Pain is a costly problem for both individuals and society. People seek the services of health care practitioners to address pain and its negative effects on their ability to function. Unfortunately, health care costs dedicated to pain management have skyrocketed over the last 15 years, but the ability of pain patients to manage pain and maintain function has not improved. Evidence-based guidelines exist for the rehabilitation of certain conditions; however, these guidelines may not necessarily be generalizable to individual specific needs and have not demonstrated an ability to reduce costs with respect to musculoskeletal pain. Yelin estimated that in 2000, about 2.9% of the gross domestic product, or approximately $240 billion, was spent on medical care for musculoskeletal conditions and related pain. An estimated 70% to 80% of all Americans will have an episode of low back pain in their lifetime, and this pain condition is the fifth leading cause of hospitalizations. The number of people seeking care for spine-related problems increased by 49% from 1997 to 2006, and the number of spine surgeries performed in the United States is roughly double that in most developed countries. Spending for fusions increased from $75 million to $482 million from 1990 to 2003.

So why has spending for pain and conditions such as spinal care increased, but self-reported health status has not changed for the better? Possible explanations include the complexity and chronicity of pain-related conditions, the wide variety of factors correlated with musculoskeletal pain, and high variability in current treatment of these conditions. This chapter describes each of these explanations in turn and then discusses the contribution of classification systems to the treatment of and research on musculoskeletal pain.
Complex and Chronic Nature of Musculoskeletal Pain

If pain level correlated directly with pathophysiology, pain treatment would be straightforward, but this is not the case. Pain is a highly subjective state of being. Evidence shows that degenerative changes in connective tissues bear little relationship to reported pain intensity and sensitivity.\(^8\)\(^-\)\(^11\) Musculoskeletal pain has physical, neurological, cognitive, and psychoemotional mechanisms\(^12\)\(^-\)\(^20\) and manifests in chronic, highly complex conditions involving multiple body systems, such as the immune, endocrine, musculoskeletal, neurological, and digestive systems. Whereas less involved pain states may require only patient education and a home exercise program, multisystemic pain requires a multifaceted approach that may include biofeedback, occupational and physical therapy, psychology, and pain management. These programs can be highly effective but are also costly and do not guarantee a change. A 2004 study by Proctor et al\(^21\) revealed that 25% of patients with chronic musculoskeletal pain sought additional treatment even after completing a multidisciplinary pain management program. These patients experienced a lower return-to-work rate, a higher level of leaving work after returning, excess health care consumption, and unremitting disability payments.\(^21\) Thus, about a quarter of pain patients consume disproportionate resources over long periods of time. The research suggests that it is crucial to identify these individuals early if care is to be cost-effective.

Factors Correlated with Musculoskeletal Pain

Another reason for the lack of improvement in the health condition of the population experiencing chronic musculoskeletal pain may be the wide variety of factors that have been correlated with pain. Many theories exist as to what predisposes people to pain. Is it genetics, is it life experiences, is it attitude or coping strategies? From a research standpoint, predisposition to pain is difficult to determine because so many factors come into play. In a recent systematic review of persistent pain following traumatic injury, for example, predictive factors for persistent pain included symptoms of anxiety and depression, patient’s perception that the injury was attributable to an external source (ie, the patient was not at fault), cognitive avoidance of distressing thoughts, alcohol consumption prior to the trauma, lower educational status, injury at work, eligibility for compensation, pain at initial assessment, and older age\(^22\)—factors that may be a function of biological and physiological vulnerabilities.\(^22\) The sections that follow highlight socioeconomic status, age, gender, race and culture, cognition level, and other factors correlated with pain.

