

SCIENTIFIC NEWSLETTER - 1994 *Selected Articles*

TABLE OF CONTENTS

- [The Target Specificity of Lumbar Medial Branch Nerve Blocks](#)
- [Communications from the Members - Discography Appeal](#)
- [The Roles of the Zygapophysial Joint and Intervertebral Disc in Chronic Low Back Pain: Results of a MultiCenter Study](#)
- [Sacroiliac Joint Syndrome: The Diagnostic Value of Single Photon Emission Computed Tomography](#)

This article is an ISIS sponsored research project.

THE TARGET SPECIFICITY OF LUMBAR MEDIAL BRANCH NERVE BLOCKS

P. Dreyfuss 1, A.C. Schwarzer 2, P. Lau 3, N. Bogduk 2

1: The NeuroSkeletal Center, 816 S. fleishel, Tyler, Texas 75701;

2: Faculty of Medicine, The University of Newcastle, NSW, 2308, Australia;

3: Hunter Valley X-Ray, Newcastle, NSW, 2308, Australia.

Objective: The objective of this study was to determine the target specificity of blocks of the lumbar medial Branches of the dorsal ramus.

Summary of Background Data: Blocks of the medial Branches of the dorsal ramus, at two levels, constitute a means by which putatively painful zygapophysial (z) joints may be anesthetised. They have been regarded as diagnostically equivalent to intraarticular z-joint injections. However, their target specificity has not been formally addressed. A fundamental concern is whether or not these blocks anesthetise the medial branch nerves exclusively or whether they also anesthetise other potentially painful structures.

Methods: In the first phase of the study, a 25 gauge needle was placed over the medial Branches of the L4 and L5 dorsal rami at each of three positions in a cadaveric specimen dissected to expose the medial branches of the dorsal ramus. Position 1 was on the superior border of the subjacent transverse process for the L4 medial branch and at the superior junction of the sacral ala and the superior articular process of S1 for L5. Position 2 was at the level of the mamillo-accessory ligament and position 3 was at the midpoint between these 2 positions. Corresponding anteroposterior and oblique radiographs were obtained. Using these three reference target positions fifteen asymptomatic volunteers (10F, 5 M), age 31 (+- 5.4) years (mean +- SD) were recruited for the second phase of the study. Each subject underwent bilateral injections of 0.5 cc of radiographic contrast over the L2-5 medial branches under fluoroscopic guidance using a cephalo-caudad and lateral to medial needle approach. For L2 medial branch blocks the needles were placed at position 1. For L5 medial branch blocks the needle was placed between position 1 and 3 in ten subjects and at position 3 in five subjects. Blocks for L3 and L4 medial branches were performed at position

3. All right-sided injections were performed over a period of 30 seconds. In 5 subjects all left sided injections were performed over 60 seconds, in another 5 subjects over 5 seconds and in a further 5 subjects over 1 second. Final bevel position was not consistently controlled. Plain radiographs using anteroposterior, oblique and lateral views were taken following all injections. All subjects underwent a post-injection CT scan from L2 to S1 using 4 mm cuts with a 1 mm overlap. Soft tissue and bone windows were used; angled cuts were used for L4 and L5 levels. Tracings of the distribution of radiographic contrast were obtained from plain films. CT scans were read by a radiologist and a spine physician, both blinded, to assess the presence and extent of spread of the contrast medium.

Results: A total of 120 injections of contrast medium was performed. Contrast medium incorporated the medial branch of the dorsal ramus in all injections. There was some spread of contrast into the epidural space or the intervertebral foramina following 18 injections (11 epidural and 7 foraminal). The spread of contrast medium was independent of the speed of injection. The most frequent site of epidural/foraminal spread was L2 in 8/30 or 27% followed by L5 in 6/30 or 20%. Using a position low on the transverse process as in L3 and L4, few, that is, 4/60 or 7% resulted in epidural or foraminal spread. For L5 medial branch blocks when the needle was inadvertently placed slightly higher than between position 1 and 3 as determined by independent review there was contrast now through the L5-S1 foramina. With the needle placed at position 3 there was a substantial occurrence (3 of 5 subjects) of contrast spread through the S1 foramina. The proportion of epidural/foraminal spread was minimal compared to the proportion of dorsal compartment spread following injections over the L3-L5 medial branches. In 8% of the injections there was venous uptake seen with contrast injection despite aspiration being negative.

In those medial branch blocks in which there was epidural or transforaminal spread as outlined, the injections were repeated in the same subjects and at the same levels where abnormal spread occurred. All four L3 and L4 medial branch blocks, in which there was epidural spread were repeated. Needles were precisely placed in position 3 with the bevel facing medially and inferiorly. Each injection again consisted of 0.5 cc of radiographic contrast given over 30 secs. Net epidural or transforaminal spread of contrast medium occurred. Four out of 6 of the L5 medial branch blocks were repeated. One subject in which there was bilateral abnormal spread could not be located. The needles were placed between positions

1 and 3 using a direct needle approach as opposed to a cephalad to caudad and lateral to medial needle approach. The needles were placed with the bevel facing medially. Again, there was no epidural or foraminal spread seen on CT. However, in two injections there was spread of radiographic contrast anteriorly, with a proportionately minimal amount reaching, but not encompassing the ventral ramus.

Conclusions: Using correct needle positions, injected contrast medium consistently incorporates the medial branch of the dorsal ramus. The position of the needle is critical for the target specificity of a block of the medial branch. A needle placed high on the transverse process or in the proximal/superior portion of the nerve may be associated with epidural or foraminal spread. However, when such spread of contrast medium to the epidural/foraminal space occurs it represents a small proportion of the overall volume used for the block. When the needle is positioned midway along the course of the medial branch nerve for L3 and 4 medial branch blocks (position 3) such spread occurs uncommonly. When the needle is placed between positions 1 and 3 for L5 medial branch blocks epidural/foraminal spread occurs less commonly than injections at position 3. The rate of injection has no bearing on the extent of spread of contrast medium. In those injections where there was initially epidural or transforaminal spread of contrast medium, repositioning the needle to absolute precise determined locations, accounting for bevel position, and modifying the needle approach for L5 medial branch blocks eliminated such spread of contrast medium.

Final recommendations for needle placement include position 3 for L1-4 medial branch blocks using a cephalad to caudad and lateral to medial needle approach. The bevel should face medial and inferior. For L5 medial branch blocks, a direct or slight cephalad to caudad and medial approach should be used with final needle placement between position 1 and 3 with the bevel facing medially. A small amount of contrast should be injected prior to anesthetic to assure venous uptake does not occur and injectant spread is appropriate.



Communications from the Members

DISCOGRAPHY APPEAL

Mike Karasek, MD
Neurology Disorders of the Spine

The enclosed article is a recent review of discography that I submitted to the State of Oregon Department of Insurance and Finance. This is part of an appeal that was necessary when the largest workers compensation managed care organization determined that no discography of any kind should be allowed. This was based on their contention that outcome studies do not show the value of fusion based upon discographic data, and the fact that discography is "controversial" and "not universally accepted".

I would like to emphasize that readers should understand the target audience of this appeal i.e., the medical director of state bureaucracy. Because of the need to maintain clarity, I purposely simplified some of the conclusions regarding the evaluation of back care patients. As we all know, the decision-making process in complicated spine patients requires a perception of nuance and a synthesis of, at times, contradictory literature.

Therefore, after first stating this disclaimer, I offer this review and hope that the readers of the ISIS Newsletter will find it useful.

Mike

October 5, 1994

DISCOGRAPHY APPEAL

PATHOLOGY OF LUMBAR PAIN POST-INJURY

It is currently accepted that the most common cause of persistent low back pain following injury is a painful lumbar disc. There is broad agreement that beyond 3-4 months, "lumbar strain" with musculoskeletal pain is not a viable diagnosis. Disc herniation with nerve root irritation, although a well-accepted cause of persistent low back and leg pain, is felt to be present in a relatively low number of patients with back injury. Bogduk and others have indicated that "the cardinal

lesion that renders the lumbar disc painful is internal disc disruption. (1,21, 22, 23) In this condition, the pathology is restricted to the inside of the disc. The external contour of the disc remains essentially normal and no changes are evident on CT. Although changes may be seen on the MRI scan, there is abundant literature to indicate that this is not always the case. In a prospective, multicenter CT/discography study, Vanharanta, et al. (24) found that "intradiscal pathology plays a major role in nonspecific low back pain syndromes". In a prospective study of 300 patients with over 800 discograms, they clearly demonstrated a high correlation between ultimate surgical diagnosis and discography findings. Their findings: "The study supports that intradiscal pathology is a major factor in nonspecific Low back disorders such as lumbar syndrome, lumbar radicular syndrome and degenerative disc."

"Disc lesions often are suspected to be the source of low back pain. However, standard diagnostic procedures are often used to identify protruded disc and intradiscal lesions are ignored, even though they have been found to correlate with discographic pain reproduction. Computer tomography/discography provides a method by which to detect these potentially painful disc lesions."

The etiology of internal disc disruption is conjectural, but the most widely accepted view is that intervertebral endplate failure is followed by inflammation of the nuclear material which is immunologically reactive. What ensues is gradual degradation of the nucleus, followed by degradation of the inner annulus. As degradation of the inner portion of the disc occurs, there is gradual increase in stress to the outer annulus. The outer annulus then may develop mechanical-type pain due to stress and chemical pain if fissures occur with exposure of the annulus to nuclear material. It should again be emphasized that most painful disc conditions are not associated with painful herniation and nerve root compression. (1, 24) When the painful annular fissure completely erodes the annulus, the stage is set for disc prolapse and disc herniation with nerve root irritation may occur. This model stipulates that disc herniation does not occur or is quite rare in normal disc but rather occurs only in discs that are undergoing some degree of degradation.

A disc in which internal disc disruption is confined to the nucleus pulposus or inner half of the annulus is probably not symptomatic. During this early phase of disc disruption, the outer annulus is sufficiently intact to serve mechanical

functions of the disc.

