminal	13 (43%)	17 (57%)		5 (20%)	
Both	2 (12%)	15 (88%)		3 (23%)	
Alignment deformity			0.52		0.40
None	27 (33%)	54 (67%)		19 (27%)	
Yes	14 (41%)	20 (59%)		5 (18%)	
Facet joint pathology#			0.04		1.00
None	19 (49%)	20 (51%)		11 (32%)	
Degeneration	10 (23%)	34 (77%)		3 (8%)	
Hypertrophy	14 (36%)	25 (64%)		11 (33%)	

*Spinal pathology refers only to those levels where facet blocks were carried out. The following data was not available for analysis in the negative MBB group: annular tear (n = 1), stenosis (n = 2), alignment deformity (n = 1); in the single positive MBB group: disc protrusion (n = 2), alignment deformity (n = 3); in the confirmatory MBB group: disc protrusion (n = 1).

†Data represent the number of patients who experienced positive responses to at least a single medial branch block carried out with lidocaine (> 50% pain relief). It includes patients with positive responses to 2 medial branch blocks (> 80% pain relief from both blocks).

‡The *P* values in this column reflect 2 × 2 tables categorizing patients with negative or positive single MBB by the presence or absence of pathology (ie, for disc height, none or mild vs. moderate or severe).

§The high index group is comprised of patients who obtained ≥ 80% pain relief after 2 MBB. The denominator used to calculate the percentage excluded patients who obtained ≥ 80% relief after their first block but did not undergo a second MBB.

∥The *P* values in this column reflect 2 × 2 tables categorizing patients with negative or positive confirmatory MBB by the presence or absence of pathology (ie, for disc height, none or mild vs. moderate or severe).

¶For disc height, each disc was graded on a 0 to 5 scale.

#One patient each in the negative and confirmatory block groups, and 2 patients in the ≥ 1 positive MBB group, had both degeneration and hypertrophy of the facet joints.

hypothesis by correlating MRI findings with the results of diagnostic facet blocks and RF denervation. As diagnostic facet blocks are fallible,[17,28] and RF denervation is an expensive, time consuming endeavor associated with rare but significant complications,[29,30] attempting to identify those patients most likely to respond to treatment is a valuable undertaking.

The principal finding from this study is that patients with spinal stenosis are more likely to positively benefit from RF denervation of the affected facet joints. There is a trend ($P > 0.05$ but < 0.20 would be considered a "trend" toward significant effect) between spinal stenosis and positive MBB ($P = 0.08$), however, this retrospective study may not have been adequately powered to detect a significant correlation between those 2 variables and large prospective studies may better address this issue. Although facet joint hypertrophy may contribute to spinal stenosis, whether the converse is true has not been well studied. A study by Chung et al,[31] conducted in 20 volunteers, found that motions that reduced the spinal canal diameter (eg, extension or rotation) increased the thickness of the ligamentum flavum, which was incorporated into the internal facet joint capsule. Further evidence supporting a relationship between facet arthropathy and spinal stenosis comes from a clinical correlation study conducted in 40 lumbar spine surgery patients that sought to establish whether inflammatory cytokines released from facet joint tissue might contribute to the neurologic symptoms in lumbar disc herniation and spinal stenosis.[32] The authors found a higher rate of all measured inflammatory cytokines (tumor necrosis factor-α, interleukin 1-β, and interleukin 6) in the spinal stenosis patients compared with the disc herniation group, with the difference being most pronounced for interleukin 1-β. The authors postulated that inflammatory cytokines that leak out through the ventral capsule in patients with degenerative facet joints might contribute to pain production in spinal stenosis.

