12 Spinal Therapeutics Based on Responses to Loading

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In this chapter, we explore the clinical reasoning for spinal assessment and therapy, variously referred to as the McKenzie approach, protocols, or system. Our purpose is to explicate the underlying philosophic and practical perspectives of the McKenzie approach, as it accounts for phenomena related to spinal loading and its unique manner of satisfying the "demands" of rehabilitation. This chapter is not intended to impart clinical competency regarding the skills necessary to use the McKenzie protocols in practice. Such competency requires study of "The Lumbar Spine"' and "The Cervical and Thoracic Spine"' by McKenzie, as well as the formal instruction that applies the clinical reasoning found within these texts to assessment and therapy of patients on a day-to-day basis. The material presented here can only hope to supplement such study and instruction.

APPROACH TO CLINICAL REASONING

In the following attempt to expand an understanding of the McKenzie system, new terminology is introduced. Hopefully what such terminology distinguishes will stimulate established and future students of the McKenzie approach to further appreciate its intrinsic principles.

Relation of the McKenzie Approach to Manipulation and Rehabilitation

Both manipulation and rehabilitation use movement as therapy. In manipulation, movement is used as therapy when the clinician moves the patient's spinal joint structures to end range. The rehabilitation tradition also uses movement as therapy, but with a preference for "activity as therapy," i.e., patients performing the movements themselves.

As with manipulation, the McKenzie approach uses spinal movements to end range. As with the rehabilitation tradition, the preference is for patient self-generated movements. The significant difference between the McKenzie approach and that of traditional manipulative therapy, however, is *not* that of rejecting manipulation in favor of patient-generated movements, although the latter is always preferred. Manipulation is actually an option according to McKenzie protocols, when patient-generated movements prove only partially successful.

The most significant difference between the McKenzie approach and other methods of treating the spine is the *criteria* on which assessments and therapeutics of the spine are predicated. The issue of when and how criteria dictate the direction and type of force applied to the spine is critical to the understanding of the McKenzie approach.

QUESTION OF CRITERIA

The criteria according to which any inquiry is conducted for the purpose of resolving a problem profoundly affect how the solution is conceived. In other words, the answers you get depend on the questions you ask. The McKenzie approach predicates spinal assessment and therapeutics on asking questions about the mechanical and symptomatic responses to loading the spine.

Patients present with a variety of mechanical and/or symptomatic spinal complaints, and their responses to movements and positionings of the spine are variable. Sitting may exacerbate spine-related complaints in some individuals, whereas others find relief while seated. Standing, walking, or reclining may similarly evoke disparate responses in the same or different individual. It is noted, therefore, that patients have different stories to tell about how movement and positioning affect their spine-related complaints.

Concerns regarding specific spine-related complaints, which are essentially mechanical and symptomatic responses to movement and positioning, motivate patients to seek professional care. The details of how spine-related mechanics and symptoms are affected by movement and positioning, however, are seldom of specific concern to the clinician for purposes of assessment or therapeutics.

Standard range of motion examinations and orthopedic tests do not adequately explore how the particular patient's spinal mechanics and symptoms are affected by specific movements and/or positionings. Perhaps the greatest limitation of these examinations and tests is the supposition that each test movement need be performed only once to fathom how the patient's complaints respond. The effects of repetitive movements, pr positions maintained for prolonged periods of time, are not explored, even though such loading strategies might better approximate what occurs in the "real world."

The mechanical or symptomatic response to a movement performed once might be radically different from what would occur if that movement were performed five or ten times,

thereby revealing an entirely different clinical picture. Similarly, the mechanical or symptomatic response to assuming a particular position for a few moments might be radically different from what would occur after assuming that identical position for a few minutes.

Just as mechanical and symptomatic responses are rarely considered regarding their relationship to repetitive movements and/or sustained positioning, little inquiry is directed to how mechanical and symptomatic responses relate *to each other; i.e.,* how they respond in tandem to movement and positioning.

The possibility of mechanical and symptomatic responses serving as meaningful criteria on which to predicate treatment is precluded if cognition of such is wanting. Unfortunately, many spinal examinations are all too often only cursory formalities, serving as preludes to predetermined treatment plans, independent of specific assessment findings.

Treatment Without Specific Criteria

Treatment for spine-related complaints is often routinely and ceremoniously applied in the exact same manner for each patient, even though distinguishing mechanical and symptomatic presentations are potentially discernible between individuals. More often than not, the criteria that motivate the patient to seek care are *not* intimately connected with the criteria used by the clinician to assess the patient, to determine appropriate case management, or to monitor the effectiveness of care. Identical care applied to all patients with common spinal complaints is often the result of criteria that routinely conceive of a universal problem underlying all particular complaints.

A Priori Versus A Posteriori Approaches

Preconceived, *a priori* notions about common spinal disorders can blind clinicians to meaningful and individuating phenomena. *A priori* knowledge argues "from what is before" (i.e., from causes to effects) and attempts to be independent of particular experience. On the other hand, *a posteriori* knowledge argues "from what is after" (i.e., from effects to causes) and uses empiric knowledge derived from experience.

Implicit in the McKenzie approach is an a posteriori, empiric study of phenomena related to spinal loading, after which pathoanatomic explanations are proposed. A careful description of clinically presenting phenomena is possible independent of the pathoanatomic interpretation of the day, and this description should remain accurate if that interpretation changes tomorrow. With this approach, a priori judgments are less likely to prejudice the perception of the clinically presenting phenomena. It is acknowledged that one can only *attempt* this goal, as no one can truly be free of all pre-conceived notions.