However, as a fissure reaches the middle or outer third of the annulus, it does encounter nerve endings and chemical nociception and mechanical nociception may then occur. Therefore, internal disc disruption should cause constant deep, aching pain which is present due to chemical nociception, with aggravation by movement due to mechanical nociception. At this phase of disc deterioration, however, conspicuously lacking would be neurological signs, since little or no compression or nerve root dysfunction is seen. The greater the erosion of the annulus, the greater the likelihood of neurological symptoms, but probably annular disruption must be nearly complete to cause radicular findings.

It should also be noted that the nature of the herniated disc can be a matter of clinical importance. Whether a disc bulge, a disc protrusion, a contained disc herniation (within the posterior longitudinal ligament), or an extruded or sequestered disc fragment is present is not well visualized in imaging and may be an important clinical determination, as will be pointed out later in this discussion.

DISCOGRAPHY

This condition of the lumbar disc can be best diagnosed by CT discography. (1,2,3,4,5,6,7,8,11,12,24) The provocation phase of discography reveals whether or not the disc is painful. Instilling contrast marks the internal structure of the disc which can be clearly seen by CT scanning. (4,5) The degree of internal disruption can be graded according to the extent of contrast spread using various discogram scales such as the Dallas Scale or the Extensive Scale developed by Bernard (12).

Clinical management may not require visualization of the disease process, particularly when conservative managements are undertaken and are successful. But in a great many patients with persistent disabling pain of many months duration, discography is indicated for diagnosis. This is particularly true when accurate diagnosis is required for medical-legal purposes.

The pathologies that would be expected to be discovered from discography would include painful internal disc derangement syndrome, contained herniation, foraminal herniation, lateral herniation, sequestered disc fragment, and recurrent herniation with disc fragment contained within scar. Discs that remain painfully symptomatic beneath a posterior fusion may also be identified with discographic

injection.

DIAGNOSTIC EVALUATION

Other diagnostic testing should be utilized before discography is employed. Clinical examination and possible EMG to evaluate for neurological deficit is important. Imaging studies such as CT/myelography and MRI are useful. However, the literature is clear that these studies, including MRI, will certainly miss abnormal discs, identified by discography, with painful radial fissures. Zuckerman and Derby (15) and Kornberg (16) have clearly proven, in separate studies, the common phenomenon of positive discography with "negative" MRI.

Horton and Detari (3) have shown that discs that are abnormal by MRI imaging may or may not be painful and that, "in many cases, magnetic resonance imaging could not reliably predict or replace discography". Greenspan, et al. (8) have emphasized that in carefully controlled studies, MR imaging is not as sensitive for painful disc degradation as CT/discography. They state "while having documented the value of CT discography as a source of information, particularly when surgery is contemplated, and as an effective means of staging disc herniation, we recommend MRI as the ideal screening test for lumbar radiculopathy and low back pain, reserving discography for problematic cases".

Some authors have suggested that external bracing and psychiatric evaluation may clarify which patients should be surgical candidates and that these somehow should proceed or replace discography. The comments of Fischgrund and Montgomery (2) reflect the general view that an external bracing trial is unfortunately unable to adequately restrict spinal motion at any single lumbosacral segment; therefore, it is not predictive for response to fusion. They also raise questions regarding applicability of commonly utilized scores of MMPI. They point out that Sternbach, et al. found no MMPI differences between organic and functional groups of patients and called the grouping 'useless' for the evaluation of low back pain. Other psychological profiles are also of questionable value in ruling in or out the need to make an accurate diagnosis of discogenic pain.

TECHNIQUE

Bogduk and others have called for rigorous application of appropriate technique

for lumbar discography. Three-level discographic evaluation should be routine. At times, two-level discography may be valid if a positive L5-S1 disc is associated with an entirely normal L4-5 disc. Usually, however, the lower three or more discs are evaluated. Stringent requirements of re-creation of the patient's pain and correlation with positive CT discography have been well-outlined. (17) The discography should only be called positive if there is a concordant pain response with a positive CT for outer annular disruption in conjunction with one or more normal levels. Image intensifiers, C-arm digital fluoroscopy units, readily available CT, and modern injection of radio-opaque materials all make discography a less painful and more accurate procedure technically than in earlier years.

RESULTS

Although originally the studies of Holt indicated an unacceptably high false positive rate in lumbar discography, these studies have been thoroughly refuted. The careful study by Walsh, Weinstein, and Aprill et al. (17) clarify the strict criteria of use for positive discography and showed a near zero false positive rate. They emphasize that the patient must be blinded to the levels being injected and careful recording of pain response must be employed and correlated with the degree of annular disruption on CT discography. Walsh, et al. found that normal discs are not painful. Other authors have demonstrated that degenerative discs in asymptomatic patients are also not painful or are characterized by atypical pain patterns. (12, 24)

CLINICAL USES

Therefore, discography does have application in a number of clinical settings. They are:

1. Discography is useful for discovering the pain source in low back pain patients. This is particularly helpful in the injured worker with nondiagnostic MRI. Various studies clearly indicate that a normal disc is not painful to injection and that asymptomatic patients with degenerative lumbar discs do not experience pain on careful injection. The false positive rate for discography should approach zero when strict criteria are used. It is clear from the literature that discography is a safe and reliable means to derive the appropriate diagnosis. The infection rate with discography is well below 0.1% in the hands of experienced discographers.

There is not significant x-ray exposure.

In the injured worker with persistent, prolonged back pain, it is not acceptable to make a vague diagnosis such as "low back pain" From that diagnosis will follow decisions regarding length of physical therapy, ultimate duty level, return to work status, length of disability, need for further medical attention, and the degree of permanent partial disability. The determination of these factors requires accurate diagnosis. The care is much different for simple lumbar strain than for significant disc injury with intradiscal pain. The injured worker rightfully expects an accurate diagnosis and a fair resolution of all these questions.

2. Selecting fusion levels. It is clear that a disc that is abnormal on MRI is not necessarily the appropriate symptomatic disc for fusion. Furthermore, when an L4-5 or L5-S1 disc is abnormal appearing on MRI, it may have degenerated to the point that it is no longer a source of mechanical instability or pain. Discography will clarify this matter and help avoid inappropriate fusion of a nonpainful disc. Furthermore, in selecting the patient for fusion, the health of the disc above and below the fusion must be ascertained. It is the current standard of practice to utilize discography for selecting the patient for spinal fusion following a spine injury. Discography, in fact, rules out surgery in more patients than not. The negative predictive value of discography in selecting patients for fusion is not commonly appreciated or emphasized but is very significant. In our experience, 75 percent of the patients evaluated with discography are ruled out as surgical candidates because of multiple level or inconsistent abnormalities.

The Spine Care Group in San Francisco has recently found that when surgeons evaluated patients in a double-blinded fashion before and after discography results, the surgical plan was altered in 39 percent of these cases. (19) This indicates that discography is definitely helpful in surgical planning. Fischgrund and Montgomery emphasize the importance of discography in selecting fusion levels. Murtaugh, et al. (7) strongly emphasize the need for discography to select fusion levels. The study of Calhoun indicated an 89 percent benefit from operation in those patients in whom discography revealed disease and provoked symptoms. They found only a 50 percent clinical success in those showing morphological abnormality on discography but no provocation of symptoms. This suggests that surgical outcomes are affected by the utilization of discography, a view widely held among spine surgeons. Kozack, et al. (27) also have

emphasized the importance of discography on fusion outcome.

Bernard listed numerous instances in which discography assisted in surgical planning. (12) He reviewed approximately 250 patients with low back pain in a prospective study. Bernard found that discography was very helpful in predicting type of herniation (protruded, extruded, sequestered, or internally disrupted) with a high degree of sensitivity superior to MRI. He emphasized the role of discography in fusion planning as well as in determining the appropriate approach for disc herniation surgery (percutaneous discectomy, extraforaminal approach, etc.). His Table 5 in the paper listed examples where computer tomomography after discography provided useful diagnostic information in 234 patients. Clearly it was a diagnostic test of high value in Bernard's study.

3. In the postlaminectomy or postfusion patient, discography is quite useful in determining the source of pain when nerve blocks and facet blocks are not effective or are equivocal. This is, by definition, a patient group who have multiple imaging abnormalities. Hacker (14) has emphasized the role of discography in postlaminectomy syndrome. It is clear from the work of Selby (Dallas Spine Group) that, following posterior fusion, the disc may continue as a source of pain. Discography is the only method of making the diagnosis in this case. Fischgrund and others have emphasized that when posterolateral fusion fails and an anterior interbody fusion "salvage" is considered, the appropriate discography findings must be present.

4 When selecting for percutaneous automated nucleotomy or laser: A CT/discography must be done discectomy, the literature is clear. to evaluate the patient for the appropriate use of this limited outpatient procedure which may be effective in a number of patients with painful contained disc disruption. (9,10) Discography may be the only way to determine if a herniation is contained within the disc space. (12)

5. Lateral and foraminal disc herniation is frequently difficult to evaluate and the article of Segnarbieux (6) clarifies the important role of CT/discography in planning surgical approaches in extraforaminal and foraminal disc herniation. Bernard also emphasizes this role for discography. (12)

6. The negative predictive value of discography should be emphasized:

- (a) A patient who has multiple abnormal levels, is probably not a surgical candidate and the case may be resolved.
- (b) When a patient has a low pain threshold and reports significant pain response in radiographically normal discs or pain response at every disc tested, the surgery is not done and the case can be closed.
- (c) When a patient has negative discography and persistent back pain, it indicates that the back pain is probably a persistent muscular pain and therefore benign and the case can be resolved satisfactorily.
- (d) Discography, by clarifying abnormal levels, prevents surgery on MRI abnormal discs which are asymptomatic, a further negative predictive benefit.

In all of these instances, the worker's compensation managed care organization seems to have failed to understand the beneficial effect of discography in resolving worker's compensation cases to the satisfaction of all involved regarding diagnostic certainty.