Our hypothesis that patients with diminished disc height might be more inclined to benefit from facet joint interventions was not borne out in statistical analysis. However, a trend was observed whereby patients with increased loss of disc height were more likely to respond to both diagnostic facet blocks but not RF denervation. It is therefore possible that with a larger sample size, a statistically meaningful relationship between intervertebral disc degeneration and facetogenic pain might be demonstrated. Cadaveric and radiologic studies have demonstrated a strong association between degenerative disc disease, and increased z-joint strain and accelerated degeneration.[9–11]

TABLE 3. Results of Radiofrequency Denervation Stratified by Spinal Pathology*

	Negative Radiofrequency Denervation (n = 32)	Positive Radiofrequency Denervation (n = 28)	*P*†
Loss of disc height‡			0.29
None mild	14 (64%)	8 (34%)	
Moderate	16 (55%)	13 (45%)	
Severe	2 (25%)	6 (75%)	
Disc protrusion			0.51
0-1 disc	5 (45%)	6 (55%)	
≥ 2 discs	26 (58%)	19 (42%)	
Annular tear			0.40
No	30 (57%)	23 (43%)	
Yes	2 (33%)	4 (67%)	
Stenosis			0.02
None	15 (79%)	4 (21%)	
Central	4 (33%)	8 (67%)	
Foraminal	5 (50%)	5 (50%)	
Both	8 (42%)	11 (58%)	
Alignment deformity			
None	20 (48%)	22 (52%)	0.24
Yes	11 (69%)	5 (31%)	
Facet joint pathology§			0.78
None	9 (53%)	8 (47%)	
Degeneration	10 (43%)	13 (57%)	
Hypertrophy	10 (50%)	11 (50%)	

*Spinal pathology refers only to those levels where facet blocks were carried out. The following data was not available for analysis in the negative RF group: disc protrusion (n = 1), alignment deformity (n = 1), facet pathology (n = 3); in the positive RF group: disc height (n = 1), disc protrusion (n = 3), annular tear (n = 1), alignment deformity (n = 1).

†For all analyses, the *P* values reflect 2 × 2 tables categorizing patients with negative or positive RF denervation (as defined by > 50% pain relief for at least 3 mo) by the presence or absence of pathology.

‡Each disc was graded on a 0 to 5 scale.

§Four patients in the positive RF group had both degeneration and hypertrophy of facet joints.

One noteworthy finding is that patients who obtained ≥ 80% pain relief after 2 MBB did not fare better with RF lesioning than those who proceeded to denervation by way of less rigorous inclusion criteria. These findings are consistent with 2 studies which found that elevating the cutoff for designating a diagnostic MBB as positive from 50% to 80% was not associated with improved outcomes.[19,33] In converse, studies that used confirmatory blocks as part of their selection criteria have tended to report better outcomes than those conducted with uncontrolled blocks.[18,34,35] Clearly, large-scale prospective studies are needed to ascertain the optimal screening paradigm for selecting candidates for z-joint RF denervation.

Axial low back pain is a notoriously challenging condition to treat, being less responsive to surgical, injection, and pharmacologic therapy than neuropathic back pain.[36,37] One exception to this maxim is z-joint pain, for which most,[18,38,39] but not all [40,41] studies have demonstrated intermediate-term relief after facet joint RF denervation. Patients with significant spinal stenosis on MRI may be categorically excluded from facet joint interventions by virtue of their underlying condition. Among the published controlled trials evaluating lumbar z-joint RF denervation, all either explicitly or by inference (ie, excluding patients with pain extending below the knee or neurologic symptoms) excluded patients with narrowing of the spinal canal. Yet, the results of this study demonstrate that patients with MRI evidence of spinal stenosis can benefit from treatment of the facetogenic component of their pain.

When stratified by age, younger patients were more likely to fail both MBB and RF denervation. As spinal stenosis is more likely to occur in older than younger patients, this demographic variation may be partially attributable to other factors.

A final point in need of context is that radiologic evidence of facet arthropathy was associated with a positive response to MBB in the larger cohort, but not in the "high-index" group or among patients who proceeded to RF denervation. In previous studies that sought to identify the relationship between radiologic findings and response to facet joint blocks, approximately half found a positive correlation.[1] Several possible explanations exist for this paradox, including a higher false-positive rate in this population, and a reduced success rate to denervation secondary to concomitant pain generators. Whether or not patients with pathologic facet joints should therefore be subject to different screening procedures is a question only large scale, prospective studies can answer.

The inherent flaws in our study warrant that our results be interpreted with caution. These limitations include the retrospective design, multiple variables evaluated, the fact that only some of our patients underwent double-confirmatory blocks, and the relatively small sample size.