Putting Pathoanatomic Criteria in Their Place

Predicating treatment on a priori constructs rooted in the pathology model has led to what has been called the "failure of the pathology model."' These a priori constructs, based on hypothesized pathoanatomy, have generated treatments that may be tangential to the patient's needs and obscure the clinical perception of phenomena specific to the individual patient's situation.

For example, if all spine-related complaints are perceived, a priori, to be the result of inflammation, this preconception limits the clinician's ability to appreciate the possibility of mechanical strategies for patient care. It conceptually promotes treatment strategies of rest and anti-inflammatory medication, which may not be efficacious if, indeed, mechanics and not chemistry is the relevant component in that patient's case.

Pathoanatomy and the McKenzie Approach

The McKenzie approach recognizes patterns of mechanical and symptomatic phenomena that are labeled "syndromes." Although the McKenzie approach names syndromes according to certain pathoanatomic suppositions, these syndromes refer primarily to phenomenologic patterns that can be discerned apart from any particular pathoanatomic interpretation. The assertion that the syndrome patterns detailed in the McKenzie approach accurately describe the phenomena related to spinal loading *independent* of the pathoanatomic interpretation of the day applies, as well, to those interpretations forwarded as part of the McKenzie approach.

By first describing presenting empiric phenomena before making pathoanatomic interpretations, we hope to afford the reader a fresh perspective without putting the "pathoanatomic cart before the empiric horse." The alternative method of first presenting the pathoanatomic conclusions of the McKenzie approach runs the risk of diminishing an appreciation for the clinical utility of the approach, the basis of which is therapeutic intervention and management made possible by careful observations of spine-related responses to movements and positionings, and not by the ability to ascribe meanings to these responses via dogmatic diagnostic conclusions based on pathoanatomic models.

Objective Signs Alone Are Not Adequate Criteria

Some clinicians maintain the a priori notion that concentrating on mechanical or other objective signs alone (and there-fore ignoring symptoms) is a more scientific approach, be-cause signs are more amenable to measurement. Mechanical or other objective signs, however, such as range of motion measurements or spinal imaging, do not adequately account for the phenomena of spine-related complaints.

What might at first seem to be indistinguishable objective measurements between two patients, may, on closer inspection, prove to be part of different clinical pictures when judged in the broader context within which they occur. The identical mechanical sign may be associated with different symptoms, or even different *other* mechanical signs, from patient to patient. In addition, the *apparently* same mechanical sign may respond differently to identical movement and/or positioning stimuli from patient to patient.

Orthodox Versus Alternative Health Care Signs

In orthodox medicine, the focus on signs and the a priori assumptions of a pathoanatomic model is the result of, or leads to, an inability or unwillingness to rationally appreciate spine-related symptomatology. This same approach taken by the so-called "alternatives" to orthodox medicine entails the use of "alternative" signs, which also avoids the recognition of symptoms as meaningful. In this regard, no alternative is really being offered.

Alternative approaches, often described as "holistic," frequently make the a priori claim to "treat *causes* not symptoms." This predilection often leads the patient and practitioner to *alternative signs* so removed from the phenomena at hand that both common signs *and* symptoms related to the patient's complaints are ignored. The signs sought may be so removed from the patient's complaints that they better resemble signs of "divination" (omens, portents, etc.) than any serious, rational diagnostic endeavor. Common, mundane signs and symptoms are ignored in the search for the miraculous.

The alternative health care complaint that symptoms *themselves* cannot be treated is appreciated as a valid objection to the pharmacologic suppression of symptoms via analgesics as a means of therapy. This concern, however, does not justify the total rejection of appraising symptoms as relevant phenomena.

Subjective Symptoms As Potentially Valid Criteria

Symptoms are an important key to the puzzle of spinal complaints. Signs and symptoms are important diagnostic components in most health care specialties. Unfortunately, when the specialty concerns common spinal complaints, symptoms are usually denigrated to the status of epiphenomena, principally because of the confusion that has resulted from the inability to appreciate rationally the symptomatic responses to spinal loading stimuli.

Because health care disciplines have been unable to make sense of spine-related symptoms, these symptoms have been relegated to the realm of nonsense. This lack of appreciation not only denies patients a certain dignity and respect (the absence of a concerned audience regarding their symptomatic story), but it also denies health care practitioners the clinical utility of that story.

Subjective Symptoms Alone Are Not Adequate Criteria

As with mechanical signs, symptoms taken by themselves do not account adequately for the clinical presentation of spine-related complaints. *Both* the symptomatic *and* the mechanical responses to spinal loading must be considered to best appreciate common spinal disorders.

Responses of Mechanical Signs and Subjective Symptoms to Loading As Criteria

The McKenzie approach is a system of assessment and therapeutics based on the recognition of patterns concerning the mechanical and symptomatic responses to the stimuli of loading (applying forces to) the spine. This recognition is derived from historical information related by the patient as well as clinical findings that compare mechanical and symptomatic responses before, during, and after (1) singular movements, (2) repetitive movements, and (3) sustained positionings.