INDICATIONS:

1. The indications for discography as published in the Position Statement on Discography from the Executive Committee of the North American Spine Society states: "Discography is indicated in the evaluation of patients with unremitting spinal pain, with or without extremity pain, of greater than four months duration, when the pain has been unresponsive to all appropriate methods of conservative therapy. Before discography, patients should have undergone investigation with other modalities which have failed to explain the source of pain; such modalities should include, but not be limited to, either CT scanning, MRI scanning and/or myelography. In these circumstances, discography, especially when followed by CT scanning, may be the only study capable of providing a diagnosis by permitting a precise description of the internal anatomy of a disc and a detailed determination of the integrity of the disc's substructures." "By including multiple levels in the study, the patient acts as his or her own control for evaluation of the reliability of the pain response." (20)

"Discography is also of utility in the evaluation of persisting pain in the postoperative patient whose symptoms may be arising from intervertebral disc

degeneration or recurrent herniation, or from pseudarthrosis of a spine fusion. Additional uses of discography include the determination of the number of levels to include in a spine fusion and the determination of the primary symptom producing level when chemonucleolysis is being contemplated." (20)

2. The International Spinal Injection Society, represented in the lengthy review of discography by Bogduk, Derby and Aprill (1), states that the indications for a lumbar discography are "the desire to prove whether a given disc is symptomatic and contains the required altered internal architecture." Importantly, Bogduk, et al. comment "discography is not warranted if there is no desire to establish an anatomical diagnosis, as is the practice when nonspecific therapies of work hardening are used to manage the patient's problem". This is an important concept, as the managed care organization's goal may be to not establish a specific diagnosis beyond the vague diagnosis of "low back pain". Unfortunately, this fails to adequately address the need for diagnosis in the suffering patient.

3. Bernard (12) lists, in his exhaustive review, the overwhelming positive emphasis on the value of discography in the literature and reviews prospectively 250 patients who underwent discography with computer tomography. His indications are those listed in his Table 1 (page 1 in the exhibits attached).

4. In the textbook, *Managing Low Back Pain*, by Kirkaldy-Willis and Burton (1992), (25) the authors list the following situations where discography is useful:

1. To evaluate equivocal abnormalities seen on myelography, CT or MRI.
2. To isolate a symptomatic disc among multiple level abnormalities.
3. To diagnose a lateral disc herniation.
4. Establish contained discogenic pain.
5. To select fusion levels.
6. To evaluate the previously operated spine.

5 The North American Spine Society in its report of Common Diagnostic and Therapeutic Procedures of the Lumbosacral Spine (1991), lists lumbar discography as a Class II procedure, i.e., generally accepted and well established

but limited application. The discussion in the Table clearly indicates that the limited application refers to the fact that MRI or other imaging should precede discography and that it should be reserved for the patient who is unresponsive to conservative treatment.

VANTAGE ONSITE

Vantage Onsite has indicated that they will allow no lumbar discography. I have requested and not received a more full explanation beyond that stated in their denial of authorization letter. Vantage Onsite has indicated in their denial of authorization the following reasons.

1. It is not universally accepted as a reliable test.
2. There is not an outcome study of lumbar fusion that proves the value of discography.

I have asked for a more full explanation from Vantage Onsite regarding this position and have not received any further information. I will address these two issues.

1. The first issue is inappropriate in its requirement that universal acceptance be present for a test to be performed. There is almost nothing in medicine in general or the care of spine patients in particular which is universally accepted.

The literature that I have reviewed in the preceding document clearly establishes discography as a sensitive and specific test for intradiscal pain with architectural disruption. It is a diagnostic test with a near zero false positive rate and a high degree of specificity. Therefore, the statement that it is not universally accepted or is unreliable is clearly refuted by review of the literature.

2. This is a diagnostic test used for the determination of the patient's source of pain. The results of this test may be a wide number of therapeutic approaches including further conservative management, closure of the case with no further management, simple surgical procedure for foraminal or lateral disc herniation or recurrent disc herniation, or possibly fusion of a painful lumbar spine segment.

It is not pertinent in the discussion of the value of the diagnostic tests to argue whether one of the treatment choices may or may not be effective. This is really a

separate issue which will no doubt be addressed at a future date, since it is obviously the intention of Vantage Onsite to actually try to stop lumbar fusion surgery.

It should be the position of the managed care organization to require discography in patients being considered for fusion.

Discography should be a required part of the evaluation for the complicated back patient so that decision making can be based on an accurate diagnosis and resolution of these cases can finally occur. Fusion surgery should not be allowed unless a carefully performed discography reveals the appropriate single or, in rare cases, two level abnormality. Whether only single level fusions for single level abnormality or more extensive fusion procedures for multiple level abnormality should be performed is an area for fruitful discussion. Total disallowance of discography to avoid accurate diagnosis is not reasonable and hopefully will be overturned by the Department.

I have also enclosed a section of the discussion and conclusions from Bernard (12) regarding discography. I would direct the interested reader to this discussion as listed in Exhibit 2 and Exhibit 3 respectively. In Exhibit 2, Bernard states "Precise localization of the anatomic source of pain leading to an accurate diagnosis is a basic requirement for successful management of low back pain. Attention should be directed to the lumbar disc as a source of pain after other less well-recognized causes of low back pain have been excluded"

"When the clinical diagnosis suggests that the disc is a source of pain, discography followed by CT scanning is useful in the clinical situations listed in Table 1."

"Conclusions: Discography is a valuable, reliable and safe procedure which is not harmful to the lumbar disc. Combining CT scanning after a lumbar discography gives information not obtainable by other means. It may be the only positive test. Its accuracy has been proven prospectively in surgical cases. Computer tomography scanning after discography defines the type of disc herniation and is useful in evaluating the previously operated spine. Considering the information gained, discography followed by CT scanning compares favorably from a cost-effective perspective with other procedures."

Sincerely,

Michael E. Karasek, M.D.

Research

THE ROLES OF THE ZYGAPOPHYSIAL JOINT AND INTERVERTEBRAL DISC IN CHRONIC LOW BACK PAIN: RESULTS OF A MULTICENTER STUDY

A.C. Schwarzer*, C.N. Aprill**, R. Derby***, J. Fortin**, G. Kine***, N. Bogduk*

The University of Newcastle, Department of Medicine, Newcastle, Australia*, Diagnostic Conservative Management, Inc., New Orleans, LA**, and SpineCare Medical Group, Daly City, CA***

INTRODUCTION

The precise prevalence of lumbar zygapophysial joint pain is not known. In selected samples the prevalence appears to range between 16% and 94%(5-8,12,14,17-19,21,23,26-29,31-33) but in larger, seemingly unselected samples is as low as 6% or 8%.(15)

Whether or not the "facet syndrome" is a true clinical entity has been the source of considerable controversy. Many viewpoints on the role of the zygapophysial joint in low back pain have been based on anecdotal experience; few have been based on valid scientific studies.

The study by Mooney and Robertson in 1976 was significant because it showed that the lumbar zygapophysial joint could be a source of pain.(26) However, there have been few studies which have attempted to address the issue of whether or not the "facet syndrome" is a clinical entity. Some studies advocate the value of certain sets of clinical findings(12,4) while others find no diagnostic features of zygapophysial joint pain.(15,18,32)

Post-mortem studies and imaging studies reveal that the intervertebral disc and zygapophysial joints are the structures that most commonly exhibit degenerative and other changes that might be construed as possible causes of pain. Indeed, some evidence suggests that degenerative changes in the disc and in the zygapophysial joints are linked such that zygapophysial joint disease is secondary to discogenic disease.(3,4,10,13,20,30,34)

These observations have led some investigators to abandon the notion of a single cause of low back pain and to enunciate, instead, the concept of the three-joint complex.(16) Thus, as pathologic changes affect all three joints in a lumbar motion segment, any or all three joints might become symptomatic. Therefore a patient's pain might stem not just from the intervertebral disc or from one of the zygapophysial joints but from some combination of the three joints. While attractive to some, this notion has never been tested and validated clinically. Instead, protagonists of discogenic pain have pursued their favoured diagnosis with magnetic resonance imaging, discography and computed tomography-discography. Meanwhile, protagonists of zygapophysial joint pain have pursued their paradigm with diagnostic blocks of these joints.

The following studies, performed in the United States in two centres, were designed to address the issue of whether or not lumbar zygapophysial joint pain was a true entity and, if so, whether it could be detected using clinical means. The validity of single as opposed to double blocks was determined. Finally, by using discography and zygapophysial joint blocks in a cohort of patients referred for discography, the relative roles of the disc and zygapophysial joint were assessed in patients with chronic low back pain. Specifically, what was addressed was whether or not the "three-joint complex" was a clinical entity.

STUDY POPULATION AND METHODS

Study population

The study population consisted of 176 consecutive patients with low back pain of greater than three months' duration seen between April, 1992 and October, 1992. They were seen at either a radiology practice in New Orleans specialising in spinal pain or at a specialist spine centre 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, orthopaedic surgeons and specialists in rehabilitation medicine because non-invasive investigations had been non-diagnostic and, in the opinion of the referring physician, the patients' pain was severe enough to warrant invasive investigations. Patients under the age of 18 or over the age of 80 years and those who had previously undergone lumbar surgery or who exhibited neurological signs were excluded.

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

Of the 176 patients, 92 patients were referred for discography. This comprised 61 men and 31 women with a median age of 36.7 years (interquartile range 30.6-42.8). The demographic characteristics of this group of patients did not differ significantly from those of the source population.

History and physical examination

Following the granting of informed consent, patients underwent a history and physical examination. A standard form for history and physical examination was completed on all patients. The majority of examinations were performed by the principal investigator. However, a small number were performed by three other assessors. The results of all procedures were also recorded on a standard form. The following historical features were obtained from each patient: date of onset of back pain, mechanism of injury and whether it 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. Specifically, patients were asked whether they experienced pain in the buttock, groin, thigh, leg and foot. Other questions related to their present pain and the answers were graded as yes, no or indeterminate. Subjects were asked whether their pain was aggravated or improved by sitting, standing or walking.

A standard physical examination was also performed to determine whether or not the following movements aggravated their pain: forward flexion, extension, rotation of the trunk to the right and rotation to the left, rotation of the trunk to the left with extension to the right, and rotation to the right with left extension. Straight leg raising was performed with the patient supine to assess whether either their back pain or their leg pain could be aggravated. All movements except forward flexion were assisted movements. The spine was palpated with the patient prone and the location of maximal spinal tenderness was noted.