In conclusion, the results of this study suggest possible correlations between lumbar facetogenic pain, and MRI abnormalities and spinal stenosis. This study does suggest the possibility that patients with spinal stenosis, often considered an exclusion criterion for facet interventions, may respond to RF denervation of facet joints. Future prospective studies might shed more light on these associations, and help to better refine the selection criteria.

REFERENCES

1. Cohen SP, Raja SN. Pathogenesis, diagnosis, and treatment of lumbar zygapophysial (facet) joint pain. *Anesthesiology*. 2007; 106:591–614.
2. Manchikanti L, Pampati V, Fellows B, et al. Prevalence of lumbar facet joint pain in chronic low back pain. *Pain Physician*. 1999;2:59–64.
3. Schwarzer AC, Wang SC, Bogduk N, et al. Prevalence and clinical features of lumbar zygapophysial joint pain: a study in an Australian population with chronic low back pain. *Ann Rheum Dis*. 1995;54:100–106.
4. Jackson RP, Jacobs RR, Montesano PX. Facet joint injection in low-back pain. A prospective statistical study. *Spine*. 1988;13:966–971.
5. Schwarzer AC, Wang SC, O'Driscoll D, et al. The ability of computed tomography to identify a painful zygapophsial joint in patients with chronic low back pain. *Spine*. 1995;20: 907–912.
6. Cohen SP, Hurley RW, Christo PJ, et al. Clinical predictors of success and failure for lumbar facet radiofrequency denervation. *Clin J Pain*. 2007;23:45–52.
7. Bogduk N. International Spinal Injection Society guidelines for the performance of spinal injection procedures. Part I: zygapophysial joint blocks. *Clin J Pain*. 1997;13:285–302.
8. Dreyfuss PH, Dreyer SJ. Lumbar zygapophysial joint (facet) injections. *Spine J*. 2003;3:50S–59S.
9. Yang KH, King AI. Mechanism of facet load transmission as a hypothesis for low-back pain. *Spine*. 1984;9:557–565.
10. Adams MA, Hutton WC. The effect of posture on the role of the apophysial joints in resisting intervertebral compressive forces. *J Bone Joint Surg (Br)*. 1980;62:358–362.
11. Fujiwara A, Tamai K, Yamato M, et al. The relationship between facet joint osteoarthritis and disc degeneration of the lumbar spine: an MRI study. *Eur Spine J*. 1999;8:396–401.
12. Butler D, Trafimow JH, Andersson GB, et al. Discs degenerate before facets. *Spine*. 1990;15:111–113.
13. Gotfried Y, Bradford DS, Oegema TR. Facet joint changes after chemonucleolysis-induced disc space narrowing. *Spine*. 1986;11:944–950.
14. Oegema TR, Bradford DS. The inter-relationship of facet joint osteoarthritis and degenerative disc disease. *Br J Rheumatol*. 1990;30(Suppl 1):16–20.
15. Vernon-Roberts B, Pirie CJ. Degenerative changes in the intervertebral discs of the lumbar spine and their sequelae. *Rheumatol Rehabil*. 1977;16:13–21.
16. Schwarzer AC, Aprill CN, Derby R, et al. The relative contributions of the disc and zygapophyseal joint in chronic low back pain. *Spine*. 1994;19:801–806.
17. Schwarzer AC, Aprill CN, Derby R, et al. The false-positive rate of uncontrolled diagnostic blocks of the lumbar zygapophysial joints. *Pain*. 1994;58:195–200.
18. Nath S, Nath CA, Pettersson K. Percutaneous lumbar zygapophysial (Facet) joint neurotomy using radiofrequency current, in the management of chronic low back pain: a randomized double-blind trial. *Spine*. 2008;33:1291–1297.
19. Cohen SP, Bajwa ZH, Kraemer JJ, et al. Factors predicting success and failure for cervical facet radiofrequency denervation: a multi-center analysis. *Reg Anesth Pain Med*. 2007; 32:495–503.
20. Cohen SP, Larkin TM, Chang A, et al. The causes of false-positive medial branch (facet joint) blocks in soldiers and retirees. *Mil Med*. 2004;169:781–786.