Common Connecting Criteria

Spine-related complaints and the means for their resolution become intimately connected at each stage of the McKenzie approach because of the common connecting criteria, which is the mechanical and symptomatic response to loading strategies. These criteria, on which the approach is predicated, pro-vide a rational thread connecting:

- Complaints
- Assessment
- Therapeutic prescription
- Monitoring the course of therapy
- Prophylaxis

SPINAL LOADING

Spinal loading refers to the administration of a force to the spine. No matter what position the spine is in, at least the force of gravity is loading the spine in that position and *internal forces* (within the disk) are at play. Although it is understood that the *unloaded* spine refers to the reclined position, it can also be viewed as *a different kind* of loading. Unloading the spine, as it is commonly understood, may diminish external axial forces to a motor segment while in-creasing internal forces as a result of the inhibition of fluid. These distinctions may have some importance considering the conventional a priori notion that any *unloading* action is of benefit to the spine. This is not necessarily true. For example, for a significant number of patients, low back and leg pain is worse in the morning, and others respond poorly to traction.

Loading can be viewed as a mechanical stimulus to which mechanical and symptomatic responses occur. Loading may be considered the independent variable, with the resulting mechanical and symptomatic responses the dependent variables.

LOADING TACTICS

Loading tactics refer to individual loading stimuli, procedures or methods that are components contributing to an overall loading strategy. They include the following:

- Dynamic loading
- Static loading
- Loading intensity
  - Loading frequency
  - Loading amplitude (overpressure, mobilization, manipulation)
- Loading within a specific movement plane direction
- Loading within a specific range of a movement plane
- Loading at a specific point of a movement plane

- Loading posture
- Loading source (source of force)
  - Patient-generated tactics
  - Patient use of appliance or machine
  - Clinician-generated tactics
  - Clinician use of tool, appliance, or machine

Dynamic Loading

This term refers to a system of forces on the spine *in motion,* or undergoing *movement,* under specific conditions.

Static Loading

Static loading refers to a system of forces on the spine at rest, or during *positioning,* under specific conditions. Static loading of the spine in a specific position for a prolonged period of time may be referred to as *sustained positioning.*

Loading Intensity

Intensity is defined as tension, activity, or energy. Curiously, the word intensity is derived, in part, from the Latin verb, *tendere,* to stretch. *Intensity* refers to the frequency and/or the amplitude accompanying loading. To increase the intensity of loading, the frequency and/or the amplitude can be increased.

LOADING FREQUENCY

Loading frequency refers to the number of loadings per unit time (cycles). In dynamic loading, loading frequency refers to the number of movements performed per unit time. In static loading, loading frequency refers to sustained positioning per unit time.

LOADING AMPLITUDE (OVERPRESSURE, MOBILIZATION, MANIPULATION)

Loading amplitude refers to the amount of force applied during each cycle. For the purpose of the McKenzie approach, loading amplitude usually refers to the amount of force applied to promote movement of the spine toward a more *complete* end range position. This movement is accomplished by the application of overpressure or manipulation.

Overpressure applied during dynamic loading permits further movement into end range with every cycle. Overpressure applied during static loading at end range permits positioning even further into that end range. It may be accomplished strategically by the patient's own means or with the use of a device or an appliance. It may also be accomplished by the application of a force by the clinician, using a "hands on" technique, with or without, alone or in combination with a device or appliance. When the clinician's hands perform the overpressure in a cyclic fashion, this practice is called *mobilization.* The chiropractic concept of "taking the slack out" corresponds to moving a joint to end range. The cyclic performance of this movement is mobilization.

The greatest loading amplitude is applied by means of spinal *manipulation.* Overpressure and mobilization are thought to bring spinal joint structures beyond voluntary end range, toward physiologic end range. Manipulation is thought to bring spinal joint structures beyond physiologic end range, just short of anatomic end range.

For the McKenzie approach, the mechanical and symptomatic responses to overpressure and/or mobilization are carefully noted in order to predict what the mechanical and symptomatic responses would be to manipulation. In other words, the responses to loading at physiologic end range serve as a criteria on which to predicate loading toward anatomic end range. Only therapeutically beneficial responses noted with the former permit performance of the latter. Complete recovery by means of the former obviates the latter. Manipulation is appropriate when loading of lesser intensity evidences beneficial responses that are not complete.

Loading Within a Specific Movement Plane Direction

Movement planes are derived from dimensions in space. Movement planes contain two opposite potential directions in which loading can occur, referred to as *movement plane directions.*

SAGITTAL MOVEMENT PLANE

In this plane, also called the anterior-posterior movement plane, movement occurs about the coronal axis. The opposite movement plane directions are referred to as flexion and extension.

Special features regarding this movement plane are noted for the cervical spine. Protrusion of the head in the sagittal plane involves extension of the upper cervical spine and flexion of the lower cervical spine. Retraction of the head in the sagittal plane involves flexion of the upper cervical spine and extension of the lower cervical spine. These movements may be referred to as *translation* through the sagittal plane.

TRANSVERSE MOVEMENT PLANE

Movement occurs about the longitudinal axis. The opposite movement plane directions within this plane are referred to as rotation right and rotation left.

CORONAL MOVEMENT PLANE

In this plane, also called the frontal or lateral movement plane, movement occurs about the sagittal axis. The opposite movement plane directions used by the McKenzie approach within the coronal movement plane are different for the cervical and lumbar spine. For the cervical spine, right lateral flexion and left lateral flexion are noted. For the lumbar spine, right and left side-gliding are noted.

Side-gliding refers to a superior anatomic part moving through the coronal plane in the opposite direction relative to an inferior anatomic part. It also refers to the trunk moving in the relative opposite direction, through the coronal plane, above the pelvis. This movement may be referred to as *translation* through the coronal plane.