Blocks of the zygapophysial joints

Zygapophysial joints were investigated with diagnostic blocks using lignocaine and bupivacaine on separate occasions. Blocks with lignocaine were performed prior to 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 two 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 then the procedures were carried out at this level followed by joints at L4-5 and then L3-4. If L4-5 was the site of maximal tenderness then L4-5 was injected first followed by L5-S1 and then L3-4. If L3-4 was the site of maximal tenderness then the order of injections was L3-4, L4-5 and L5-S1. If the site of maximal tenderness was the posterior superior iliac spine or over the sacroiliac joint then the L5-S1 joint was injected first followed by L4-5 and then the sacroiliac joint. In those few cases in which pain was also located in the upper lumbar area then L2-3 and L1-2 zygapophysial joints were also blocked. All of these blocks were performed on the same day.

The zygapophysial joints were anaesthetised using either blocks of the medial branches of the dorsal ramus or intra-articular injections depending on the preference of the person performing the procedure. 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 followed by an alcohol solution and the surrounding area was draped. The skin overlying the joint was infiltrated with 1% lignocaine using a short 23 gauge needle. Under intermittent fluoroscopic guidance a 20, 22 or 25 gauge 3-1/2 inch (90 millimetre) spinal needle was then used to gain access either to the cavity of the target joint or to the medial branches that innervated the joint. A larger gauge needle has the advantage that it is easier to manipulate and direct towards the target joint. The disadvantage is that it renders the procedure more painful than if a smaller gauge needle is used. A finer needle is more difficult to manipulate and requires more dexterity but is preferred by patients.

Intra-articular blocks

Intra-articular injections were performed under fluoroscopic guidance using a standard technique. A volume of 0.3 millilitres of non-ionic contrast medium was used to confirm intra-articular placement of the needle and the joint was anaesthetised with 0.5 millilitres of 2% lignocaine. The joint was injected slowly and imaging was used to verify that extravasation of contrast medium had not occurred. The present volume was considered sufficient to anaesthetise the joint without the risk of extravasation in those joints with smaller capacities due to osteoarthritis.

Medial branch blocks

A standard technique was used to perform blocks of the medial branches of the dorsal rami. The needle was introduced and directed to the upper third of the groove formed by the superior articular process and the transverse process. In order to anaesthetise one joint both medial branches which innervate it must be blocked: each zygapophysial joint is innervated by articular branches of the medial branches of the dorsal rami at that level and the level above. For example, the L4-5 zygapophysial joint is innervated by the medial branches of L4 and L3 dorsal rami and the L5-S1 joint by the medial branches of L5 and L4 dorsal rami. Each medial branch traverses the transverse process of the vertebra below. For example, the L4 medial branch will cross the L5 transverse process. To denervate the L5 medial branch the L5 dorsal ramus is blocked. The L5 dorsal ramus traverses the ala of the sacrum at its junction with the S1 superior articular process.

Radiographically, the target point is the upper part of the "eye of the scotty dog" which is seen with the patient in an oblique/prone position. Each nerve was infiltrated with 0.5 millilitres of 2% lignocaine. The injection was performed slowly over 30 seconds. When spondylolysis was suspected radiographically medial branch blocks, and not intra-articular blocks, were performed to avoid the spread of local anaesthetic to adjacent joints. When defects of the pars interarticularis are present intra-articular injection of radiographic contrast in one joint can spread to adjacent joints ipsilaterally and bilaterally.(9,22,24)

Discography

Provocation discography was adopted as the test for discogenic pain in accordance with the position statement on discography of the Executive Committee of the North American Spine Society,(11) on the grounds that there are no other means of establishing whether a disc is painful. The diagnostic criteria adopted were those specified by the Taxonomy of the International Association for the Study of Pain namely that for a disc to be deemed the source of pain, provocation of that disc should reproduce the patient's accustomed pain provided that provocation of an adjacent disc did not reproduce their pain.(25) Furthermore, to ensure that patients with discogenic pain had structurally abnormal discs, the criteria for internal disc disruption had to be satisfied, namely discogenic pain coupled with morphological abnormalities on CT-discography.(25)

Discography was performed only in the 92 patients referred for this procedure. Discography was always performed after the screening blocks of the zygapophysial joints with lignocaine. Approximately one hour was allowed between the last of the zygapophysial joint blocks and discography. It was considered that previous blocks of the zygapophysial joints would not interfere with the results of discography. Zygapophysial joint blocks are specific for these joints, will not anaesthetise the disc and therefore will not diminish the pain response to provocation of the disc. It was the response to provocation of the disc that was sought and not the analgesic response to injection of the disc with local anaesthetic.

Discography was usually initiated at the lower two lumbar levels or higher if the patient's pain was centred above the lumbosacral junction. At least two discs, and up to four, were studied in each patient. All studies included a control level i.e. a disc that did not reproduce the patient's pain upon injection of contrast medium. If the patient's MRI demonstrated a disc with severe loss of signal intensity on spin echo T2-weighted images, that disc was injected last.

Discography was performed by the method of Aprill.(2) An extrapedicular approach was used and the patient was placed in a prone oblique position with the side selected for puncture uppermost. This was the side opposite to the symptomatic side. If the disc is punctured from the asymptomatic side then provocation of discogenic pain can be differentiated from pain occurring from penetration of tissues by the needle. The patient was rotated until the superior

articular process of the subjacent vertebra at the level selected was projected almost immediately between the anterior and posterior margins of the vertebral endplate above. A 3-1/2 inch (90 millimetre) 25 gauge needle was then directed vertically toward the anterior margin of the superior articular process, and slowly withdrawn while injecting 3.0 to 5.0 millilitres of lignocaine 1%. A 22 or 25 gauge 6-inch (152 millimetre) spinal needle could then be directed along the same course toward the disc. After advancing the needle into the disc substance, its position was checked in both the sagittal and frontal planes. This technique was used for discography at all levels except the lumbosacral level which required a different technique.

For the L5-S1 intervertebral disc the lumbosacral angle was observed on a lateral view and a line projected back to the skin surface. A point along that line was selected that would allow the passage of a needle medial to the iliac crest and adjacent to the lateral margin of the superior articular process of the sacrum. A 25-gauge 3-1/2 inch (90 millimetre) spinal needle was then directed from the selected point caudally and medially toward the superior process. The patient was then rolled to the lateral position and the position of the needle was then checked fluoroscopically. Once the correct position was established, the small needle was withdrawn while 5.0 millilitres of lignocaine 1% was injected. For disc injection, a double-needle technique was used with 18 and 22 gauge (or 20 and 25 gauge) needles. The procedure needle was curved manually before the procedure with the bevel facing the outside. The optimal position of the guide needle is immediately adjacent to the anterolateral aspect of the superior articular process of the sacrum. With the patient in the oblique position the procedure needle was advanced within the guide needle, which was simultaneously retracted slightly. The result of this dual action was an unsheathing of the inner needle, allowing it to bow medially and to enter the disc. Non-ionic contrast medium (iohexol) was then injected into the disc. The usual volume injected is two millilitres but it may range from one to four millilitres.

Assessment of response

Ten minutes after blocks with lignocaine at each level 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 patients obtained a definite or complete response at one or more segmental levels from the screening procedures with lignocaine they were asked to return two 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 following the previous injection of lignocaine. Following anaesthetisation of the putatively symptomatic joint, patients were issued with a series of visual analogue scales (VASs) to complete after discharge over the ensuing 8 hours. The VAS is an objective method of measuring pain and was used in the previous study. Patients were instructed not to rest and were encouraged to carry out their daily activities. Ratings were performed at 1/2 hour, 1 hour and then hourly. Relief of more than 50% of pain that was sustained for three 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 anaesthetised 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.

During provocation discography, all patients were assessed for a pain response by the principal investigator. Pain was graded as "unfamiliar pain", "no pain", "similar pain" or "exact pain" reproduction. Images obtained on discography were assessed by the person performing the procedure and the observer, and both had to agree on the presence or absence of an abnormality and the specific findings. After the procedure, CT was performed to further evaluate symptomatic discs. A disc was graded as abnormal on CT-discography if it exhibited a radial fissure of grade 3 or 4, according to the classification of Aprill and Bogduk.(1) The criteria for a positive discogram were exact pain reproduction and an abnormal image on CT-discography, provided that no pain was reproduced at a control segmental

level.

RESULTS

1. The false-positive rate of uncontrolled blocks

Eighty-three patients (47%) reported a definite or greater response to lignocaine. Of these 83 patients, 71 (86%) proceeded to confirmatory blocks. Confirmatory blocks were not undertaken in the remaining 12 patients either because they had no pain at the time they returned for investigation or because they lived too far away and were unable to attend.

Following the confirmatory blocks with bupivacaine, 26 patients had a 50% or greater improvement in pain. Thus, positive responses were confirmed in only 26 of the 83 patients who responded initially to blocks with lignocaine (Table 1).

To calculate the specificity of single, uncontrolled blocks of the zygapophysial joints, their sensitivity was assumed to be about 95%. This was determined on the grounds that patients with genuine zygapophysial joint pain are not likely to deny relief of their pain if the painful joint is anaesthetised. Failure to relieve genuine pain would occur only if the injected local anaesthetic failed to anaesthetise the target joint adequately. The prevalence of such technical failures is not known, but for present purposes was estimated as not more than 5% (Table 1). An example of a basis for technical failure is the inadvertent injection of local anaesthetic into the companion vein of the medial branch of the dorsal ramus. Such an injection would pass unnoticed unless contrast medium was regularly used to monitor medial branch blocks; and would fail to anaesthetise the target nerve. This phenomenon, however, has been observed only twice in an unreported series of over 50 medial branch blocks using contrast medium* which constitutes the basis for our estimated false-negative rate of 5%.

For the purposes of calculating specificity, once the number of false-negative responses was calculated, all remaining patients who had no response to lignocaine were assumed to be true-negative (Table 1). Using the response to bupivacaine as the criterion standard, the specificity of screening blocks with lignocaine was found to be only 62% (95% CI 54-70%); the resultant false-positive rate was 38% (95% CI 30-46%) (Table 1). Based on these values, the positive predictive values and negative predictive values of uncontrolled

zygapophysial joint blocks over a selected range of possible prevalences are shown in Table 2.

