

Interdisciplinary Perspectives on Mechanisms and Management of Low Back Pain

David K. Ahern, PhD, *Moderator*
Duane Bishop, MD
Michael J. Follick, PhD
Melvyn Gelch, MD
Phillip Lucas, MD
John Parziale, MD
William Marras, PhD
Dianne L. Wilkin, PhD
Steven Wolf, PT, PhD

Chronic low back pain (CLBP) is one of the most pervasive and costly problems facing medicine today. In addition to personal suffering, CLBP accounts for a greatly disproportionate amount of consumer health care over-utilization, employee absenteeism, lowered work productivity, disability and compensation payments. Recent research in the area has called attention to the complex nature of the problem and the need for an interdisciplinary approach to identification and management. Toward this end, a panel of health care professionals with skill in the assessment and treatment of chronic pain was convened on November 17, 1988. Sponsored by the Institute for Behavioral Medicine in Providence and with funding from the National Institute for Neurological Disorders and Stroke, Stroke and Trauma Program, the purpose of the panel discussion was to bring together clinicians and researchers from distinctly different specialties but who all work with CLBP patients. Topics of discussion included etiology, current status of medical diagnostics and treatments for chronic pain, conceptual and systems issues, and directions for future research.

Moderator: What do you believe to be the critical signs or symptoms in a medical examination which would suggest the presence of disc or nerve root involvement?

Lucas: The presence of herniated disc or nerve root irritation is probably the easiest of all diagnoses to make for the physician treating individuals with lower back pain. One can often spot the individual with such a symptom complex as he/she walks into the examining room, and very often the history gives the diagnosis. The major complaint is that of leg pain, weakness or numbness. Any or all of these symptoms can be

present with nerve root compression.

There are two groups of patients that we see with nerve root involvement: A younger group, aged 20 to 40, that present with leg pain secondary to a herniated disc, and an older group, aged 50 and beyond, who present with leg pain secondary to spinal stenosis. Their complaints are different. The younger group complains of leg pain, and may also complain of numbness and weakness. Pain is exacerbated by standing or sitting. Relief can often be found in a reclined position. Symptoms begin acutely, often preceded by back pain, but

very often when the leg pain begins the back pain disappears. The older group with spinal stenosis generally complains of an achiness or weakness in the legs which is present with standing and walking and is relieved by sit-

ABBREVIATIONS USED:

CLBP: Chronic low back pain
CME: Continued medical education
CT: Computerized tomography
EMG: Electromyography
MRI: Magnetic resonance imaging
TNS: Transcutaneous nerve stimulation

ting down, much the opposite of the patient with an acute disc herniation. The leg symptoms are differentiated from those of vascular claudication in that the patient with spinal stenosis needs to sit down to get relief. He or she cannot stop walking or stand still.

On physical examination, the younger patient generally will report excruciating pain and show marked restriction in spinal mobility. He or she more often will show neurological deficit on examination of the extremities, with decrease in sensation, weakness, and reflex changes, and radiating pain with straight leg raise. The patient with spinal stenosis may show some spinal restriction, but generally this is in extension rather than flexion of the spine and the physical exam is remarkable only in the paucity of findings. Generally there is no evidence of neurological deficit. In a classic picture of nerve root involvement either due to stenosis or disc herniation, diagnostic studies such as a CT scan, MRI or myelogram should only confirm the diagnosis arrived at on the basis of the history and examination. It is very rare to have a false negative diagnostic test in a patient with nerve root involvement. On the other hand, patients with minimal clinical findings may have notable abnormalities on their CT scan, myelogram or MRI which may not be clinically significant. One must always keep in mind, especially in the surgical treatment of back pain and nerve root involvement, to treat the pa-

David K. Ahern, PhD, is Director of Research at the Institute for Behavioral Medicine and Clinical Assistant Professor with the Department of Psychiatry and Human Behavior, Brown University Program in Medicine, Providence, Rhode Island.

tient based on presentation of symptom rather than solely on the basis of diagnostic tests.

Moderator: What are the indications for surgical intervention in chronic low back pain?

Gelch: First, there is a major problem with the phrase "low back pain." I don't treat "low back pain" per se. I am a surgeon and operate for radiculopathy, that is, pain that radiates down the back and side of the leg along the distribution of the sciatic nerve. Low back pain can occur because of surgically-correctable conditions such as slippage of bones, spondylosis or spondylolisthesis. Radiculopathy can arise from tuberculosis or a metastatic process. Finally, low back pain can be secondary to instability of the spine because of some injury. If the spine were all vertebrae, that is, all bone, an individual wouldn't be able to bend at all. The spinal column is a flexible rod that permits bending and twisting. But where there's movement, particularly flexion, there is a significant amount of force or pressure applied to the spinal column. For example, if an individual bends over to lift an object, there is a tremendous acute pressure placed on the discs and the ligaments around them. And so when an individual tears a ligament somehow, the disc displaces. When a disc becomes displaced it pinches the nerve, transmitting pain down through the buttocks, legs, and occasion-

Duane Bishop, MD, is Chief of Rehabilitation Psychiatry at Rhode Island Hospital and Associate Professor with the Department of Psychiatry and Human Behavior, Brown University Program in Medicine, Providence, Rhode Island.

ally the groin. By examining the pattern of pain distribution, the clinician can identify the level of the involved disc.