Positioning within this movement plane results in the clinical presentation of the "antalgic list." This antalgic deformity, constituting an acute lumbar scoliosis, is a result of translation through the coronal plane. The antalgic list is referred to as *a lateral shift,* and is named according to the direction (right or left) by which the superior anatomic part is positioned relative the inferior anatomic part.

Loading Within a Specific Range of a Movement Plane

When dynamic loading occurs, it may involve movement to end range or only to within mid-range of a movement plane. During dynamic loading, each point in the movement plane has a "directional component" defined by the intended movement plane direction.

Loading at a Specific Point of a Movement Plane

Sustained positioning (static loading) may be at mid-range or end range. Sustained positioning in mid-range may have a directional component relative to a previously assumed sustained positioning. Static loading at end range is usually referred to as having the movement plane direction of which that end range is the culmination.

Loading Posture

This term refers to the orientation of the body (standing, sitting, etc.).

Consider the cervical spine loaded in the movement plane direction of extension. The patient may be standing, sitting erect, sitting slouched, lying prone, or lying supine with the head and neck off the end of a treatment table—all examples of different ways to position the body (loading postures) while extending the cervical spine.

Loading Source (Source of Force)

Loading tactics may be generated or modified by patients themselves, appliances or machines, as well as by the clinician's intervention. Certain appliances or machines are readily used by patients themselves, whereas other devices (be-cause of expense, mechanics, or expertise required) may be used only in a clinical setting.

PATIENT-GENERATED TACTICS

Movements or positions may be accomplished by patients themselves. Patients may perform movements actively by recruiting muscular structures that specifically move or maintain positions of spinal joint structures concerned. They are also able to strategically perform "passive" movements of the spine. For example, patients may rotate the cervical spine by using the pressure of the hand against the cheek without recruiting the intrinsic neck musculature. Similarly, passive extension of the low back may be accomplished by performing a "press-up" from the prone position with the pelvis remaining on the exercise surface, thus recruiting only elbow extensors and not the extensors of the back.

PATIENT USE OF APPLIANCE OR MACHINE

Various devices that affect spinal loading and do not require the assistance of the clinician or presence in the clinical setting are available to patients. These appliances range from mattress and chair types to braces, traction devices, and exercise equipment.

CLINICIAN-GENERATED TACTICS

Force introduced by the clinician may be combined with, or apart from, patient-generated forces. Clinician-introduced forces range from mobilization to manipulation. Mobilization has been characterized as forces that do not bring joint structures beyond physiologic end range, whereas manipulation has been characterized as bringing joint structures beyond physiologic end range, but short of anatomic end range.

CLINICIAN USE OF TOOL, APPLIANCE, OR MACHINE

This category includes certain appliances or machines unavailable to patients because of expense, mechanics involved, or the need of a clinician's expertise. Examples include sophisticated traction units, "drop tables" that enhance manipulative procedures, treatment tables permitting various spinal positionings, and continuous passive motion units designed for the spine (Fig. 12.1). Surgical intervention is certainly a mechanical intervention that represents a loading tactic.

PREFERRED LOADING STRATEGY

Strategy refers to a plan devised to attain a goal. *Loading strategy* refers to the choice or rejection of particular loading tactics and the order in which those chosen loading tactics are employed. A *preferred loading strategy* is framed by deciding which:

- Loading tactics to avoid
- Loading tactics to pursue simultaneously
- Loading tactics to pursue sequentially
  - Immediate sequence
  - Delayed sequence: introduction of previously avoided loading tactic

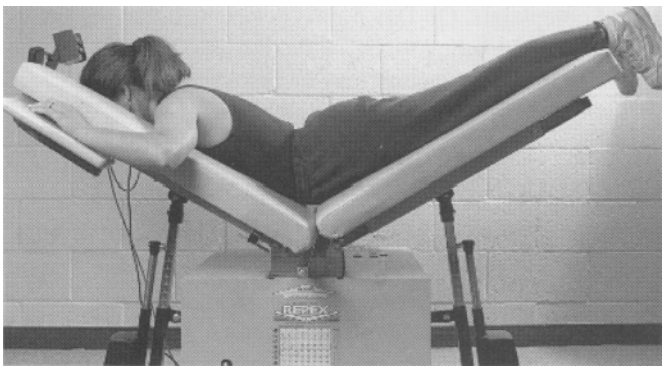


Fig. 12.1. McKenzie Repex (Repeated End range Passive Exercise) unit.

Tactics to Avoid

Specific loading tactics deemed therapeutically detrimental are to be avoided as constituents of the preferred loading strategy. The practitioner must take into account the effects of avoiding specific loading tactics as much as he or she considers the effects of pursuing specific loading tactics. Avoidance can be of equal, if not greater, importance in resolving an individual's spine-related complaints than which tactics to pursue.

Tactics to Pursue Simultaneously

The preferred loading strategy always involves the simultaneous performance of loading tactics; for example, it may concurrently load the cervical spine dynamically, in the movement plane direction of extension, while sitting, with overpressure, and a certain frequency of repetition.

Tactics to Pursue Sequentially

Loading tactics applied one after the other.

IMMEDIATE SEQUENCE

This term refers to loading tactics applied immediately, one after the other, e.g., loading the cervical spine in the movement plane direction of left lateral flexion, immediately followed by loading in the movement plane direction of extension.