TABLE 1

A TWO-BY-TWO CONTINGENCY TABLE COMPARING THE RESULTS OF SINGLE BLOCKS USING LIGNOCAINE AND DOUBLE BLOCKS USING BOTH LIGNOCAINE AND BUPIVACAINE

	Double block positive	Double block negative
Single Block Positive	26	57
Single Block Negative	1	92

Sensitivity: 95% (95%CI 87-100%); specificity: 62% (95%CI 54-70%); false positive rate: 38% (95%CI 30-46%); positive predictive value: 31% (95%CI 21-41%); negative predictive value: 99% (99%CI 97-100%).

* personal communication, Dr Charles Aprill, Spine radiologist Magnolia Diagnostics Inc, New Orleans, LA, USA

TABLE 2

POSITIVE PREDICTIVE VALUE (PPV) AND NEGATIVE PREDICTIVE VALUE (NPV) OF SINGLE DIAGNOSTIC BLOCKS AT VARIOUS PREVALENCE RATES FOR LUMBAR ZYGAPOPHYSIAL JOINT PAIN

Prevalence	PPV	NPV
0.1	0.22	0.99
0.2	0.38	0.98

0.3	0.52	0.96
0.4	0.6	0.94
0.5	0.72	0.93
0.6	0.79	0.90
0.7	0.85	0.85
0.8	0.91	0.76

2. Prevalence of zygapophysial joint pain

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 L4-5 (6), L3-4 (3) and L2-3 (1). In one patient with a lumbarised sacral segment there was a positive response at L5-6. 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 after both blocks.

With respect to the types of blocks carried out, 16 of 83 patients (19%) who were eligible to undergo confirmatory blocks underwent different blocks on each occasion, for example an intra-articular block followed by a medial branch block or vice-versa. Five patients of 26 (19%) who were positive following the confirmatory block underwent different types of blocks for each of the screening and confirmatory blocks. The screening blocks used for these 26 patients were medial branch blocks in 11 and intra-articular blocks in 12. Three patients underwent both medial branch blocks and intra-articular blocks simultaneously.

3. Clinical features

There was no statistically significant association between response to blocks and

any single feature on history or physical examination (Table 3). The results are similar when analyses were performed for patients with unilateral pain (Table 4). The pattern of pain referral was not a useful discriminator between patients with and without a diagnosis of zygapophysial joint pain (Table 5). Similar findings were obtained irrespective of the type of block.

When combinations of clinical features were assessed by logistic regression no model could be found 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.

TABLE 3

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

Excluded from this analysis are 12 patients who did not undergo confirmatory blocks.

TABLE 4

RELATIONSHIP BETWEEN CLINICAL FEATURES AND RESULTS OF DOUBLE DIAGNOSTIC BLOCKS OF THE LUMBAR ZYGAPOPHYSIAL JOINTS

Examination features	P value(1)	P value(2)
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

(1) left-sided pain. (2) right-sided pain. SLR - straight leg raising test;

* - insufficient cells for analysis.

TABLE 5**THE PREVALENCE OF PAIN REFERRAL PATTERNS IN PATIENTS WITH AND WITHOUT ZYGAPOPHYSIAL JOINT PAIN**

Area of pain referral	Zygapophysial joint positive n=26	Zygapophysial joint negative n=138
left groin	4 (15%)	15 (11%)
right groin	1(3%)	23 (17%)
left buttock	11(42%)	54 (39%)
right buttock	10 (15%)	58 (42%)
left thigh	10 (38%)	49 (36%)
right thigh	10 (38%)	59 (43%)
left calf	7 (27%)	34 (25%)
right calf	4 (15%)	45 (33%)
left foot	8 (31%)	23 (17%)
right foot	2 (8%)	28 (20%)

Excluded from this analysis were 12 patients who were unable to undertake confirmatory blocks using bupivacaine

4. The relative contributions of the disc and zygapophysial joint in chronic low back pain

Discography was performed on a total of 255 discs, most frequently at L4-5 (90), followed by L5-S1 (83), L3-4 (63), L2-3 (16) and L1-2 (3). Thirty-six patients (39%) had an abnormal discogram at one or more levels. Discography was positive most frequently at L5-S1, followed by L4-5, L2-3 and L3-4; no discograms were positive at L1-2 (Table 6). Control discograms were achieved in all patients.

In two patients, the discographic studies were incomplete. In one patient, MRI demonstrated a disc protrusion and sequestered fragment at L4-5; as a result discography was not attempted at this level. Discograms otherwise were negative at two other levels. In the other patient, discography was considered technically too difficult because she had a grade three spondylolisthesis in conjunction with a severely degenerated disc at L5-S1. In this patient, discograms at two other levels were negative.

Screening blocks of the zygapophysial joints using lignocaine were successfully performed in all patients, of whom 42% underwent medial branch blocks, 44% had intra-articular blocks, and 14% underwent both. Thirty-six patients (39%) achieved a definite or greater response to lignocaine at one or more levels.

Confirmatory blocks, using bupivacaine, were performed in 32 of the 36 eligible patients (89%). In four patients, confirmatory blocks were not undertaken either because their pain had not recurred or because they lived too far away and were unable to attend. After confirmatory blocks with bupivacaine, eight patients had a 50% or greater improvement of their pain. Of these patients, six suffered unilateral pain and two suffered bilateral pain. The symptomatic level was L5-S1 in six patients and L4-5 in two.

All patients who had positive discograms at L5-S1 (17) or L4-5 (18) had zygapophysial joint blocks performed at those levels. Four of the six patients with positive discograms at L3-4 underwent zygapophysial joint blocks. Blocks were not performed at L3-4 in the other two patients because their pain could be abolished at L4-5 or L5-S1. None of the three patients with positive discograms at L2-3 underwent zygapophysial joint blocks at that level because the protocol did not include injection of these joints as a routine.

In only three of the patients with positive discograms (8%) were the zygapophysial joints symptomatic. Most patients with positive discograms (92%) did not have zygapophysial joint pain. Forty-five patients (49%) suffered neither discogenic pain nor zygapophysial joint pain. Five patients suffered zygapophysial joint pain but showed no evidence of discogenic pain (Table 7). Overall, only three percent of patients exhibited combined discogenic and zygapophysial joint pain. Combined pain occurred at L4-5 in two patients and L5-S1 in one. In these three patients positive discograms and positive zygapophysial joint blocks occurred at the same level.

TABLE 6**NUMBERS AND PROPORTIONS OF DISCOGRAMS POSITIVE AT EACH LEVEL**

Level	Number of discograms	Number of positive discograms	Percentage of discograms which were positive
L5-S1	83	17	20.5
L4-5	90	18	20
L3-4	63	6	9.5
L2-3	16	3	18.8
L1-2	3	0	0

These figures correspond to the number of patients undergoing discography at each level. Discography was performed on 92 patients at two or more levels.

TABLE 7**TWO-BY-TWO CONTINGENCY TABLE OF RESULTS OF ZYGAPOPHYSIAL JOINT BLOCK AND DISCOGRAPHY**

	Zygapophysial joint positive	Zygapophysial joint negative
Discography positive	3	33
Discography negative	5	45

Excluded from this table are four patients who did not undergo confirmatory zygapophysial joint injections and two patients who were unable to undergo discography at all appropriate levels.

CONCLUSIONS

Using the response to confirmatory blocks as the criterion standard, the false-positive rate of uncontrolled diagnostic blocks was 38% and the positive predictive value of these blocks was only 31%. Because the positive predictive value of a test is lower when the pre-test probability (prevalence) is low, and because the prevalence of lumbar zygapophysial joint pain is likely to be less than 50%, uncontrolled diagnostic blocks will always be associated with an unacceptably low positive predictive value. These features render uncontrolled diagnostic blocks unreliable for the diagnosis of lumbar zygapophysial joint pain not only in epidemiologic studies but also in any given patient.

2. The zygapophysial joint is an important source of chronic low back pain occurring in 15% of patients visiting two spinal diagnostic centres in the U.S.. However, none of the clinical tests used could discriminate between pain of zygapophysial joint origin and pain of other origins. Likewise, the pain referral pattern and other aspects in the history were unhelpful. The existence of a "facet syndrome" must therefore be questioned.

In patients with chronic low back pain, pain arising from the disc is more common than pain arising from the zygapophysial joint. The combination of discogenic pain and zygapophysial joint pain is uncommon. The concept of the three joint complex therefore pertains to pathology but does not carry a clinical correlate.

REFERENCES

1. Aprill C, Bogduk N: High-intensity zone: a diagnostic sign of painful lumbar disc on magnetic resonance imaging. *Brit J Radiol* 65:361-369,1992
2. Aprill CN: Diagnostic Disc Injection. *The Adult Spine: Principles and Practice*. Edited by JW Frymoyer. New York, Raven Press, Ltd, 1991, pp 403-442
3. Butler D, Trafimow ~H, Andersson CBJ, McNeill TW, Huckman MS: Discs degenerate before facets. *Spine* 15:111-113,1989
4. Bywaters EGG: The pathological anatomy of idiopathic low back pain. *Idiopathic Low Back Pain*. Edited by AA White, S Gordon. St Louis, C.V. Mosby,