Socioeconomic Status

People of lower socioeconomic status tend to have higher levels of pain.\(^23\) During economic downturns, socioeconomic issues such as job loss affect health care and vice versa, fueling costs. Organizational downsizing has been shown to increase back pain and musculoskeletal problems\(^24\); downsizing also increases the rate of early retirement on long-term disability and contributes to psychological stress.\(^25\) As organizational structures and work-related stress change, pain statistics change as well.\(^24\)

Age

Pain can happen at any age. The ability to detect and interpret pain is mature at birth. The public view has often been that older and younger people are capable of feeling less pain than middle-aged people; this is not true.\(^26\) In a 4-year follow-up study, it was shown
that widespread pain is common in children, just as in adults.\textsuperscript{27} Depression, fatigue and sleep problems, somatic axial pain symptoms, female gender, and older age were predictive of chronic widespread pain among children. However, children were reported to have a “fluctuating course with a more favorable prognosis” compared with many adults with widespread pain.\textsuperscript{27}

One age-related difference that relates to pain mechanisms is in patients’ affective motivational response to the pain and coping strategies they use. Brain physiology changes with age, especially in the areas of the brain associated with the ability to cope.\textsuperscript{28-30} Just as a parent informs a child of the meaning of a sensory input, including pain, health professionals need to inform patients about the meaning of their pain through positive education about pain mechanisms, assessment of the patients’ readiness to change behavior, and management individualized to age and learning capability.

Evidence exists of age-related changes in the brain that support the affective and motivational response differences. The older the individual, the less brain activity is noted in these areas. Clinically, children in pain tend to play more aggressively and sleep more compared with adults in pain, who are less active and have difficulty with sleep cycles.\textsuperscript{31-34}

A difference in coping also exists in older adults who experience injury. Active coping has been associated with younger age (less than 60 years) and increased disability and passive coping with older age (greater than 60 years).\textsuperscript{30} These age-related changes may be best conceptualized as a reduced capacity in the functional reserve of the coping system. Clinically, older adults are especially vulnerable to the negative impacts of pain, the under treatment of pain, functional loss, and pain-associated events.\textsuperscript{29,35} Thus it may not be the sensory input of pain that changes, but rather the primary coping mechanism used that influences how pain affects the individual. This can be observed in a study on physical health and psychosocial factors of chronic pain patients in a multidisciplinary retrospective analysis.\textsuperscript{36} The investigators found that there were no intrarace differences between younger Black and younger White Americans who reported more depressive symptoms and symptoms related to post-traumatic disorder than their older counterparts. In this sample, both older cohorts reported better coping ability than their younger counterparts from the onset.

Although age-related studies do indicate a maturing of the connective tissues overall, no correlation has been found between age and pain intensity and sensitivity.\textsuperscript{8,9,11} There is, however, a direct relationship between functional loss in the elderly and pain intensity, sensitivity, and disability. In the elderly population, it appears that functional loss related to pain motivates the patient to seek treatment, and often restoration of function desensitizes the pain mechanism. In addition to age-related changes, it was commonly thought that wear and tear on the spine may increase the incidence of low back pain with aging. Holmberg et al\textsuperscript{37} refuted this concept by demonstrating that aging farmers with elevated physical workloads did not have an increased prevalence of back pain. Focusing on functional improvements and keeping the aging spine active may or may not decrease the incidence of pain depending on whether the brain processes interactions with pain appropriately along the way.

The principles of pain management described in this book are practical for all ages. The education and mode of treatment delivery, however, need to be individualized based on the patient’s age and stage of readiness to change.

**Gender**

Physiological differences exist between the hypothalamus and globus pallidus of men and women between the second and eighth decades of life. Women have 15% more mu opioid receptor binding sites, which have been linked to pain modulation, perhaps related to childbearing.\textsuperscript{28} A woman’s life cycle may include the hormonal milestones of menarche, pregnancy, contraceptive use, and menopause. Each of these events involves changing levels of
sex hormones and may cause a change in frequency and intensity of musculoskeletal pain.\textsuperscript{38} Hormonal changes in women have been linked to increased incidence of headaches, osteoarthritis of the knee, and lower back pain, especially during menopause, when there is an imbalance in levels of progesterone, testosterone, and estrogen.\textsuperscript{38}

Thus, for women, varying levels of diffuse pain in multiple locations may be a signal of hormonal imbalance as opposed to mechanical symptoms. In women who do not appear to be responding conclusively to mechanically based treatments, clinicians should consider hormonal causes of inflammation. Clinicians should investigate the hormonal milestones in their review of systems with their female patients to understand regularity and pain as it relates to these events. Clinicians may need to refer patients to another professional or recommend further diagnostic testing such as blood levels or a 24-hour urine test to determine whether a hormonal imbalance is present. In addition, some patients may be experiencing a hormone-related inability to cope, depression, or insomnia that may be better addressed psychologically. The clinician should consider multiple triggers other than those related to a direct injury or mechanical effect in the pain differential diagnosis.