In my practice I treat patients who have leg pain secondary to nerve compression. Those who have low back pain symptoms only are more appropriately treated conservatively. In those cases of low back pain secondary to spinal instability, an orthopedic surgeon such as Dr Lucas, who understands the mechanics of the back, would be the most appropriate treating physician. On the other hand, if the low back pain is derived from trigger points or lumbosacral or sacroiliac joints, a physiatrist such as Dr Parziale would be the most appropriate.

Low back pain is really only a description and not a diagnosis. A patient either has low back pain secondary to a specific working diagnosis or sciatica. If a patient has sciatica, he/she may require neurosurgical evaluation to rule out multiple sclerosis, herpes zoster, or diabetes affecting the nerve, and neurosurgical intervention may be required.

Moderator: Dr Gelch has raised some interesting points. The definition of terms is important to discuss. Dr Follick, would you differentiate acute and chronic pain conditions, and what the implications are for treatment of these two types of pain problems?

Follick: A clear distinction must be made between acute and

Michael J. Follick, PhD, is President of the Institute for Behavioral Medicine and Clinical Associate Professor with the Department of Psychiatry and Human Behavior, Brown University Program in Medicine, Providence, Rhode Island.

chronic pain. In the context of an acute pain problem, the pain per se is considered as a symptom. Acute low back pain is the phrase used to describe pain that is less than three months in duration and typically is related to some injury. When considering chronic pain, the situation is quite different. Pain is not necessarily viewed as a symptom but rather often times is the primary problem. Chronic pain, in contrast to acute pain, is a complex phenomenon comprised of sensory, affective and evaluative components. Chronic pain is usually experienced daily and is pain that has persisted for an inordinately long period of time, usually six months or more, despite repeated medical interventions.

The mechanisms involved in the maintenance of chronic pain are hypothesized to be different than those for acute pain. In the case of chronic pain, psychosocial and/or environmental factors are considered to have a major influence on the clinical picture. Hence, treatment of chronic pain needs to be different than the treatment employed for an acute pain.

Moderator: Returning to the question of diagnosis, recently the field of medicine has witnessed major advances in technology. Diagnostic techniques have improved considerably with magnetic resonance imaging (MRI) perhaps as the best example. Dr Parziale, what additional information does MRI provide beyond Computerized Tomography (CT)? Also, would you comment on other techniques that are now

Melvyn Gelch, MD, is a Clinical Assistant Professor of Surgery with Rhode Island Hospital, Brown University Program in Medicine, Providence, Rhode Island.

available for the diagnosis of low back disorders?

Parziale: Magnetic resonance imaging (MRI) allows excellent visualization of anatomy. It has certain specific advantages over CT, especially when evaluating soft tissues. With MRI the clinician can examine the saggital plane quite clearly, something that is often difficult to do with CT. Additionally, the hydration status of a disc can be evaluated by MRI more readily than with CT. This aspect of MRI is important because in some disc syndromes, a dehydrated disc can in itself be a source of pain where a well-hydrated disc is less likely a source of discomfort. MRI can help in differentiating between fibrosis, hematoma, recurrent disc, and the patient who has a failed back surgery syndrome. A neurosurgeon would be less likely to operate upon a person who previously had back surgery if they were operating upon scar tissue only, since pain will most likely recur. If pain is related to a recurrent disc, that surgeon might be more likely to reoperate. MRI allows good visualization of the spinal cord and the spinal nerve root without intrathecal contrast. The sensitivity of the examination can be enhanced by weighing it differentially using T1 and T2 weights. That along with paramagnetic agents such as TV gadolinium can dramatically improve the contrast between the various soft tissue structures. Another advantage of MRI over CT is that MRI does not result in any radiation exposure. CT still has

Phillip Lucas, MD, is Clinical Assistant Professor of Orthopedics with Rhode Island Hospital, Brown University Program in Medicine, Providence, Rhode Island.

an important place in evaluation of the patient with low back pain. In particular, CT is very good at examining bony structures. For fracture, displacement, or arthritis, CT is the preferable technique.

Is there still a place for myelography? Clearly, there is, but the role of myelography will be changing as we become more familiar with MRI techniques. Yet MRI is not without drawbacks. The MRI gantry is a narrow tunnel, and some patients become claustrophobic during testing. Also, MRI has certain contraindications such as its use with patients who have pacemakers or metallic implants.

Plain film X-rays have been used for many years and continue to be valuable as part of a baseline evaluation for low back pain. Thermography has been advocated by some although the reproducibility of the thermograph remains in question; thermography is not considered a particularly reliable diagnostic test at the present time. Electro-diagnostic studies such as EMG and nerve conduction studies can give excellent information about the integrity of the nervous system. Finally, somatosensory evoked potentials reveal the function of the spinal cord. To summarize, a variety of diagnostic techniques and studies as well as local injections and bone scans are available to help the clinician diagnose the causes of acute and chronic low back pain.