1982, pp 144-175

5. Carette S, Marcoux S, TNchon R, Grondin C, Gagnon J, Allard Y, Latuiippe M: A controlled trial of corticosteroid injections into facet joints for chronic low back pain. *New Engl J Med* 325:1002-1007,1991
6. Carrera GF: Lumbar facet joint injection in low back pain and sciatica: preliminary results. *Radiology* 137:665-667,1980
7. Carrera GF, Williams AL: Current concepts in evaluation of the lumbar facet joints. *CRC Grit Rev Diagn Imaging* 21:85-104,1984
8. Destouet JM, Gilula LA, Murphy WA, Monsees B: Lumbar facet joint injection: indication, technique, clinical correlation, and preliminary results. *Radiology* 145:321-325,1982
9. Dory MA: Arthrography of the lumbar facet joint. *Radiology* 140:23-27,1981
10. Dunlop RE, Adams MA, Hutton WC: Disc space narrowing and the lumbar facet joints. *J Bone Joint Surg (Br)* 66:706-710,1984
11. Executive committee of the North American Spine Society: Position statement on discography. *Spine* 13:1343,1988
12. 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* 6:598-605,1981
13. Gotfried Y, Bradford DS, Oegema TR: Facet joint changes after chemonucleolysis-induced disc space narrowing. *Spine* 11:944-950,1986
14. Helbig T, Lee CK: The lumbar facet syndrome. *Spine* 13:61-64,1988
15. Jackson RP, Jacobs RR, Montesano PX: Facet joint injection in low-back pain-A prospective statistical study. *Spine* 13:966-971,1988
16. Kirkaldy-Willis WH, Wedge JH, Yong-Hing K, Reilly J: Pathology and pathogenesis of lumbar spondylosis and stenosis. *Spine* 3:319-328,1978
17. Lau LS, Littlejohn GO, Miller MH: Clinical evaluation of intra-articular

injections for lumbar facet joint pain. Med J Aust 143:563-565,1985

18. Lewinnek GE, Warfield CA: Facet joint degeneration as a cause of low back pain. Clin Orthop 213:216-222,1986

19. Lippitt AB: The facet joint and its role in spine pain. Management with facet joint injections. Spine 9:746-750,1984

20. Lipson SJ, Muir H: Experimental intervertebral disc degeneration: morphologic and proteoglycan changes over time. Arthritis Rheum 24:12-21,1981

21. Lynch MC, Taylor JF: Facet joint injection for low back pain. A clinical study. J Bone Joint Surg (Br) 68:138-141,1986

22. Maldague B, Mathurin P, Malghem J: Facet joint arthrography in lumbar spondylolysis. Radiology 140:29-36,1981

23. 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 49:325-328,1992

24. McConnick CC, Taylor JR, Twomey LT: Facet joint arthrography in lumbar spondylolysis: anatomic basis for spread of contrast medium. Radiology 171:193-196,1989

25. Merskey II, Bogduk N: Classification of chronic pain. Descriptions of chronic pain syndromes and definitions of pain terms. 2nd Edition. Seattle, IASP Press (In Press)

26. Mooney V, Robertson J: The facet syndrome. Clin Orthop 115: 149-156,

27. Moran R, O'Connell D, Walsh MG: The diagnostic value of facet joint injections. Spine 13: 1407-1410,1988

28. Murtagh FR: Computered tomography and fluoroscopy guided anesthesia and steroid injection in facet syndrome. Spine 13:686-689,1988

29. Nash TP: Facet joints: intra-articular steroids or nerve block?. The Pain Clinic 3:77-82,1990

30. Oegema TR, Jr., Bradford DS: The inter-relationship of facet joint osteoarthritis and degenerative disc disease. *Br J Rheumatol* 30 Suppl 1:16-20,1991
31. Raymond J, Dumas J: Intraarticular facet block: diagnostic test or therapeutic procedure?. *Radiology* 151:333-336,1984
32. Revel ME, Listrat VM, Chevalier XT, Dougados M, N'guyen MP, Vallee C, Wybier M, Gires F, Amor B: Facet joint block for low back pain: identifying predictors of a good response. *Arch Phys Med Rehabil* 73:824-828,1992
33. Taylor MB, Evans RT, Bubeia CB: Intraarticular facet block in chronic low back pain: results of patient selection based on clinical evaluation. *The Pain Clinic* 1:157-162,1987
34. Vernon-Roberts B, Pirie CJ: Degenerative changes in the intervertebral discs of the lumbar spine and their sequelae. *Rheumatol Rehabil* 16:13-21,1977

SACROILIAC JOINT SYNDROME: THE DIAGNOSTIC VALUE OF SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY

Curtis W. Slipman, MD*, Elliot Sterenfeld, MD*, Kevin Pauza, MD", Richard Herzog, MD**, Edward J. Vresilovic, Jr.,MD,PhD***

The Penn Spine Center, Departments of Rehabilitation Medicine*, Radiology**, and Orthopedic Surgery*** - University of Pennsylvania Medical Center

The data included in this article was presented at the 55th Annual Assembly of the American Academy of Physical Medicine and Rehabilitation on November 1, 1993

Abstract

Sacroiliac joint syndrome represents a common cause of low back pain with or without associated leg symptoms. Determining the presence of this disorder in an individual represents a challenge. Its symptoms are varied and examination maneuvers have not been proven to be confirmatory. Sacroiliac joint block is considered to be the definitive diagnostic tool, but is an invasive procedure with known risks. Single photon emission computed tomography has been utilized in the evaluation of sacroiliac joint disorders. It is a less invasive study and could potentially displace sacroiliac joint block in the diagnostic algorithm. In this study we prospectively analyze single photon emission computed tomography results in 11 patients with symptom, examination, and sacroiliac joint block confirmed sacroiliac joint syndrome.

Effective treatment of low back pain necessitates providing a patient with a precise diagnosis. Adhering to this principle prevents generic treatment thereby enhancing the therapeutic regimen prescribed. Unfortunately, a specific diagnosis cannot always be rendered for each patient with low back pain as there are a myriad of etiologies with many syndromes sharing identical features. This issue certainly pertains to sacroiliac joint syndrome (SUS) as its' manifestations can include low back, buttock, inguinal, abdominal, groin, and hip pain with or without leg symptoms. Spinal disorders, including, but not limited to, zygoapophyseal arthralgia/synovitis, posterior complex ligamentous injury, central or lateral recess spinal stenosis, piriformis syndrome, iliotibial band syndrome, stress reaction of the pars interarticularis, spondylolysis,

spondylolisthesis, intranuclear disc disruption, and segmental instability, can present similarly. As an illustrative example we shall describe the following case history:

A 38 year old female with a chief complaint of low back, right buttock, and bilateral leg pain of a three year duration was evaluated at the Penn Spine Center. The referring rheumatologist requested diagnostic and therapeutic sacroiliac joint blockade (SIJB) be performed. Upon examination the patient demonstrated normal sensorimotor function, negative root tension signs, negative Patrick's, Gaenslen's, Pace, and Frieberg tests, negative rectal exam, and full and pain free forward flexion and side bending. Pain was perceived over the right sacral sulcus following pressure application to this region. During terminal extension and with Yeoman's maneuver low back pain was elicited. Gillet's test was positive. Radiographic review revealed Grade I spondylolisthesis at the L4-5 level without excessive sagittal translation or rotation on flexion/extension views. Our initial impression deemed spondylolisthesis to be a probable cause, and SIJS a possible cause, of her back, right buttock, and bilateral lower extremity pain. Since epidural blockade could provide amelioration of SIJS as well as spondylolisthetic symptoms, while SIJB would only address SIJS, we elected to perform diagnostic SIJB. The patient obtained no benefit from SIJB. Subsequent epidural injection resulted in immediate complete pain abatement. She ultimately responded to serial epidural injections, bracing, and physical therapy for a working diagnosis of spondylolisthesis.

Since SIJS can manifest with symptoms and/or examination findings observed in other spinal disorders the critical issue of diagnosis specific treatment may not be feasible without obtaining diagnostic tests. Our desire to employ precision while limiting invasive procedures during the pursuit of a low back pain etiology led to a prospective analysis of the utilitarian value of Single Photon Emission Computed Tomography (SPECT) in diagnosing SIJS.

Recent literature unanimously supports the high sensitivity of SPECT in diagnosing early sacroiliitis (19,25,27,40). If was our expectation SPECT would be incorporated into one of the first steps in our diagnostic algorithm for the patient who provided symptoms and examination findings suggestive of SIJS. If a positive SPECT result was obtained conservative treatment could be instituted, potentially avoiding SIJB.

In this study patients who presented with probable SIJS underwent SPECT. Soon thereafter SIJB was performed for diagnostic confirmation. An analysis of SPECT results for those patients with definitive SIJS was then completed.

METHODS

Patients included in this study were referred to our Spine Center with complaints of low back pain which included the region of the sacral sulcus regardless of associated hip or leg symptoms. A history of spondyloarthropathy, urethritis, peripheral arthritis, psoriasis, inflammatory bowel disease, or pain associated with early morning stiffness which resolves with exercise represented exclusion criteria. Physical examination had to demonstrate a positive response to a minimum of three widely accepted maneuvers typically used to diagnose SIJS. Two of the three positive responses had to include two specific stress maneuvers: Patrick's test and pain with pressure application to the sacroiliac ligaments at the sacral sulcus while in the prone position. Other maneuvers we performed, which are believed to be indicative of SIJS, were shear, standing extension (28), Gaenslen, Gillett, and Yeoman. If a sensorimotor abnormality was identified appropriate work up was completed prior to addressing SIJS. If a positive imaging and/or electrodiagnostic study for a root or peripheral nerve injury was obtained these disorders were appropriately addressed prior to commencing with SPECT and SIJB.

Once a probable diagnosis of SIJS was made SPECT was ordered. SPECT analysis was performed three hours following antecubital intravenous injection of Tc-99m methylene diphosphonate. With the patient supine on the pallet, SPECT studies were acquired using a dual head rotating gamma camera (Picker Prism 2000) equipped with a high resolution parallel hole collimator. Views were taken around a 360 degree elliptical orbit, with 64 projections at 20 seconds per projection and acquisition into a 128 x 128 matrix. After back projection correction, transaxial, coronal, and sagittal sections were reconstructed using the Odyssey Supercomputer's parallel and integral vector processing. The results of SPECT were analyzed by two experienced nuclear medicine physicians who were asked to rule out sacroiliac disease.

Following SPECT imaging each patient was scheduled for an SIJB. Approximately fifteen minutes prior to this procedure a pre-injection visual

analog scale (VAS) rating was completed. Administration of each VAS was by a trained medical technician. Fluoroscopically guided SIJB performed by C.W.S. Hendrix's technique was utilized with incorporation of slight modifications; patient positioning proceeded in a different manner (23). This was necessary because of technical limitations; all blocks were performed in a myelographic suite and not with a C-arm imager. Following infusion of 0.5 cc of Iohexol 300 mgI/ml (Sanofi Winthrop) into the most caudal aspect of the SIJ, establishing proper needle position, a combination of 1.0 cc of Betamethasone sodium phosphate and acetate suspension 6 mg/ml (Schering) and 2.0 cc of 1% Lidocaine hydrochloride (Elkins-Sinn) was injected (see figure 1). Between 10 and 15 minutes after SIJB each patient completed a post-injection VAS. A minimum reduction of 80% in the VAS rating was required to be included in this study. All data accumulation and analysis was performed by E.S. and K.P.