Apart from hormonal factors, psychosocial symptoms such as depressive feelings, hypermobility, and waking at night predicted pain reoccurrence in preadolescent and elderly women compared with men.\textsuperscript{39,40} Women, as well as people with less education, poorer health, and depression, were found to experience the greatest pain burden\textsuperscript{8,38-41} and poorer treatment outcomes.\textsuperscript{42}

In a recent critical review of studies on gender and pain, Fillingim et al\textsuperscript{43} noted that women are at greater risk for many chronic pain conditions and that pain sensitivity is greater among women than men for most pain modalities, including invasive procedures. They noted, however, that the relationship between gender and pain is not simple. Although pain risk and sensitivity may be greater for women, Fillingim et al\textsuperscript{43} noted inconsistencies in pharmacological and nonpharmacological treatments for pain; a tendency was found to undermedicate female pain patients in comparison to male patients. This suggests that health professionals may have underlying sex biases in the treatment of pain in women.\textsuperscript{40}

### Race and Culture

Culture affects the way people perceive and respond to chronic pain in themselves and in others.\textsuperscript{44} Differences in pain thresholds and responses have been found between people of different cultures.\textsuperscript{45} Many studies suggest that clinicians should explore the relationship among pain, psychosocial factors, and demographic characteristics when working with patients of different cultures.\textsuperscript{36-49} Ethnicity and cultural background are less important factors than the individuals’ socioeconomic status and beliefs regarding their ability to improve; regardless of cultural background, lower income, poor self-rated health status, depression symptoms, lower education level, lower functional self-efficacy, and history of smoking predisposed individuals to chronic musculoskeletal pain and disability.\textsuperscript{50-53} People in the lowest social class experienced nearly a threefold risk of chronic widespread pain compared with those in the highest social class, and lower social class during childhood was found to be a predictor of regional and widespread chronic pain.\textsuperscript{54}

Green et al\textsuperscript{49,55} demonstrated that Black Americans of all ages had more depressive symptoms and symptoms consistent with posttraumatic stress disorder than White Americans. Older and younger Black Americans reported more pain and sleep disturbance on initial assessments and more self-identified comorbidities including dizziness, chest pain, and high blood pressure.\textsuperscript{49} It has been suggested that Asian Americans may be more reactive to pain than European Americans, but these findings may be more suggestive of acculturation (ie, adaptation to new cultural norms) than true genetic differences.\textsuperscript{56}
An understanding of the role a patient’s culture plays in his or her health care practices can help the clinician facilitate and advocate for pain control methods that are consistent with the patient’s cultural worldview. By recognizing differences in the ways patients of different cultures communicate their perception of the meanings and intensity of pain, researchers can begin to delineate the perspectives on pain of different cultures. It appears that an understanding of how the individual patient feels about the pain is as important as the fact that he or she has pain, regardless of cultural background.\textsuperscript{57}

**Cognition Level**

Pain can be difficult to treat in patients with cognitive or communication deficits. Adults aging with cognitive and physical disabilities experience a variety of pain disorders that affect their functionality and quality of life.\textsuperscript{58} Clinical observations of facial expressions and vocalizations are accurate means of assessing the presence but not the intensity of pain in patients who are unable to communicate.\textsuperscript{59} Musculoskeletal pain is a common symptom in people with physical disabilities. In general, the more limited a person’s function, the more severe the pain. Patients with advanced dementia have a lower reported prevalence of pain and analgesic use,\textsuperscript{60,61} but pain may be underreported in patients with dementia because of limitations in awareness and cognition. Patients who had limited communication but awareness of person, place, and time were found to be more at risk for underdetection and undertreatment of pain, indicating that their lack of ability to vocalize their concern led to a discrepancy in their care.\textsuperscript{61}

Clinicians relying on the close observation of facial expressions in patients with communicative disorders to infer the presence of pain were found to be correct between 80\% and 90\% of the time. When facial expressions were integrated into the clinical context of a painful procedure or disease process, the ability of the clinician to detect the presence of pain was even higher.\textsuperscript{59} Clinicians caring for patients with cognitive disabilities should be knowledgeable about the prevalence of pain and be able to perform a thorough history and physical examination with respect to the operant pain mechanisms. The classification and intervention strategies presented in this book are appropriate for all levels of mobility and communicative ability. Mode of communication and delivery of education should be patient specific.