Moderator: There is some excit-

John Parziale, MD, is Physiatrist-in-Chief of the Department of Rehabilitation Medicine at Rhode Island Hospital and Assistant Professor with the Department of Orthopedics, Brown University Program in Medicine, Providence, Rhode Island.

ing work being done now in the area of the biomechanics of the lumbar spine. I would like to pose this question to Dr Marras first and then ask Dr Wolf to comment as well. Dr Marras, in your opinion, what are the critical biomechanical factors in low back pain?

Marras: Before I describe the biomechanical factors involved in low back pain, first let me give you a brief overview of the way I perceive the world. I like to divide the world up into both internal and external forces. External forces are those forces against which gravity works. In other words, if I'm going to lift a box, the force of gravity opposes the lift. Internal forces, on the other hand, are the muscular reactions to external forces and these can often become quite strong, as Dr Gelch had mentioned. It is important to look at the muscular involvement and that is often reflected by the motion of the back. I would like to come back to this point.

Wolf: It's remarkable that most of the low back pain patients we see don't have clear discogenic problems, nor is there clear evidence of radiculopathy. Thus, we have learned to ask a patient the critical question, "What activities exacerbate your pain and then show us those activities?" This question begins to address the biomechanical aspects of low back pain. We thought several years ago that one gained insight toward understanding the aberrations in movements in low back pain patients by evaluating bilateral paraspinous electromyographic activity to see how these

William Marras, PhD, is Associate Professor with the Department of Industrial and Systems Engineering, Ohio State University.

mirror-imaged muscles move relative to one another. While this approach has provided some insight into abnormal movements when compared to normal patterns, and also provided the basis for certain training and treatment strategies, it has not been the revelation that some clinicians would have liked. This is not surprising when we consider the complexity of the anatomy of the lower back. Presumably, most low back pain problems will govern the L4-L5 or L5-S1 vertebrae interspaces, and if we consider each as the minimum of four joints, and each moved by seven pairs of muscles on each side of the back, then any mechanical factors that produce an aberration in alignment can cause a change in the relative activity or tension in those muscles. As a result, there will be unequal pull upon the various bones. In turn, this excessive muscle tension can serve to reinforce the misalignment, thus leading to further pain.

A more exciting and promising approach to examining the importance of biomechanical factors is still in its infancy, and although we have touched upon this approach in recent years I think we are going to hear a lot more about it. This approach de-emphasizes electromyographic analysis and rather concentrates on kinematics; that is, the individual's ability to move through three planes during dynamic activities. There is accumulating evidence that kinematics may be a far more sensitive indicator of aberrations of movement in terms of pain than electromyography.

Marras: I agree totally with Dr

Dianne L. Wilkin, PhD, is Project Coordinator at the Institute for Behavioral Medicine, Providence, Rhode Island.

Wolf. Given my perspective as a biomechanicist, I want to determine what the low back muscles are doing to produce that force outside the body during dynamic movements. I think of this process in terms of a transfer function. What I mean by that is input versus output. In other words, I want to know what those muscles have to do to supply that counter force so as to maintain spinal equilibrium. As Dr Gelch mentioned, a particular lift may result in 2000 lbs of force exerted on the lumbar spine. From a biomechanical viewpoint, if an individual is holding 100 lbs some distance from the body, say a foot or two away, then a moment around the spine has been created which will be equivalent to the force times the distance. That moment must be counteracted by another moment, which is supplied by the muscle position relative to the spine. However, that muscle is only an inch or two away from the spine, so the forces have to be very, very great which is why there can be 2000 lbs of pressure on the spine. As Dr Wolf mentioned, there are several ways to evaluate the forces on the lumbar spine. One method involves electromyography to determine the amount of activity required to produce the necessary counterforce to the forces outside the body. Another method involves determining the net sum of that muscle activity, which is often reflected in motion patterns around the spine. In our laboratory, we have done studies that have demonstrated that there are dramatic differences in the motion patterns of individuals who are suffering

Steven Wolf, PT, PhD, is Professor of the Department of Rehabilitation Medicine, Emory University School of Medicine, Atlanta, Georgia.

from chronic low back disorders as compared to controls. I think that motion patterns are our "window to the world." This biomechanical approach determines exactly how all these muscles operate. However, there needs to be a word of caution. Presently, there are a number of back testing machines available on the market that measure these types of biomechanical parameters. It is very important to determine the net sum of the muscle activity during dynamic movement. Several machines claim they measure velocity parameters and motion components yet these machines may alter the motion so much that the clinician is no longer evaluating what the person has naturally developed over a lifetime of programmed learning of recruitment of those muscles. Several machines control the velocity of movement, which may be desirable when examining electromyography.