RESULTS

Thirteen patients met our symptom and examination criteria and were referred for SPECT imaging. Of this population a total of 11 patients consisting of 7 women and 4 men met our symptom, examination, and injection response criteria. Ages for this latter group ranged from 22 to 53 years old with an average age of 37.5 years old. Unilateral involvement was identified in seven patients. Five were on the left and two on the right. Four patients demonstrated bilateral SIJS. Duration of symptomatology ranged from 1 to 72 months with an average of 25.6 months (see Table 1). Pre-injection VAS scores ranged from 8.5 to 2.0 with an average of 6.0. Post-injection VAS ranged from 0.9 to 0.0 with an average of 0.02 (see Table 2). The percentage reduction in VAS ratings ranged from 100 to 82 with an average of 96 (see Table 3).

Neurological examination failed to reveal any true dermatomal or peripheral nerve sensory deficits in any patient. Manual muscle testing and deep tendon reflexes were normal for all patients except one, 9. Reproducible deficits demonstrated for motor strength and right knee jerk; 5-/5 EHL bilaterally and 1+, respectively. Subsequent electrodiagnostic testing confirmed the presence of a chronic bilateral L5 radiculopathy and lumbosacral MRI was normal.

One of eleven subjects, 9.1%, who met our symptom, examination and injection criteria had a positive SPECT result.

DISCUSSION

Sacroiliac joint (SIJ) pathology as a source of low back pain was initially proposed by Goldthwait and Osgood in 1905(14). In 1909, Albee reported the results of fifty cadaver SIJ dissections and seven illustrative cases. It was his impression the sacroiliac articulation is a true joint, has inherent motion, and "its afflictions are, undoubtedly the cause of many obscure and unexplained backaches and persistent sciatica's"(1). Sacroiliac dysfunction became accepted as a source of low back pain and was soon considered one of its principle precipitators. Yeoman attempted to refine the diagnostic process by correlating pain provocation with hip hyperextension in the prone position and radiographic changes in the SIJ(44). Yeoman's radiographic interpretations have ultimately been proven to be clinically insignificant as they are frequently observed in asymptomatic individuals. In addition, cadaveric studies have demonstrated them to be an aging phenomenon(37,42). Nevertheless, the value of his described examination maneuver has not diminished. Subsequent reports of cadaver dissections provided supportive results of Albee's three aforementioned conclusions(37).

A major advance in the refinement of the diagnostic approach to low back disorders sprung from the work of Steindler and Luck in 1938. Lesion localization via procaine instillation was described. Their data highlighted the effectiveness of this technique. It also demonstrated numerous anatomical structures can precipitate low back pain(39). Following the presentation of their work "before the American Medical Association in June 1937"(21) Haldeman employed Steindler and Luck's concepts for therapeutic intervention of SIJ conditions. Forty-two treated cases of sacroiliac strain were described in detail with impressive results obtained(21).

It is upon this historical foundation much of our current conceptualizations are built. As already described this structure consists of several premises. First, movement, albeit minimal, occurs at the sacroiliac articulation. Second, the sacroiliac articulation is a true joint. Third, low back pain can originate from the SIJ. Fourth, relief of pain after injection of local anesthetic into the joint confirms it as the pain generator. Subsequent articles have collectively supported these tenets(4,5,8,9,11,13,22,26,32,38,43).

The one issue which seems to still initiate heated debate involves motion of the

SIJ despite an overwhelming majority of both in vivo and in vitro studies supporting this contention. In a thoughtful and thorough analysis of published literature about this topic Walker, in 1992, determined motion does indeed occur(43).

While it is evident SIJS is a potential cause of low back pain our ability to decipher who has this condition is not optimal. In part this is related to the various body regions in which pain due to SJI pathology can be experienced. Low back(1,5,8,9,11,14,22,34,38,43,44), buttock(8,14,22,26,30,34) greater trochanteric(8,10,26,44), inguinal²⁹, abdominal'4' 2" 32, groin(26,32), posterior thigh(5,8,22,26,29,34,38,44), anterior thigh(10,26), posterior calf(5,29,34,38,44), and lateral calf(29,34,38) pain have been described. Recently, efforts have been directed towards establishing SIJS symptom specific abnormalities. Fortin and Aprill, via fluoroscopically guided SIJ distension in normal volunteers, provide compelling evidence of where a patient should always describe a portion of their symptom complex; "an approximate 3.0 by 10.0 cm linear strip extending from just inferior to the PSIS caudally"(17). This elegantly performed study supports Bemard's contention, developed from a retrospective review of 250 patients with SIJS, that SIJS pain "does not seem to originate in the lumbar area"(29).

Nevertheless, relying on symptom description is hazardous when making a diagnosis of possible SIJS. Manifestation of this syndrome is too diverse and overlaps with other musculoskeletal conditions. In our view, symptom location can only provide the suggestion this diagnosis is possible. This has led us to incorporate Bemard's and Aprill's observations such that if pain emanates from, or includes, the region just inferior to the PSIS we enter SIJS into our differential diagnosis. Physical exam maneuvers are then employed which can elevate the diagnosis to the probable category. Unfortunately, in our view, examination findings cannot prove SIJS is present.

An array of indirect examination techniques, as none directly examine the joint, have been described in medical, osteopathic, physical therapy, and chiropractic literature. These maneuvers are designed to either provoke SIJ pain or detect abnormal motion.

Provocative maneuvers we routinely administered were Gaenslen's test, Patrick's test, Yeoman's test, Shear test, pressure application to the posterior sacroiliac ligaments at the sacral sulcus, simultaneous pressure to each ASIS while the

patient is supine, pressure application to the superior ilium while patient is in the lateral decubitus position, and standing hyperextension. Although, as stated by Russell, the employment of these techniques has stemmed from a "'common sense' approach that stressing the sacroiliac joint ought to be positive in sacroiliac disease"(36) and reinforced by "occasional positive responses"(36) there are no studies confirming their predictive accuracy. Russell's study suggests Gaenslen's maneuver, Yeoman's test, and pressure application in the prone, supine, and lateral decubitus position does not offer discriminative information in the evaluation of the patient with an inflamed SIJ(36).

The other broad category of clinical tests involves observing the movement of spinal and pelvic landmarks. Numerous maneuvers have been described(4,11,14,34) but their interrater reliability has been demonstrated to be notoriously low; 23%-50%(34). Additionally, an high incidence of false positive responses was recently proven in a single blinded prospective study by Dreyfus et al.

Clearly, one cannot rely on detection of motion to refute or confirm a diagnosis of SIJS. We believe provocative maneuvers represent the best, though not ideal, sequence of clinical tests to investigate a case of possible SIJS. This view is supported by Walker who, after extensive literature review, states "all types of studies suggest use of extreme caution in claims to isolate motion to the SIJ" (during physical examination) "and give support to use of pain provocation tests"(43). Blower demonstrated high interrater reliability for three commonly used provocative maneuvers; anterior, lateral, and sacral compression. Bernard suggests a minimum of two positive stress tests must be present to place SIJS in the differential diagnosis(30). Mierau et al adopted this minimum criterion in their prospective study(29). We also acknowledge Bemard's recommendation by incorporating them into our inclusion criteria.

If physical examination cannot provide confirmatory evidence of SIJS other tools are required. Performing SIJB for diagnostic purposes is appealing. Numerous authors, as do we, consider this to be the definitive diagnostic test for SIJS(17,21,26,30,31,32). Although SIJB is a relatively riskless procedure, it is invasive and is associated with potential side effects; allergic reaction, infection, and post injection pain. In an effort to enhance the risk/benefit ratio of our diagnostic algorithm we requested SPECT be completed.

Nuclear scanning has demonstrated high sensitivity and low specificity for sacroiliac disorders(19,25,27,40). However, recent reports suggest its low specificity may be an incorrect conclusion. Rather, the detected SIJS uptake abnormalities with patients who have low back pain without spondyloarthropathy may have actually represented individuals with SIJS(2,12,29). If this is true, nuclear scanning ought to be regarded as both highly sensitive and specific. Furthermore, SPECT has increased nuclear imaging sensitivity compared to standard nuclear scans(18,33). It is widely accepted as "an improvement over conventional planar imaging owing to improved lesion detection with greater definition of skeletal anatomy"(18). Complimenting SFECT scanning's potential to yield invaluable diagnostic data is its' low risk. A dose of 20-25 millicuries provides less irradiation than plane anterior-posterior and lateral radiographs of the lumbar spine(35).

The results obtained do not support a positive recommendation to include SPECT in the diagnostic algorithm of a patient with probable SIJS. Only one of 11 patients, 9.1%, with diagnostically confirmed SIJS had a positive SPECT scan (see Table 3).

Obtaining negative SPECT results in patients with definite SIJS would be the expected outcome if SIJS is a biomechanical rather than inflammatory disorder. Under this scenario a "blocked joint" would cause pain when attempts at motion exceeded the SIJ's new, albeit abnormal, limit. This process is, therefore, neither inflammatory nor, at least initially, causing changes in metabolic bone homeostasis. A negative SPECT and positive SIJB should be the anticipated result.

Other explanations for our results include limited sample size, lack of blinding, absence of a control group, and performance of only one rather than recently recommended two diagnostic blocks (N. Bogduk).

To the best of our knowledge SIJB has not been compared to sham injection. Yet clinicians, as do we, believe the sine qua non in diagnosing SIJS is pain amelioration following SIJB. This assumption represents a potential serious flaw in our study as we did not attempt to rule out a placebo response to injection(16). Without attempting to minimize this issue it should be understood our main objective was to treat patients with a concurrent secondary goal of extracting

clinically relevant information which could impact the diagnostic work up of SIJS. Consequently, all subjects followed our usual diagnostic and therapeutic algorithm for SIJS; no one had treatment withheld (underwent sham injection).