21. Hooten WM, Martin DP, Huntoon MP. Radiofrequency neurotomy for low back pain: evidence-based procedural guidelines. *Pain Med*. 2005;6:129–138.
22. Guerts JW, Van Wijk RM, Stolker RJ, et al. Efficacy of radiofrequency procedures for the treatment of spinal pain: a systematic review of randomized clinical trials. *Reg Anesth Pain Med*. 2001;26:394–400.
23. Stadnik TW, Lee RR, Coen HL, et al. Annular tears and disk herniation: prevalence and contrast enhancement on MR images in the absence of low back pain or sciatica. *Radiology*. 1998;206:49–55.
24. Jensen MC, Brant-Zawadzki MN, Obuchowski N, et al. Magnetic resonance imaging of the lumbar spine in people without back pain. *N Engl J Med*. 1994;331:69–73.
25. Pathria M, Sartoris DJ, Resnick D. Osteoarthritis of the facet joints: accuracy of oblique radiographic assessment. *Radiology*. 1987;164:227–230.
26. Weishaupt D, Zanetti M, Boos N, et al. MR imaging and CT in osteoarthritis of the lumbar facet joints. *Skeletal Radiol*. 1999;28:215–219.
27. Haughton V. Imaging techniques in intraspinal diseases. In: Resnick D, ed. *Diagnosis of Bone and Joint Disorders*. Philadelphia: Saunders; 1995:237–276.
28. Manchikanti L, Pampati V, Fellows B, et al. The diagnostic validity and therapeutic value of lumbar facet joint nerve blocks with or without adjuvant agents. *Curr Rev Pain*. 2000; 4:337–344.
29. Alcock E, Regaard A, Browne J. Facet joint injection: a rare form of epidural abscess formation. *Pain*. 2003;103:209–210.
30. Orpen NM, Birch NC. Delayed presentation of septic arthritis of a lumbar facet joint after diagnostic facet joint injection. *J Spinal Disord Tech*. 2003;16:285–287.
31. Chung SS, Lee CS, Kim SH, et al. Effect of low back posture on the morphology of the spinal canal. *Skeletal Radiol*. 2000;29:217–223.
32. Igarashi A, Kikuchi S, Konno S. Correlation between inflammatory cytokines released from the lumbar facet joint tissue and symptoms in degenerative lumbar spinal disorders. *J Orthop Sci*. 2007;12:154–160.
33. Cohen SP, Stojanovic MP, Crooks M, et al. Lumbar zygapophysial (facet) joint radiofrequency denervation success as a function of pain relief during diagnostic medial branch blocks: a multi-center analysis. *Spine J*. 2008;8:498–504.
34. Lord SM, Barnsley L, Wallis BJ, et al. Percutaneous radio-frequeny neurotomy for chronic cervical zygapophyseal-joint pain. *N Engl J Med*. 1996;335:1721–1726.
35. Dreyfuss P, Halbrook B, Pauza K, et al. Efficacy and validity of radiofrequency neurotomy for chronic lumbar zygapophysial joint pain. *Spine*. 2000;25:1270–1277.
36. Cohen SP, Argoff CE, Carragee EJ. Management of low back pain. *BMJ*. 2008;337:a2718.
37. Deyo RA, Nachemson A, Mirza SK. Spinal-fusion surgery-the case for restraint. *N Engl J Med*. 2004;350:722–726.
38. van Kleef M, Barendse GA, Kessels A, et al. Randomized trial of radiofrequency lumbar facet denervation for chronic low back pain. *Spine*. 1999;24:1937–1942.
39. Gallagher J, Petriccione di Vadi PL, Wedley JR, et al. Radiofrequency facet joint denervation in the treatment of low back pain: a prospective controlled double-blind study to assess its efficacy. *Pain Clinic*. 1994;7:193–198.
40. Leclaire R, Fortin L, Lambert R, et al. Radiofrequency facet joint denervation in the treatment of low back pain. A placebo-controlled clinical trial to assess efficacy. *Spine*. 2001;26: 1411–1417.
41. van Wijk RM, Geurts JW, Wynne HJ, et al. Radiofrequency denervation of lumbar facet joints in the treatment of chronic low back pain: a randomized, double-blind, sham lesion-controlled trial. *Clin J Pain*. 2005;21:335–344.