If the clinician is interested in examining the net sum of motion then the types of machines described above are not necessarily appropriate. There are other machines that let you use motion parameters as a dependent measure. The person is placed in a chair and then moved around in different planes. The motion patterns or the motion components are observed and analyzed for those with and without back problems. However, this type of machine also has limitations because the mechanics of the device may alter the motion of the back significantly. Usually the upper harness of these types of devices may weigh anywhere from 30 to 50 lbs which create huge moments of inertia. Thus, when an individual pushes against the device, the mass begins to move and will continue to move by itself even when the individual stops pushing against it. Clearly,

the clinician should carefully consider the advantages and disadvantages of the various types of machines, and the purpose for which it is intended, prior to making a purchase.

Moderator: Dr Follick alluded to the role of psychosocial factors in pain syndromes, especially as the transition occurs from acute to subacute, and ultimately chronic pain. First, Dr Bishop, what is the role of testing for organic signs when evaluating low back pain? And second, to what extent should the presence of significant emotional and psychosocial difficulties alter the medical approach to both assessment and treatment?

Bishop: Clearly clinicians need to conduct a careful assessment of the psychosocial components. There is compelling evidence that psychosocial factors are extremely important in the development of persistent pain conditions. George Engel and a number of other researchers promulgated the concept of the pain-prone individual. This research has suggested that a number of factors, in particular, individuals with a background of inordinate feelings of guilt, with a marginal adjustment to life and a high degree of problems, strong aggressive drives and those who experience loss or even the threat of loss are prone to developing persistent pain problems.

Other researchers have documented physical and sexual abuse in the backgrounds of individuals with chronic pain. They claim that these individuals have led miserable lives and are depressed. However, the research evidence suggests that most often depression associated with chronic pain is qualitatively different than major affective illness. Thus, we cannot claim that pain is simply a

symptom of an underlying major depression.

From a clinical perspective, the psychosocial examination will help the clinician make judgments about the course of treatment, which is a clinically important issue. It is also generally acknowledged that a central psychosocial component of chronic pain is depression. It is, therefore, important to determine the extent of depressive symptoms. For example, does the individual present with a history of chronic depressive symptoms or a depressive personality? Perceive the glass as being half empty rather than half full? Is the depression reflective of a psychiatric disorder? The presence of a chronic medical condition does not preclude the presence of a concomitant psychiatric disorder. Does it represent an adjustment to some chronic marital or family dysfunction, with an exacerbation of personality features as a result? And last, but not least, is the pain a result of depression secondary to the medication syndrome these patients often develop, the "junk syndrome" of multiple medications? The clinician must sort out these etiological factors, and remember that in a given patient several of them may be active.

Another approach is to consider different models, for example, a social learning theory point of view. Do operant or reinforcement factors account for pain complaints and behavior? Classical conditioning is also an important paradigm to consider. Patients frequently come to hospitals or treatment centers and have negative experiences because of unpleasant procedures, such as myelograms, and they may develop a conditioned fear as a result. These fears may persist and lead to full-blown phobias. Many of these patients have more phobias than we realize.

Also, modeling is an important process by which patients learn to respond to pain and illness. It is, therefore, important to determine whether these individuals have been exposed to family members or other individuals who suffered from pain or other disabling conditions and how they handled it. Hence, if we examine the patient from a social learning point of view, and find positive evidence, then this information will help to determine the kind of treatment to be provided.

The second model is adaptation. As clinicians we often overlook the individual's preferred coping strategy. Some people read books when they get upset, some people go out and chop wood. If you're a wood chopper, and you develop a chronic back condition, you not only have the back problem, but you have lost your coping strategy, whereas the person who reads the books may actually be able to make use of that activity to overcome or modulate the pain problem. The other aspect to consider within the adaptation model is the presence of maladaptively used defense mechanisms. For example, is the individual someone who tends to somatize, ie, express distress in physical symptoms, overly focus on bodily functions or displace conflicts onto their body?

To summarize, there are many psychosocial contributions to chronic pain and several models we can use to assess them. We need to evaluate carefully in order to choose the most appropriate treatment.

Moderator: The assessment of low back pain is compounded further by the fact that there are significant socioeconomic implications when an assessment is conducted of a chronic pain patient. The terms that describe limitations are not understood clearly

and, consequently, often confused. Dr Parziale, would you comment on and distinguish among the terms impairment, disability and handicap?

Parziale: The terminology is often misused in clinical practice. The World Health Organization has developed standard definitions for impairment, disability and handicap. Impairment is an abnormality of psychological, anatomical or physiological function.

Disability is a loss of functional capacity at an individual level. Handicap is the resultant disadvantage of the disability which can take various forms. It can assume socioeconomic, vocational, or cultural forms. Let me give you an example of how these terms may be distinguished. A young man presents with spondylosis or spondylolisthesis in his lumbar spine found on routine X-rays. That individual may be symptomatic or asymptomatic. If he's asymptomatic, he has an impairment; there is a structural abnormality, but there is no resultant disability. If this man is symptomatic, he may have very little disability if he is employed in a fairly sedentary type of job and has the types of coping strategies that Dr Bishop spoke about for his pain problem. On the other hand, if this individual is a professional football player who has significant pain from this impairment of his lumbar spine, he may have significant disability which will then give rise to a resultant handicap. He may not be able to pursue his vocation, which would then lead to a cultural and socioeconomic hardship.