DELAYED SEQUENCE

This term is used to describe the application of loading tactics separated by a significant length of time. It usually refers to the timely re-introduction of previously avoided loading tactics. Loading tactics once considered therapeutically detrimental, may, after the appropriate delay, prove to be of significant therapeutic benefit. For example, on Day 1, it is determined that right side-gliding (Fig. 12.2) is the most therapeutically beneficial movement plane direction for the lumbar spine, and loading in all other movement plane directions is considered detrimental. On Day 2, it is determined that the previously avoided loading tactic of extension is now therapeutically beneficial, and in fact, necessary for further resolution of complaints. On Day 5, it is determined that the previously avoided loading tactic of flexion is of benefit for the patient so that full function may be recovered.

PROPERTIES COMMON TO MECHANICAL *AND* SYMPTOMATIC RESPONSES TO LOADING

Although mechanical versus symptomatic responses to loading have unique features or perspectives, they have certain common response properties or *parameters,* described here as *response value, response temporal, factors, point of response elicitation, movement plane-specific responses,* and *mechanically impeded end range.*

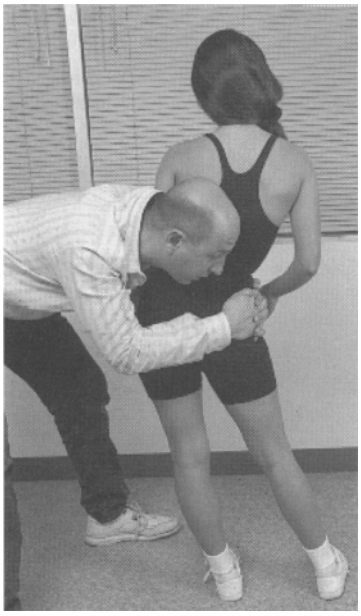


Fig. 12.2. Right lateral shift as a result of clinician overpressure during right side-gliding.

Response Value

Mechanical and symptomatic responses may be considered the same, better, or worse after a particular loading strategy is pursued. Considering before and after possibilities, responses may be:

- Normal before and remain normal afterwards
- Normal before and remain abnormal afterwards
- Abnormal before and remains abnormal afterwards with
  - Equal magnitude
  - Greater magnitude
  - Lesser magnitude
- Abnormal before and remains normal afterwards

Response Temporal Factors

These factors include *frequency of complaints, time required to elicit a response,* and *response persistence after loading cessation.*

FREQUENCY OF COMPLAINTS (RESPONSES)

The frequency with which mechanical or symptomatic responses to loading occur during a specified time period may be characterized as one of the following:

- Total absence of the response (no complaints)
- Intermittent frequency of the response (intermittent complaints)
- Constant frequency of the response (constant complaints).

A patient may have no symptoms, experience symptoms intermittently, or experience symptoms constantly during a specified period of time. Similarly, a patient may have no restricted ranges of motion, experience a restricted range of motion intermittently, or experience a restricted range of motion constantly during a specified period of time.

TIME REQUIRED TO ELICIT A RESPONSE

This parameter refers to the number or duration of dynamic or static loading cycles required to elicit a mechanical or symptomatic response as well as the *delay*, if any, for the response to occur after loading ceases.

The *number of loading* cycles refers to the frequency of a movement or sustained positioning per unit time; these may be relatively few or many. *Duration* refers to the amount of time a sustained positioning is held. An *immediate response* to dynamic loading or sustained positioning occurs on the initiation of the loading tactic. *A delayed response* occurs some time after loading ceases.

The range of possibilities are:

- No response elicited, regardless of the number and/or duration of loading cycles
- Response elicited on initiation of loading cycle (immediate response)
- Response elicited after relatively few and/or short duration of loading cycles
- Response elicited after relatively many and/or long duration of loading cycles
- Response elicited after cessation of loading cycle (delayed response)

Consider the following scenarios.

Responses elicited on initiation of the loading cycle (immediate response), for example, would be the patient who, during the performance of one dynamic extension or on initiating static extension, experiences symptoms or deviation from the intended movement plane direction. Another patient's response could be the relief of symptoms and aberrant movement.

Responses elicited after "relatively few" or "short duration" of loading cycles, for example, would be the patients for whom 10 spinal extensions or 5 minutes of static loading result in the onset or resolution mechanical and symptomatic responses.

Responses elicited after "relatively many" or "long duration" of loading cycles, for example, would be the patients for whom 50 dynamic spinal extensions or sustained extension end-range positioning for 30 minutes is required to experience the onset or resolution mechanical and symptomatic responses.

Responses elicited after cessation of the loading cycle (delayed response) are, by definition, responses that occur after the responsible dynamic or static loading stimuli ceases. Medicolegal issues arise concerning the meaning and the credibility of delayed responses, proportional to the delay.

RESPONSE PERSISTENCE AFTER LOADING CESSATION

Mechanical and symptomatic responses may demonstrate a varying degree of persistence after cessation of the loading strategy responsible for generating the responses. The possibilities are as follows:

- Responses do not persist after loading cessation
- Responses persist for a short period of time after loading cessation
- Responses remain after loading cessation

Consider a patient who has low back symptoms that, at the end range of flexion, radiate to the calf. If the radiation re-solves immediately, every time the patient returns to the neutral standing position, this individual experiences a symptomatic response that does not persist.

If calf symptoms remain for a couple of minutes after returning, from flexion, to the neutral posture, this person has a response that persisted for a short period of time without remaining.

A response that persists is evident if dynamic flexion causes calf symptoms that remain for days after flexion loading ceases.