Nevertheless, it is unlikely a placebo response significantly effected our data. Of the 13 consecutive patients who met our symptomatic and examination criterion and underwent SPECT, 11 obtained 80% or greater VAS score reduction. Assuming a false positive or placebo response rate of 35%, a "worst case scenario" response rate of 62% (8/13) is obtained. Under this scenario, 12.5% (1/8) of patients with definite SIJS would have had a positive SPECT. A "best case scenario" can also be postulated. The two excluded patients, 12 and 13, ultimately derived good resolution of their presenting symptomatology despite a presenting duration of 25 and 60 months, respectively. Subject 13 had utilized numerous non-steroidal anti-inflammatory agents (NSAID's), participated in extensive passive and active physical therapy, and underwent four prior fusion procedures to address her presenting symptomology. Therapeutic intervention for both involved additional SIJB and participation in physical therapy for SIJS. Only patient 12 took any medication; an NSAID. Such improvement can be interpreted as confirmation of the presence of SIJS, false negative diagnostic SIJB, thereby providing a "best case scenario" response rate of 100% (13/13). In this instance 7.7% (1/13) of patients with definite SIJS would have had a positive SPECT.

In summary, the performance of SPECT in the work up of SIJS is not supported by the results of this preliminary study regardless of which singular scenario or combination thereof one accepts as accurate. It is recommended future studies of larger sample size, which employ double blind, double injection methodology be performed.

FIGURE 1

Sacroiliac Joint Injection before and after contrast - Arthrogram of entire joint including filling of inferior capsule

TABLE 1

Demographic Representation of Patients Who Met Symptom and Examination Criteria

PATIENT	SEX	AGE (years)	SYMPTOM DURATION (months)	SIDE OF INVOLVEMENT
1	M	32	63	B
2	F	35	6	L
3	M	26	24	B
4	M	39	1	L
5	F	22	8	B
6	M	48	18	L
7	F	41	8	L
8	F	39	9	R
9	F	49	72	R
10	F	53	48	L
11	F	28	5	L
12	F	21	25	R
13	F	19	60	B

TABLE 2

Pre and Post Injection VAS Scores for Patients Who Met Symptom and Examination Criteria

PATIENT	PRE-INJECTION	POST-INJECTION
1	5.0	0.9
2	7.8	0.0
3	8.2	0.0
4	8.4	0.0
5	6.2	0.7
6	4.1	0.0
7	8.5	0.0
8	5.6	0.0
9	5.8	0.0
10	2.0	0.0
11	4.5	0.9

12	6.4	2.4
13	7.0	4.6

TABLE 3

Percent VAS Score Reduction and SPECT Result for Patients Who Met Symptom and Examination Criteria

PATIENT	VAS REDUCTION (%)	SPECT
1	82	-
2	100	-
3	100	-
4	100	-
5	89	-
6	100	-
7	100	+*
8	100	-
9	100	-
10	100	-
11	80	-
12	63	-
13	36	-

*SPECT positive for the bilateral SIJ

REFERENCES

1. Albee S: The study of the anatomy and the clinical importance of the sacroiliac joint, JAMA 16:1273-1276, 1909
2. Ayres J, Hilson I, Maise M, Laurent R, Panayi G, Saunders A: An improved method for sacroiliac joint imaging: a study of normal subjects, patients with sacro-iliitis and patients with low back pain, Clin Radiol 32:441-445, 1981

3. Beecher Fl: The powerful placebo, JAMA 1602-1606, 1952
4. Bemis T,Zaniel M. A validation of the long sitting test on subjects with ilosacral dysfunction, JOSPT 7:336-345, 1987
5. Bernard T, Kirkaly-Willis W: Recognizing specific characteristics on non-specific lower back pain, Clinical Orthop 217:266-280, 1987
6. Bernard TN, Cassidy JD: The sacroiliac joint syndrome: pathophysiology, diagnosis and management, The Adult Spine: Principles and Practice. Raven Press Limited, ed. JW Frymoyer 1991, pp 2107-2130
7. Blower PW, Griffin AJ: Clinical sacroiliac tests in ankylosing spondylitis and other causes of low back pain-2 studies, Annals of the Rheumatic Diseases, 43:192-195, 1984.
8. Bohay B, Gray I: Sacroiliac joint pyarthrosis, Orthopaedic Review July 1993 817-823
9. Cibulka M: The treatment of the sacroiliac joint component to low back pain: a case report, Phys Ther 12:917-922, 1992
10. Cibulka MT, Delitto A: A comparison of two different methods to treat hip pain in runners, JOSPT 17(4):172-176, 1993
11. Daly I, Frane P, Rapoza P: Sacroiliac subluxation: a common treatable cause of low back in pregnancy, Family Practice Research Journal 2:149-158, 1991
12. Davis P, Lentle B: Evidence for sacroiliac disease as a common cause of low back pain in women, Lancet Sept. 2, 496-497, 1978
13. DonTigny R: Dysfunction of the sacroiliac joint and its treatment, JOSPT 1:2335, 1979
14. DonTigny R: Anterior dysfunction of the sacroiliac joint as a major factor in the etiology of idiopathic low back pain syndrome, Phys Ther 4:250-265, 1990
15. Dreyfuss P, Dreyer S, Griffin J, Hoffman J, Walsh N: Positive sacroiliac screening tests in asymptomatic adults, Spine 19(10):1138-1143, 1994

16. Fields Fl, Levine J: Biology of placebo analgesia, *Amer J Med* 4:745-746
17. Fortin I, Aprill C, Dwyer A, Pier J: Sacroiliac Joint: Pain Referral Maps. Abstract 78, pp 83. Presented at the 7th annual NASS meeting, Boston, Massachusetts, July 9-11, 1992.
18. Gates G: SPECT imaging of the lumbosacral spine and pelvis, *Clin Nuclear Med* 12:907-914, 1988
19. Goldberg R, Genant H, Shimshak R, Shanes D: Applications and limitations of quantitative sacroiliac joint scintigraphy, *Radiology* 128:683-686, 1978.
20. Goldthwait JH, Osgood RE: A consideration of the pelvic articulations from an anatomical, pathological and clinical standpoint, *Boston Medical and Surgical Journal*, 152(21):593-601, 1905
21. Haldeman K, Sotohall R: The diagnosis and treatment of sacro-iliac conditions involving injection of Procaine (Novacain). *J Bone Jt Surg* 3:675-685, 1938.
22. Harvey J, Tanner S: Low back pain in young athletes: a practical approach. *Sports Med* 6:399, 1981
23. Hendrix R, Paul Lin P, Kane W: Simplified aspiration or injection technique for the sacroiliac joint. *J Bone Jt Surg* 64-A:1249-1252, 1982.
24. LaBan M, Meerschaert J, Taylor R, Tabor H: Syphyseal and sacroiliac joint pain associated with pubic synthesis instability. *Archives of PMR* 59:470-478, 1978
25. Lantto T: The scintigraphy of sacroiliac joints: A comparison of 99mTc-VPB and 99mTc-MDP *Fur J Nucl Med* 16:677-681, 1990
26. Leblanc K: Sacroiliac sprain: an overlooked cause of back pain. *American Family Physician* November 1992, 1459-1463
27. Lentle B, Russell A, Percy J, Jackson F: The scintigraphic investigation of sacroiliac disease. *J Nuclear Med* 6:529-533, 1977
28. Marymont J, Lynch M, Henning C: Exercise-related stress reaction of the

sacroiliac joint an unusual cause of pain in athletes. Amer J Sports Med 4:320-323, 1986.

29. Mierau D, Yong-Hing K, Wilkinson A, Sibley i: Scintigraphic analysis of sacroiliac pain: Toward a diagnostic criteria for sacroiliac syndrome. Presented at the 7th annual NASS meeting, Boston, Massachusetts, July 9-11, 1992

30. Mooney, V: The subacute patient: to operate or not to operate-this is the question, Contemporary Conservative Care for Painful Spinal Disorders, ed. Mayer T & Gatchel, R, Lea and Febigr, p 260, 1992

31. Moore M: Diagnosis and surgical treatment of chronic sacroiliac arthropathy. Abstract 95. Presented at the 7th annual NASS meeting. Boston, Massachusetts, July 9-11, 1992.

32. Norman G: Sacroiliac disease and its relationship to lower abdominal pain. Amer J Surg 116:54-56, 1958

33. Onsel C, Collier ED, Kir KM, Larson SJ, Meyer GA, Krasnow AZ, Isitman AT, Hellman RS, Carrera GF: Increased sacroiliac joint uptake after lumbar fusion and/or laminectomy, Clinical Nuclear Medicine, 17:283-287, 1992

34. Potter N, Rothstein J: Intertester reliability for selected clinical tests of the sacroiliac joint. Phys Ther 11:1671-1675, 1981.

35. Russell A, Lentle B, Percy J: Investigation of sacroiliac disease: Comparative evaluation of radiological and radionuclide techniques. J Rheum 1:45-51, 1975

36. Russell A, Maksymowych W, LeClercq S: Clinical examination of the sacroiliac joint: A prospective study. Arthritis and Rheumatism 12:1575-1577, 1981.

37. Sashin D: A critical analysis of the anatomy and the pathological changes of the sacro-iliac joint. Journal of Bone and Joint Surgery 12:891-910,

38. Schuchmann J, Cannon C: Sacroiliac strain syndrome: diagnosis and treatment. Tex Med 82:33-36, 1986.

39. Steindler, Luck J: Differential dia~osis of pain lower in the back allocation of the source of pain by the procaine hydrochloride method. JAMA 106-113, 1938

40. Verlooy H, Mortelmans L, Vleugels S, DeRoo M: Quantitative scintigraphy of the sacroiliac joints. *ClinImaging* 16:230-233, 1992
41. Vleeming A, Volkers ACW, Snijders CJ, Stoeckart R: Relation between form and function in the sacroiliac joint, Part II: biomechanical aspects, *Spine* 15(2):133-136, 1990
42. Walker J: Age-related differences in the human sacroiliac joint: a histological study; indications for therapy. *JOSPT* 6:325-334, 1986.
43. Walker J: The sacroiliac joint: a critical review. *Phys Ther* 12:903-916, 1992
44. Yeoman, W: The relation of arthritis of the sacro-iliac joint to sciatica, with an analysis of 100 cases. *Lancet* 1119-1122, 1928