Moderator: I'd like to shift our focus now to treatment questions and ask Dr Gelch, what are the criteria for surgical interventions following an initial laminectomy?

Gelch: As a neurosurgeon, I'd like to comment first about the evaluation of psychological/psychiatric problems in this population. There is no question that chronic pain is very commonly associated with depression. Many of the medications used for pain such as Percodan may mask an underlying depression. But my experience as a neurosurgeon for many years has made me aware of the potential for a neurophysiologic basis for depression in these patients. For many years, I had performed a lumbar laminectomy for a pinched nerve which relieved leg pain but the patient would be discharged with depressive symptoms. For the past 4-5 years, I've been prescribing high doses of steroids post-operatively to address these symptoms, with favorable results. In many cases, the depression resolves within 24 hours. In these cases, the depression is not solely functional but rather the fact that the chronic pain produces adrenal insufficiency. Often times now when we conduct a workup for depression in the hospital, we determine ACTH levels and perform other hormonal tests to determine if there is any underlying physical cause. It is my opinion that many of these people with chronic pain, because of the stressful nature of the condition, develop adrenal insufficiency. These patients become depressed and slow down in their activities. In turn, they become so concentrated on their back pain and problems because they are afraid of more pain that they develop a chronic pain syndrome which then becomes very complicated. So it is important to rule out any physiologic basis for the depression that might be correctable.

As I mentioned earlier, surgery is indicated only if there is evidence of radiculopathy. There are

only two types of disc that are operative. One of the two types of disc is called the ruptured disc, that is, a disc that literally breaks into pieces, like a "volcano erupting." It's not a herniated disc, it's not a slipped disc, it's not a bulging disc. In a published study in the *Journal of Spinal Disorders*, researchers at the University of Pennsylvania and Pennsylvania Hospital conducted a retrospective study on their patients who were carefully selected for and underwent surgery.¹ They claimed that 95 per cent of these patients experienced good to excellent results from lumbar disc surgery. Clearly, careful screening and selection is crucial to achieve this high a success rate. The second type of disc is one that becomes displaced beneath what is called a posterior longitudinal ligament. These are ligaments that keep this soft, spongy material in place. If a tear occurs the disc can then come out through the ligament. Oftentimes a disc comes out beneath the ligament over the bone and cannot get back into place. It is likely that there are discs that "slip out and slip in" and this process is one of exacerbation and remission of pain. Indeed, most individuals with acute pain get better regardless of the treatment provided. But we do know that there are two types of disc, the ruptured disc that breaks into pieces and the incarcerated disc which is displaced and pinches a nerve to the extent that the body cannot accommodate. One can observe that the lumbar spine becomes flatter, with a disappearance of lumbar lordosis in these patients. That is nature's way of moving the disc away from the nerve. It causes a flattening of the back. But there is a limit to what the body can do to accommodate to a disc that is displaced and compressing a nerve. So we do operate only for those two types

of discs. Ordinarily, further exploration is not appropriate. The diagnostic techniques that are available, as Dr Parziale noted, are quite good. With the combination of CT, MRI, and myelography, one you can obtain as high as 97-98 per cent diagnostic accuracy. However, these tests can be costly. Most importantly, the physical examination is essential in determining whether or not a patient is likely to be a candidate for surgery. The techniques noted above are then used to confirm the diagnosis and help pinpoint the exact location of the defect. With regard to repeat surgery, an operation should not be performed solely to remove scar tissue because it simply will recur. When you cut scar tissue, what do you leave behind? You leave blood. What does blood form? Blood forms scars. Basically you would never operate just for scar tissue. However, there are cases where a bone compresses the nerve root. In these cases, a second and even third operation may be necessary. Some patients do improve with a second operation, between five and ten per cent, but as is the case for initial surgery, one has to be very careful that there is a clear disc problem and not simply scar tissue. Unfortunately, if a nerve has been compressed for some time, alterations in the nerve can occur that may never be correctable, even with decompression.

Moderator: As an alternative to surgery, a number of treatments have been developed. Dr Parziale, would you comment on the different non-invasive treatments available for chronic low back pain?

Parziale: Actually, there are many treatments that should be considered for low back syndromes prior to performing surgery. Generally,

it is acknowledged and, I believe most surgeons would agree, that there are relatively few and fairly discreet indications for low back surgery. Surgical intervention is often restricted to problems such as changes in bladder function, acute pain that has been caused by severe tissue compression and progressive neurologic deficit. Typically, the CLBP patient that we would see in our Rehabilitation Medicine Practice is one who does not have these specific clinical signs. Treatment may begin with an education program, usually coupled with a low back exercise program. If radiculopathic changes have led to weakness in the lower extremity, then usually lower extremity exercises are provided as well. The type of low back exercise that is recommended may vary from institution to institution and therapist to therapist. There is good evidence though that for many individuals who present with acute or subacute low back pain, extension exercises, such as the McKenzie techniques, can be very effective in reducing discomfort. Williams flexion exercises have been prescribed routinely for low back pain and are appropriate for many patients. Traction is often applied to theoretically reduce the tension upon the disc to the point where actual distraction of the two bodies is achieved. Substantial force needs to be applied to accomplish this objective, in the range of 50 per cent of body weight, and the force has to be applied to the pelvis keeping the upper torso fairly stable. Consequently, traction is difficult to apply consistently well and may produce additional pain. Ultrasound has been used to heat soft tissues, but may be ineffective in many conditions. In cases of small tumor or prior laminectomy ultrasound is actually contraindicated because of the potential