Mechanically, consider a patient with 50% flexion loss. Dynamic extensions result in a 25% flexion loss. Dynamic flexion results in a 75% flexion loss. After resting for a moment, however, after either dynamic tactic, the 50% flexion loss returns regardless of the movement plane direction pursued. These scenarios are examples of mechanical responses that did not persist after loading cessation.

If the patient has 0% flexion loss for 30 minutes as a result of performing 10 extensions, after which 50% flex-ion loss returns, this individual offers an example of a response that persists for a short period of time after loading cessation.

A response that persists is evident if dynamic extensions result in 0% flexion loss and remains so.

Point of Response Elicitation

Mechanical and/or symptomatic responses may occur as a result of loading at end range or between the two end ranges (mid-range) of a particular movement plane.

Movement Plane-Specific Responses

Loading within a particular movement plane direction may have mechanical and/or symptomatic responses that are movement plane (or even movement plane direction) *specific;* spinal loading in one movement plane direction may affect a response in the same or another movement plane. The possibilities include one or more of the following:

- No responses within the same or any other movement plane
- Responses in the same movement plane direction as loading occurred
- Responses in the movement plane direction opposite to the loading direction
- Responses in a movement plane different from the loading movement plane

Responses in the same movement plane direction in which loading occurs are first and foremost in the minds

of most clinicians. The patient who extends the spine and experiences a limited, symptomatic end range exhibits a mechanical and symptomatic response in the movement plane direction of extension. Repeated extensions cause further extension loss and symptoms. If no other movements are affected, these responses are occurring in the same movement plane direction in which loading occurred.

Consider two cases in which responses occur in the movement plane direction opposite to the loading direction. Two patients have flexion limited by *50%.* One patient, after performing dynamic extensions, can achieve full flexion. The other, after performing dynamic extensions, is unable to perform any flexion at all. These cases are examples of loading in one movement plane direction that affects mechanical and symptomatic responses in the opposite direction of the same movement plane.

Responses in a movement plane different from the loading movement are noted in the following example. A patient with flexion limited by 50% due to symptoms can achieve full flexion after performing dynamic right side-gliding, but is in too much pain to perform any flexion after left side-gliding. In this case, loading within one movement plane (coronal) affects the mechanical and symptomatic responses in an entirely different movement plane (saggital). In fact, loading in the opposite direction of the coronal movement plane (side gliding) had opposite effects on mechanical and symptomatic responses in the saggital movement plane.

Mechanically Impeded End Range: The Mechanical-Symptomatic Interface

"Mechanically impeded end range" is a significant phenomenon that can be perceived by both the clinician and the patient. That it is recognized from both perspectives makes mechanically impeded end range an "interface," in a sense, between "objective," clinically assessed mechanical and "subjectively" perceived symptomatic phenomena.

Consider patients who have restricted range of motion, but no significant discomfort; i.e., symptoms do not interfere with the progression of movement. These patients report that further movement is not possible. Not only is this limitation observed clinically, but also, if the clinician attempts to move the spinal area passively, an early end range is detected by the clinician. It may be stated that further motion is "mechanically impeded." This abnormal early end range resulting in mechanically impeded movement is referred to as a *"mechanically impeded end range, "* with loss of global motion of which both the clinician and the patient are aware.

Mechanically impeded end range does not refer to motion palpation of vertebral segments wherein the clinician often detects restrictions or fixations unknown to the patient, and in fact, full global range of motion may be present.

PROPERTIES UNIQUE TO MECHANICAL RESPONSES TO LOADING

Mechanical responses or objective signs constitute clinical evidence (signs) perceptible to the examining clinician. The signs include observed angulation, list, fixed deformities, range of motion phenomena, and mechanically impeded end range. The last term refers to mechanical interference with the progress of motion to normal, full end range. The signs need not be associated with symptoms.

Normal End Range and Curve Reversal

Curve reversal refers to the ability to move the spine from the extreme of one movement plane direction to that of the opposite movement plane direction. Curve reversal includes both the ability to reverse the "normal" anatomic curves in the sagittal plane and the ability to introduce curves in the opposite directions of the coronal movement plane.

Flexion in the sagittal plane *reverses* the cervical lordosis, increases the thoracic kyphosis, and *reverses* the lumbar lordosis. Extension in the sagittal plane increases the cervical lordosis, *reverses* the thoracic kyphosis, and increases the lumbar lordosis.

Lateral flexion or side gliding in the coronal plane promotes a convexity in the direction opposite that of the movement performed. The "normal" neutral spine has no curves in the corona] plane. These curves are introduced or created when movement in this plane is performed. Under normal circumstances, full range of motion from one extreme of the coronal movement plane to the other is accompanied by the ability to *reverse* curves that were introduced by movement and are not present in a neutral, resting anatomic position.

OBSTRUCTION TO CURVE REVERSAL

An *obstruction to curve reversal is* a significant mechanically impeded end range that prevents spinal motion from progressing past the neutral position into the opposite movement plane direction. Loss of the ability to reverse spinal curves results in such clinical conditions as torticollis, acute scoliosis, and fixed kyphotic or lordotic deformities.

MECHANICALLY IMPEDED END RANGE

Although loss of range of motion may result from factors other than mechanically impeded end range, only this factor is considered in this discussion.