**Other Factors**

Personal contact and emotional support play a big role in coping with life stressors. Social support systems have been found to influence the experience of pain in varied ways. People with few or no social ties who live in less affluent areas are more likely to experience pain that interferes with daily activities.\textsuperscript{50,51} In contrast, older adults who have children in more frequent contact have been found to experience greater limitation by pain in daily life,\textsuperscript{50} perhaps because their offspring draw attention to their pain. Older chronic pain patients in Sweden were more likely to be divorced, to be blue collar workers, to perceive financial strain, and to use passive coping strategies. They experienced more pain of longer duration with greater disability than their younger cohorts.\textsuperscript{50} Current smoking, history of smoking, depression, and insomnia have also been correlated with increased levels of pain and disability.\textsuperscript{52,53}

Certain genetic variants may contribute to a predisposition to persistent pain states. Glucocorticoid pathways with genetic variants in \textit{FKBP5} have been identified in patients with traumatic stress exposure who develop persistent pain states.\textsuperscript{62} In addition, the catechol-O-methyltransferase (COMT) enzyme degrades catecholamines. A variant of the
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COMT gene known as COMT pain vulnerable genotype has been associated with chronic pain. Recently this marker has helped predict which motor vehicle accident patients would take longer to recover physically and emotionally. Therefore, genetic variations may influence psychosocial predispositions to pain and individual processing of pain.

Current Practice Patterns: Variability in Care

The medical community has contributed to the staggering cost to society of the treatment of pain-related disorders. The medical community needs to take responsibility for its management of pain and should focus on positive beliefs and personal potential to enable patients to minimize disability and contribute to society through gainful employment. The high variability in care raises costs without improving outcomes and results from an overreliance on pathoanatomical diagnosis, differences in approach by clinicians of different disciplines, and a tendency to overuse diagnostic tests.

Clinicians often look at the location or structure of the pain symptoms but not at the bigger picture surrounding the pain. The pathoanatomical diagnosis may be of limited help in choosing a treatment unless it is consistent with the physical examination findings of the cause of the pain because the same anatomical structure can be influenced by different pain mechanisms. Some clinicians are convinced that a tissue or structure is creating the patient’s pain, whether it is the anterior labrum of the shoulder, the joint capsule itself, an inflammation of the subacromial bursa, or all of these. A diagnosis based on structure or pathology is incomplete; clinicians must be able to identify the stage of a disorder, dictate treatment, and predict outcomes. A comprehensive approach to the problem of pain involves not only the location, structure, irritability, and tissue pathology or impairment, but also mechanics and operant pain mechanisms. It is important to consider the patient’s history, the biomechanical stress on tissue, and the potential underlying pain mechanisms. Evidence supports the ability to restore patients’ function and diminish pain without knowing the pathoanatomic pain generator. According to orthopedic surgeon Ron Donelson, former vice president of the American Back Society, “The only time it really matters where the pain is coming from is if some invasive treatment, like an injection or surgery, is being contemplated.”

Musculoskeletal pain is treated in many different ways by many different disciplines and factions of care, including alternative medicine, conservative care, and surgical care. Clinicians from each discipline frequently provide treatment based on their training and beliefs regarding the clinical problem being treated. A wide variety of treatments may thus be selected for musculoskeletal pain, and a lack of common terminology between physician and nonphysician disciplines hinders a common approach. The evidence suggests that different clinicians come to different conclusions when using different diagnostic and clinical tests. Consequently, the various approaches to evaluating and providing a diagnosis for patients are driven by the practitioner's theory of pain production rather than features of the individual patient's clinical presentation.