for additional damage. Superficial heat can be effective at reducing paraspinal muscle spasms. Ice treatments may be used for the same reason. The other treatments that are applied in addition to exercise, traction and heat or ice modalities include electrical stimulation to reduce paraspinal spasm. Electrical stimulation can fatigue a muscle that is in severe spasm and consequently can produce relaxation of that muscle which can lead to a reduction in pain. Transcutaneous nerve stimulation (TNS) units can be used to relieve pain as well. The use of lumbar or lumbosacral corsets can increase intra-abdominal pressure and thus relieve intradiscal pressure.

Perhaps the most promising concept developed in treating pain syndromes on a long-term basis has been the idea of the "neutral" spine,² promulgated by Dr Jeffrey Saal. The objective is to move a patient through various ranges of motion and define the position of the spine that is most comfortable, which is not always what is the normal lumbar lordosis. The patient is taught to maintain that neutral position of the spine whenever they change from a standing to sitting position, sitting to standing, supine to sitting and/or lifting objects. Hence, when a transition is made, most of the force is applied to the legs rather than to the low back region. This approach represents an important theory in the rehabilitation of low back pain patients.

Moderator: Dr Wolf, do you want to make any additional comments on treatment alternatives?

Wolf: Well, I agree with Dr Parziale that there has been an attempt to develop treatment meth-

ods based upon normalization of the spinal alignment. Considerable research has been conducted utilizing paraspinal EMGs during static postures and dynamic movements with the goal of understanding the forces on the lumbar spine during these activities. I have concern with most thermal modalities. Under the appropriate conditions, either heat or ice can reduce muscle spasm; but the undeniable fact is that the cause of the spasm is often indeterminate and those spasms will persist and represent themselves as long as that imbalance in muscles remains. Unfortunately some proponents of mobilization techniques, including manipulation of the spine and gentle mobilization based upon palpation and reorganization of misaligned spinal segments, have not adequately documented the scientific validity of these approaches. In my experience, and perhaps for some of you in this room, very favorable results have been obtained with mobilization techniques. However, it is very difficult to document the validity and efficacy of this approach. With regard to electrical stimulation, particularly TNS, we have had some experience at my institution regarding its utility as a treatment technique. In most cases, patients do very well while they are under the TNS treatments along with other interventions, but as soon as the applications are relegated to the patient, out of the context of the clinical setting and when these patients are subjected to a variety of other factors over which we have no control, the benefits of this form of stimulation decrease considerably. Thus, I would say that electrical stimulation to block pain has a limited role in the total comprehensive care of back pain patients.

Moderator: A number of our panelists today have commented on the association between chronic pain and depression. Dr Bishop, would you comment on the role of antidepressants in the treatment of chronic pain.

Bishop: I think the term antidepressant is somewhat of a misnomer. These drugs affect neuronal transmission and vary in their actions and side effects depending on which enzyme systems they affect. Some of the earlier generations of these drugs affected many receptor systems. Presently, there are antidepressants available that affect only specific receptors.

Antidepressants have other effects. For example, some are very potent analgesics and can be used in conjunction with other analgesics to maximize the desired analgesic effect. Amitriptyline would be an example. Imipramine is a very effective, fast-acting antispasmodic (within 24-48 hours), quite different than the time-line for its antidepressant effect, which typically is about two weeks. The antidepressants are also potent in reducing anxiety. Clearly, they are effective in the treatment of the neuro-vegetative symptoms of depression such as sleep and appetite disturbance as well as other symptomatology such as negative attributions and the negative/pessimistic view of the world that I mentioned earlier. The antidepressants are also useful with patients who suffer from obsessive-compulsive disorders. Many chronic pain patients present with very fixed and rigid pain complaints, some of which take on a very strong, obsessive quality. In summary, antidepressants have an important role to play in the treatment of pain syndromes and the choice is determined by the symptom pattern to some extent. As I men-

tioned earlier, the promise for the future is further specificity of action and this in turn will increase our knowledge of the psychophysiological correlates of complex pain problems.

Moderator: Clearly, CLBP is a major health care problem that has stymied attempts at diagnosis and treatment. Because of its complexity and recalcitrance, CLBP has an enormous socioeconomic impact. Dr Follick, would you comment on CLBP and the Worker's Compensation System.