The degree to which curve reversal and normal end range may be accomplished *mechanically,* when compared before and after loading, is listed in the order of diminishing success:

- Reversible curve achieving full, mechanically unimpeded end range
- Reversible curve with mechanically impeded end range
- Obstruction to curve reversal with mechanically impeded end range

A reversible curve achieving full end range would indicate that no mechanically impeded end range is present. A mechanically impeded end range may be present, but curve reversal is permitted nonetheless, i.e., the progression of movement is mechanically impeded after curve reversal is accomplished.

If the progression of movement is mechanically impeded before curve reversal is accomplished, the result is a substantial loss of movement and an extremely early mechanically impeded end range, referred to as a deformity, antalgia, list, or shift.

Movement Quality

Movement quality refers to the ability to remain within the course of the intended motion plane direction. It is assessed as:

- No deviation from movement plane direction
- Deviation from the intended movement plane direction

Value of Mechanical Responses

It is generally considered beneficial to effect mechanical responses to permit curve reversal with a full range of motion, as well as the ability to accomplish, without deviation, the in-tended movement plane direction.

PROPERTIES UNIQUE TO SYMPTOMATIC RESPONSES TO LOADING

The symptomatic responses related to spinal disorders commonly considered amenable to mechanical care are pain, paresthesias, and similar symptoms of discomfort. Other symptomatic (subjective) phenomena, however, are equally important. Symptomatic (subjective) phenomena refer to:

- Symptoms of discomfort
  - topography of symptomatic responses (centralization or peripheralization)
- Judgment of fear
- Subjective perception of mechanically impeded end range
  - with or without symptoms of discomfort at end range

Symptoms of Discomfort

These symptoms include pain, numbness, paresthesias, burning, and the like. They may be experienced during motion or at the end range of motion. Not only do the symptoms of discomfort have different qualities, but also their location may change in response to spinal loading. The location or topography of symptoms is a key feature of the McKenzie approach.

Topography of Symptomatic Responses

Symptoms may be *central*, which means they are experienced about the midline of the spine. Symptoms may be *symmetric*, meaning they are equally positioned on opposite sides of the spine. *Unilateral symptoms* affect one side of the spine only. The further from the spine symptoms are experienced, the more *peripheral* are the symptoms. When the topography of symptoms changes in response to loading, they may become more central or peripheral, referred to as the *centralization response* or the *peripheralization response*, respectively.

CENTRALIZATION RESPONSE

In this symptomatic response to loading, more peripheral symptoms diminish or resolve and more central symptoms remain, appear, and/or increase in severity.

PERIPHERALIZATION RESPONSE

This symptomatic response to loading, whereby more peripheral symptoms increase or appear, may or may not be associated with changes in central symptomatology.

Judgment of Fear

Fear of symptoms of discomfort, or fear that they might worsen if experienced, is also an important subjective phenomenon because it may affect an individual's willingness to pursue a specific loading strategy. When possible, it is important to distinguish between an individual's willingness and the individual's *ability* to perform spinal motion.

Subjective Perception of Mechanically Impeded End Range

Patients often report the inability to perform a spinal motion past a certain point because of a sense of being "blocked." They may report that, "Something is in there," "It feels like there is a rock or ball in there," "A wedge is in there," or the like. This subjective perception prevents further movement. Often, it is the perception of a mechanically impeded end range, without any symptoms of discomfort, that is reported by the patient as the reason for failure of further movement. The patient's subjective perception resembles what is felt at the end range of normal, unrestricted spinal range of motion. At other times, symptoms of discomfort occur at the same time the subjective perception of the "early" mechanically impeded end range occurs.

Value of Subjective Phenomena Responses

It is therapeutically beneficial to diminish the subjective perception of mechanically impeded end range, because the typical result is improved mechanics. It is also therapeutically beneficial to diminish a patient's fear because fear prevents the resumption of activities of daily living.

It is not always therapeutically beneficial to avoid symptoms of discomfort, however. The McKenzie approach puts into perspective which symptoms are therapeutically beneficial and which are therapeutically detrimental to pursue. It is beneficial to elicit the centralization response, even though

the severity of central symptoms may increase. This increase is usually followed by improved mechanics and the ultimate reduction of central symptoms.

Peripheralization responses are therapeutically detrimental if they remain after cessation of the responsible loading action. In special circumstances, peripheralization that does not persist after end range loading ceases is considered beneficial.

The McKenzie approach demonstrates it is therapeutically beneficial to pursue certain symptoms and to avoid certain symptoms. This principle becomes clearer subsequently when the syndrome patterns themselves are discussed.

Putting symptoms into a perspective patients and clinicians can understand, rather than fear and avoid, provides a handle by which activity may control symptoms. The more common practice is actively avoiding all symptoms, which results in symptoms controlling activity.

LOSS OF RANGE OF MOTION

Loss of range of motion plays a considerable role in the evaluation of impairment and disability. It is curious, therefore, that the mechanical and symptomatic responses associated with range of motion loss do not ordinarily merit much attention.

Ostensibly, range of motion loss is an objectively measured, mechanical entity. Symptoms that the patient experiences with range of motion loss are recorded, if at all, without discriminating as to whether they occur during motion or at the end range of motion. As stated previously, range of motion loss may not be associated with any significant symptoms. The patient's only subjective experience may be that of perceiving the abnormally early end range, which may be perceived in the same manner as the "normal" proprioceptive cue to halt movement.

Range of motion studies usually have the patient perform only a single motion in each movement plane direction. The effects of repetitive movement or sustained positioning on range of motion loss in the same or in a different movement plane direction, are rarely assessed.