When arriving at a diagnosis, clinicians too often rely on diagnostic testing that may or may not correlate well with a physical exam. Research by Cherkin et al found a wide variation in tests that physicians commonly ordered for evaluating patients with low back pain. The physician disciplines ordered tests that were more extensive than those recommended by a task force created in the 1980s to study spinal disorders in the workplace. In addition, the diagnostic tests that were ordered depended more on the physician’s specialty than on the patient’s symptom response. For instance, neurosurgeons and neurologists were twice as
likely to order spinal images for patients with acute or chronic low back pain, but physiatrists and neurologists were three times as likely to order an electromyogram.69

Quality of Care
Varied definitions of quality of care make it difficult to determine cost-effectiveness. Is quality care the delivery of a desired health outcome on a quality of life measure or joint-specific outcome measure, or is it based on the patient’s or payer’s satisfaction? Is it important to recognize and diagnose a pain condition appropriately if the outcomes associated with the condition are unknown, subjective, or unmeasurable? Is quality care a responsibility shared among the patient and members of the health care pain team, or does it depend simply on patient compliance with treatment? Campbell et al71 defined quality care as access and effectiveness. Access involves the ability to obtain the care the patient needs, and effectiveness depends on both clinical care and interpersonal care. The lasting issue of effective outcome measurement for patients with pain remains to be clarified with patient-reported and condition-specific measures.

Defensive Medicine and Routine Practice
To improve outcomes and control costs, it is crucial that clinicians manage musculoskeletal pain with sound clinical reasoning rather than resorting to defensive medicine. For example, despite the fact that imaging is routine in clinical practice for conditions such as low back pain, the American College of Physicians found strong evidence that routine imaging is not associated with any clinically meaningful change in patient outcomes and in fact exposes patients to preventable harm.72 Chou et al73 concluded from a meta-analysis that “lumbar imaging for low back pain without indications of serious underlying conditions does not improve clinical outcomes. Therefore, clinicians should refrain from routine, immediate lumbar imaging in patients with acute or subacute low back pain and without features suggesting a serious underlying condition.” In addition, although primary care doctors who performed lumbar radiography had higher levels of patient satisfaction, this procedure did not improve outcomes in acute spinal management for function, pain, or overall health status.74 Although technology has improved and the speed of delivery has increased, using MRIs in place of radiographs for patients with low back pain has produced no significant improvements in outcomes; in addition, Jarvik et al75 found that substituting rapid MRIs for radiographs “may have increased the costs of care because of the increased spine operations that patients are likely to undergo.”75

In addition to the routine practice of imaging, studies comparing costs from 1997 to 2007 found that pharmacy expenditures were more than double those of diagnostic imaging. In contrast, nonphysician services such as physical therapy accounted for less than 30% of direct medical costs.76

The Case for Conservative Care
As health care continues to shift and payers demand evidence that procedures are effective, increasing attention will be paid to the cost-effectiveness of conservative (ie, nonoperative) care for certain groups of patients with chronic pain. The evidence indicates that less costly procedures can have a dramatic effect on pain and better enable patients to become active participants in their own care. Clinical examinations conducted with a comprehensive history and an objective look at the patient’s movement response and physical performance
can guide prescriptive exercises with better accuracy. For example, patients who performed exercises that matched their directional preference showed significantly greater improvements in pain and medication use compared with patients who performed exercises that did not match their directional preference or were nondirectional. Thus, in the lower back, clinical testing and imaging must correlate with patients’ symptoms to effectively guide treatment.

Other studies have shown that the treatment of low back pain as a benign, self-limiting condition was more effective in enabling patients to resume activity in contrast to treatment that promoted negative beliefs and unnecessary imaging, which may fuel disability. It is thus imperative that clinicians emphasize to patients that they will get better and should return to healthy functional activity as quickly as possible rather than allowing them to adopt a sick role. Moseley et al showed that pain education alone resulted in improvements in physical examination findings, changed beliefs about pain, and normalized catastrophizing thoughts in patients with low back pain. Patient education has far-reaching effects and minimal cost when pain is involved.

**Better Care via Classification Systems**

Certain aspects of physical examination procedures used in clinical practice for the treatment of musculoskeletal pain have not been validated, and the quality of the research is moderate. At this time, evidence indicates that many palpation techniques are not valid in physical examination and that pain provocation or symptom response methods may be more beneficial. Some clinicians rely on physical palpation and imaging studies, but these examinations rarely provide a valid explanation for a patient’s pain. Classification systems, in contrast, can help clinicians better understand the nature of the pain and how pain affects each patient’s life in order to direct treatment. A meta-analysis showed a statistically significant difference in favor of classification-based treatment over control groups for reduction in pain and disability. Thus, although little evidence is available comparing classification systems, we advocate their use on the basis of available data.