Follick: In the past few years, problems with the Workers' Compensation System have received a great deal of attention, oftentimes with a lot of finger pointing. Since CLBP is one of the most frequent and costly work-related injuries, it is an issue of great concern. Physicians, attorneys and employers at various times have been accused of contributing to the failure of the compensation system which was to meet the needs of patients and society at large. It is my opinion that there are a multitude of factors involved, each contributing to the problem. As a society, we have to consider the total system. There is little or no benefit gained from finger pointing; rather it serves to obscure the complex nature of the problem and movement toward some resolution. Another element that is often not addressed or recognized but which is part of the system, particularly in Rhode Island, is the presence of an "entitlement syndrome" among workers. According to this philosophy, once an individual is injured, he or she is *entitled* to receive benefits until death or unless a cure is obtained. This mind set contributes to the magnitude of the compensation problem.

With regard to the economic

costs of work-related injuries, approximately 75 per cent of the costs are the result of indemnity payments, with the remaining 25 per cent attributable to medical costs. Hence, the longer patients remain out of work, the greater the cost. In a ten year period between 1976 and 1986, Workers' Compensation costs rose 355 per cent. In this same time period, the average weekly pay rose 96 per cent. So you are looking at a 16.5 per cent increment in the cost of Workers' Compensation compared to a 7 per cent annual increment in the weekly wage. These statistics tell the story of a system that has spiralled out of control. Unfortunately, many patients become caught in the system because of inefficiency. In many cases there is no definitive treatment plan, or endpoint. Although I don't want to single out any one profession, those health care providers that carry on treatment indefinitely without objective evidence of improvement perpetuate the problem. It is my opinion that the time has come where people who are paying the freight for the health care system, ie, corporate America, are not going to ask anymore for changes in the system. Rather, they are going to demand a change because of limited financial resources. Thus, the system is sorely in need of overhaul with the goal of providing quality care while at the same time reducing cost.

Moderator: At this point, I would like to pose one question to all of the panel members. What are the major etiologic factors in chronic low back pain?

Parziale: Actually, there are many factors involved in low back pain. Some have been examined more carefully than others but, in particular, the data collected in re-

lation to the occupational health situation are quite compelling. The research evidence indicates that for those individuals who have suffered an on-the-job injury, certain types of work activities and the association between physical status and work activity can place them at high risk for low back pain. Those individuals who perform heavy labor, especially repeated, heavy lifting, are at risk for low back pain. One study that compared heavy vs moderate vs light manual work with the incidence of low back injuries found that those persons who are in heavier work areas have about a 2/3 higher rate for low back injury than those persons who are in moderate or light types of work activities. The frequency of load handling is another factor which can increase the risk for low back pain. The match of an individual's strength with the physical demands of the task is also important. For example, a 170 lb man who lifts a 50 lb box several times a day is at more risk for experiencing an injury compared to a 200 lb man who also lifts several times a day because of the difference in weight and strength. Prolonged sitting or standing, asymmetric lifting or twisting activities can also place individuals at higher risk for low back injuries. Many other factors that I'm sure the panel will comment on such as alcohol and tobacco use, various psychological disorders and satisfaction with the job, combine to increase an individual's risk for low back injury.

Gelch: I agree with Dr Parziale. Clearly, there is no one etiologic agent in low back pain.

Bishop: As I mentioned earlier, in the context of a low back injury, psychosocial factors con-

tribute to the transition from an acute phase into a chronic phase.

Lucas: This issue is very controversial. At the present time, we really don't know the cause. There are many etiologic theories that have been proposed and we must ascribe to some theory in order to guide the treatment we provide. One must remember that back pain is a symptom, not a disease, so it is important to try to determine an appropriate working diagnosis. One can hardly develop a treatment program if, in fact, there is no working diagnosis. As has been mentioned today, low back pain can originate from many sources including muscle strain, injury to the sacroiliac joint, herniated disc or facet joint derangement. It is very difficult, if not impossible at times, to pinpoint the precise causal factor. If we just limit ourselves to the spinal column for a moment, I will propose what I consider to be important etiologic factors. The theory I ascribe to was developed by Kirkaldy-Willis in Canada.³ According to this theory, lower back problems develop as a result of a natural degenerative process that begins at an early age, 18-20, when biochemical changes start to occur within the disc. These changes, in turn, lead to alterations of biomechanical processes in the way the disc responds to the various stresses of everyday life. As the disc undergoes degeneration, it becomes less able to protect the facet joint, which in turn, begins to set arthritic changes in motion. This theory is consistent with the clinical course where, as Dr Gelch mentioned, symptoms wax and wane. Initially, there's an injury, perhaps secondary to disc degeneration. In response to this injury, the body responds in a protective fashion which permits healing;

hence, initial symptoms resolve. This explains, I think, why most people with back problems get better. There is a natural healing process. It is only when an event occurs that the body cannot respond to that a chronic process begins to develop. This theory can also be useful to patients in terms of helping them understand the fluctuating course of the problem. There are additional factors that Dr Parziale and Dr Bishop alluded to that effect this natural history. Anything that effects the nutrition of the disc is going to accelerate the degenerative process so that if the blood supply to a disc is compromised in some way, there is likely to be a more rapid change in the degenerative process. It has been demonstrated in animal studies that exposure to cigarette smoke decreases diffusion of nutrients into the disc, and patients who smoke (compared with nonsmokers) have a higher incidence of back pain. Another relevant factor is the amount of motion or activity of the individual. Motion actually helps the disc by increasing the diffusion of nutrients and slowing the degenerative process. Finally, genetically determined body type and biomechanical characteristics are also contributing factors.