Classification systems contribute to the treatment of many medical conditions. Such systems help create a starting point of common terminology from which to treat and educate patients about musculoskeletal pain. Early identification of the correct mechanism of pain can facilitate the appropriate treatment expectation or promote realistic referrals for patients who may need redirection to services such as nutrition, psychology, or pain management. Classification systems contribute to clinicians’ ability to categorize and formulate conclusions based on prior patient experiences, an ability that distinguishes expert from novice clinicians. It is through classification systems that clinical practice can best be structured, measured, and made more efficient.

In addition, classification systems allow clinicians to conduct research in an effective manner by decreasing variation in patient selection and promoting use of a common language to describe prognosis and treatment. Classification systems aid in the accuracy of outcome prediction; studies show that patients whose treatment includes use of a classification system function better and that subgroups of patients tend to respond better to one type of intervention than another.

It is thus clear that classification systems are an effective means of predicting outcomes, generating effective treatment plans and interventions, and creating efficient use of medical resources on an individual patient basis. This book discusses the use of two classification systems in treatment—the pain mechanism classification system (PMCS) used in our institution and a mechanical classification called mechanical diagnosis and therapy (MDT).
Pain Mechanism Classification Systems

Given the vast health care resources dedicated to the evaluation and treatment of pain, it is important to understand why all patients experiencing pain do not respond to the same interventions in the same way. Just as the mechanical components of musculoskeletal impairments and loss of function can be classified, pain also deserves appropriate classification. Diagnosis and classification systems that lead to erroneous conclusions set the system up for failure. Throughout this book, the argument will be made that a pain mechanism classification system is essential to the proper management of patients with musculoskeletal pain.

In the 1980s, a task force was created to study spinal disorders in the workplace in Quebec. This task force was composed of clinicians, allied health professionals, and methodologists with the goal of identifying a gold standard for the management of spinal disorders. The Quebec Task Force concluded that the effectiveness of low back pain therapies is unproven and that it is very difficult to identify the pain generator and recommended a classification system based on symptom location rather than tissue type. Some may argue that spinal pain differs from pain in the extremities and that one cannot apply the same conclusions to the extremities. Emerging research, however, indicates that extremity joints can behave mechanically similar to the spine in regard to pain provocation, repetitive motions, and classification systems and that this behavior is observable in clinical practice. Numerous models of classifying pain have been developed for palliative care in cancer treatment, but little evidence addresses the validity or reliability of such systems for generalized musculoskeletal pain.

Because pain is the most common reason that patients seek medical attention, it is imperative that classification systems be used to efficiently evaluate all operant mechanisms and guide patient care. This book presents a musculoskeletal pain classification system that identifies subgroups of musculoskeletal pain mechanisms. These subgroups are based on operant biological pain mechanisms; this simplifies the need to specify anatomical locations and promotes consistency in treatments for various mechanisms of pain production. Diagnosing musculoskeletal pain on the basis of structure or pathoanatomy alone overstates the pathological implications of the disorder and can result in overutilization of resources, inappropriate interventions, and poor outcomes.

PMCSs have recently become popular as a component of the diagnostic process for pain practitioners such as physical therapists and physicians in pain management. Problem-based classification systems can improve clinicians’ ability to select appropriate interventions, guide communication, and direct care. The use of a PMCS in clinical practice could aid therapists and pain practitioners in identifying patients who are at risk of overutilizing services or who have psychosocial factors that can influence treatment outcomes. This system can also aid clinicians in developing screening and measuring tools and creating potential treatment effect modifiers or prediction rules.

Although the literature has described theoretical support for PMCSs, little empirical evidence indicates that use of such systems will facilitate consistency in decision making. A preliminary reliability study by Smart et al., however, concluded that a PMCS should be investigated using a large sample of patients and multiple independent examiners. Later, the researchers established discriminative validity for the categories of nociceptive, peripheral neuropathic, and central sensitization with 464 patients.

To foster better clinical reasoning among outpatient physical therapists at the Rehabilitation Institute of Chicago, the musculoskeletal practice implemented a pain classification system. Using categories of clinical criteria similar to those of Smart et al., we sought to provide further clinical validation of a mechanisms-based classification system by testing the hypothesis that therapists trained in the use of the system would demonstrate accuracy
compared with a computer-driven statistical model in classifying patients who had signs and symptoms of musculoskeletal pain. The classification system consists of six mechanisms: three were related to the peripheral nervous system (ie, mechanical)—nociceptive:inflammatory, nociceptive:ischemia, and peripheral neurogenic; and three were related to the central nervous system (ie, psychosocial)—central sensitization, affective, and motor/autonomic (see Figure 1.1). The 24 participants demonstrated good agreement with the computer-generated model, providing empirical support for the use of our PMCS in tandem with therapist education and training. This system is the primary focus of this book. After an overview of the PMCS in Chapter 2, subsequent chapters examine each mechanism in detail.

An important concept in the use of the PMCS with patients suffering from pain is determining when pain is based in the peripheral nervous system and appears related to certain directions or movements versus based in the central nervous system and appears related to cognition, behavior, emotions, and a heightened pain state. One key indicator for a mechanical pain mechanism is known as centralization. Centralization is present when pain can be “progressively abolished in a distal to proximal direction with each progressive abolition being retained over time until all symptoms are abolished.” Movements in other directions or the opposite direction potentially cause symptoms or mechanics to worsen. Centralization involves movement of radiating pain from a larger more diffuse area to a more proximal central one; “their intent is very specific: to apply beneficial loads to the

![Figure 1.1 Pain mechanism classification system.](image-url)
pain-generating pathology in such a way that the low back and leg symptoms produced by the pathology centralize and abolish and are then prevented from returning.\textsuperscript{96-98} It is clinically important to try to identify this phenomenon, but doing so may take several sessions.\textsuperscript{97} A careful assessment, patient education, and static loading are critical steps in determining whether a patient is a potential centralizer. Patients who are centralizers have a greater likelihood of good to excellent outcomes, including greater reduction in pain intensity, higher return-to-work rates, greater functional improvement, and less continuous health care use.\textsuperscript{98-106} Long et al\textsuperscript{100} showed that regardless of pain duration or location, centralizing patients showed decreased pain and improved outcomes with directional preference exercises.

Patients whose symptoms do not correlate well with direction-specific movement may be classified as nonmechanical responders or noncentralizers. Patients initially considered noncentralizers are capable of becoming partial or full centralizers during later therapy sessions, so reassessment of the dominant mechanism is imperative.\textsuperscript{107}

**Mechanical Diagnosis and Therapy**

The McKenzie Method of Mechanical Diagnosis & Therapy is a system for classifying and treating pain in patients with mechanical pain mechanisms. The MDT categories include derangement, dysfunction, posture, and other; these are defined in Chapter 2. Repeated evidence supports intertester and interexaminer reliability and validity in assessment using MDT for evaluation of the spine.\textsuperscript{108-112} By using patterns of pain response to repeated end range spinal movements, therapists were able to identify the mechanical syndromes. Classification using this patient response method has shown better outcomes in multiple measures.\textsuperscript{113} The MDT syndrome of derangement has been scientifically supported with the concept of centralization as a good prognostic indicator of outcomes with MDT treatment.\textsuperscript{97-106} The ability to identify a positive movement in a specific direction often causes symptoms to decrease, abolish, or centralize and typically creates a favorable mechanical response in other directions, altering the patient’s function for the better. As with most classification systems, the strength and reliability of the system in clinical practice rely on the training of therapists in its use.\textsuperscript{108,111,114,115}

**Conclusion**

This book looks at all types of musculoskeletal pain in all types of individuals and provides a framework for classification that can enable clinicians to treat patients as people with individual needs, desires, and goals. Rehabilitation is a conceptual process, and all processes requiring change can be difficult. How do clinicians move toward better practice in rehabilitative medicine for their patients with pain? Evidence-based medicine suggests that best practice in pain management merges patient values, clinical practice, and clinical research.