Marras: To expand on Dr Parziale's comments, there are data that support the contention that a third of the back injuries that occur in this country can be eliminated through preventive measures in the workplace. Cumulative trauma, a concept that has not been mentioned today, is in my opinion a major factor in the etiology of low back disorders. It is the repetitive wear-and-tear that is responsible for the biomechanical degenerations that are often found in these patients, as described by Dr Lucas. For exam-

ple, if I take a coat hanger and try to pull it apart with my bare hands, I would not be able to. It can't be broken apart. But if the same coat hanger is worn by bending and twisting it at the same point over and over, eventually it will break. With this process, the metal heats up, becoming more brittle. The weakened coat hanger provides a gross analogy to what happens in the body. It is that repetitive wear-and-tear and strain placed on a particular joint during the performance of work, coupled with natural degenerative changes, that, in my opinion as a biomechanicist, is responsible for many of the back injuries today. Prevention of these problems can be accomplished through the application of proper ergonomics. Ergonomics is the study of human factors and matching the workplace to an individual's capabilities. Dr Parziale mentioned the importance of matching workers with the physical demands of their jobs. I think we should go one step beyond and make sure we design the job so that anybody could do it, not just certain people. Then we do not have to worry about worker selection, and through proper engineering techniques and biomechanical analysis, this task can be accomplished today. Another point I would like to comment on is not just the risk associated with heavy lifting but the manner in which an individual conducts these lifts, especially acceleration of the back during a lift. Motion patterns play a very big role since force is equal to mass times acceleration. When either heavy or light loads are moved very rapidly, an impulse is generated on the spine. This impulse plus the co-contraction of the muscles cause impulse loadings on the spine that are substantial. Thus, it is not surprising that injuries occur particularly for those people with de-

generation and other contributing factors.

Follick: Clearly, there are multiple etiologic factors; organic, biomechanical, environmental and I want to comment on another important source, psychosocial. The psychosocial aspect of pain syndromes, as Dr Bishop stated, often times distinguishes acute from chronic and, therefore, the treatments for these conditions must be different. That is not to say that psychosocial factors are not related to acute injury. Indeed, they influence the acute injury rate. Not only are there the biomechanical factors that Dr Marras described but accident frequency can be influenced by an individual's state of mind, level of depression, behavior and job satisfaction. Another factor is malingering, although frank malingering is surprisingly low in prevalence. The last point I want to make is the impact that psychosocial factors have on the maintenance of disability. Unfortunately, it is not uncommon for a detectable organic defect, say nerve root intrapment, to be corrected at least from a strictly surgical perspective, and yet the disability persists. In this case, psychosocial and behavioral conditioning variables are likely to play a major role in determining the patient's functional disability status.

Wolf: I think the etiological factors of low back pain are as diversified as human behavior. What Dr Follick referred to as psychosocial factors, I consider more cultural factors. The manner in which we respond to back pain in our society, I believe, helps to explain why we have the problem of chronic pain behavior, compared to other cultures. With reference to other factors, certainly

there is the likelihood of a genetic predisposition to back injuries. Some individuals are going to have "bad backs" whether they want to or not; it is probably inevitable, given a genetic predisposition and the presence of precipitating factors, many of which have been mentioned today. Finally, with respect to biomechanical issues, I agree that many back injuries are related to the work place. Elements such as fatigue, lack of conditioning, and overexertion all contribute to the probability of an injury and, quite frankly, that blends into the notion of repetitive trauma. From this perspective, clearly, the better prepared, physically and emotionally, an individual is, the less likely the risk for low back injury. Pertinent to this point is the importance of preparation for work or what is referred to today as "work hardening." All too often we consider work hardening only after an injury has occurred. I would recommend the establishment of very specific conditioning programs geared at prevention rather than limited only to post-injury intervention.

Moderator: To summarize, although we are uncertain about the exact etiology of chronic low back pain syndromes, our panelists today have identified most of the likely factors. I would like to take an opportunity to thank our panelists at this time.

All recommendations or suggestions for use of drugs, devices or techniques contained in this panel discussion reflect the opinions of the discussion participants. No responsibility or liability in presenting this information is assumed by the editors, the publisher, or the accrediting institution.

References

- ¹ Garfin, S.R., Glover, M., Booth, R.E., Simone, F.A. and Rothman, R. (1988), Laminectomy: A review of the Pennsylvania Hospital experience. *Journal of Spinal Disorders*, 1(2):116-133.
- ² Saal, J. (1988), Diagnostic studies of industrial low back injuries. *Topics in Acute Care and Trauma Rehabilitation*, 2:31-49.
- ³ Willis-Kirkaldy, W.H. (1988), *Managing low back pain*, Churchill Livingstone, New York, 1988.