"Reasons" for Loss

Loss of range of motion does not result solely from mechanical factors that can be observed clinically or solely from subjective factors that can only be reported by the patient. Understanding range of motion loss requires integrating both of these perspectives. In summary, range of motion loss may be attributed to symptoms of discomfort, judgment of fear, and mechanically impeded end range, which were described previously. This underlines the importance of appreciating the patient's symptomatic experience in order to account fully for mechanical disorders of the spine.

The clinician, however, continues to play a key role. The clinical decision regarding the value of symptoms based on their topography, and not just on their intensity, is critically important. The way the clinician educates the patient dramatically affects that patient's judgment as to whether or not fear is appropriate. Lastly, regarding mechanically impeded end range, patients often perceive this early end range as "normal" because their subjective perception of the impeded end range may be identical to how "normal" end range feels. The clinician's assessment of mechanically impeded range as a mechanical sign plays an important role in those cases in which patients do not realize any motion has been lost at all.

MECHANICALLY IMPEDED END RANGE

The term *mechanically impeded end range* refers to an abnormally early end range that interferes with the progress of motion and may or may not be accompanied by symptoms. Patients may perceive the same proprioceptive cues (to halt motion) at the mechanically impeded end range as they do at normal and full end range.

The clinician and the patient both, in their own ways, may perceive mechanically impeded end range. The patient subjectively perceives a mechanically impeded end range preventing further movement, while the clinician may deduce its existence by observing the manner in which motion is impeded, or may "feel" it by passively moving the patient's spine until the mechanically impeded end range is detected.

Increasing Loading Intensity to Differentiate Restricted from Obstructed End Ranges

If loading of sufficient intensity (cycles or overpressure) is not applied, the mechanically impeded end range may be unaccompanied by symptoms. Overpressure is important in order to load joint structures further at the mechanically impeded end range, thereby "overstating" typical end range responses that occur there. The mechanical and symptomatic responses to loading mechanically impeded end ranges with a greater intensity differentiate mechanically impeded end ranges into two types, *restricted end range* and *obstructed end range.*

RESTRICTED END RANGE

This mechanically impeded end range behaves as if the progress of motion is limited, restrained, or "held back." It is slow to develop or resolve, with no mechanical or symptomatic responses during motion. Any mechanical response (e.g., deviation from the intended movement plane direction) occurs at the restricted end range only. If no symptoms are re-ported at the restricted end range, increasing the intensity of loading at the restricted end range will elicit mechanical and symptomatic responses in a characteristic fashion. Central or peripheral symptoms are experienced immediately and only at the restricted end range, and they do not persist long after loading at the restricted end range ceases. The centralization response never occurs. The peripheralization response, when it does occur, does not persist. Overpressure simply exaggerates the symptomatic response at end range, whereas increasing the

frequency of restricted end range loading does not change the characteristic response. During the initial examination, no change in how mechanics or symptoms respond to dynamic or static loading at the restricted end range is appreciable.

OBSTRUCTED END RANGE

This mechanically impeded end range behaves as if an "obstacle" or "blockage" is interfering with the progress of motion. It may be quick to develop or resolve. Mechanical and symptomatic responses may occur at any point of the involved movement plane direction, as well as at the obstructed end range. Mechanical and/or symptomatic responses may develop immediately or after a delay in response to a particular loading strategy. If no symptoms occur at the obstructed end range, increasing the intensity of the loading will elicit mechanical and symptomatic responses in a characteristic fashion.

The centralization response or the peripheralization response may be noted during motion or at an obstructed end range. Elicitation of, or changes in, mechanical and/or symptomatic responses to loading may persist after cessation of loading. Overpressure or increased frequency of loading at the obstructed end range may radically change the mechanical and/or symptomatic responses during motion or at the obstructed end range. Overpressure at the obstructed end range may result in the centralization response, the peripheralization response, or the resolution of mechanically impeded end range, or it may cause its occurrence earlier during the range of motion. During the initial examination, an appreciable change in how mechanics or symptoms respond to dynamic or static loading at the obstructed end range is usually noted.

Differentiating Obstructed End Range Symptoms from Symptoms During Motion. Mechanically impeded end ranges have been described as exhibiting two different responses, one typical of a restricted end range, the other of an obstructed end range. Loading at the restricted end range shows no significant change during the initial examination, and may show no significant changes for quite some time. Loading at an obstructed end range, on the other hand, may demonstrate rapid changes concerning mechanical and symptomatic responses.

Ordinarily, differentiating symptoms during motion from symptoms at an obstructed end range is not difficult. When an obstructed end range resolves rapidly, however, symptoms occurring at a mechanically impeded end range may be mistakenly construed as symptoms occurring during motion. Confusion in this regard may muddle the proper choice of therapeutic measures.

Assume a case in which a mechanically impeded end range interferes with the progression of movement to full extension. Dynamic loading to the mechanically impeded end range of extension resolves the mechanically impeded end range within a minute or two—a typical response of an obstructed end range.

Assume that with repetitive dynamic loading to the obstructed end range, every cycle of movement results in a lesser degree of mechanically impeded end range, i.e., permitting more and more extension range of motion with each cycle of movement. If discomfort was associated with loading at the obstructed end range, the discomfort would occur further and further into the range of motion with each cycle as the stepwise pattern of improvement occurs.

Regarding static loading, assume again that the spine is mechanically impeded in extension. Loading is performed in a static manner at the obstructed end range. The patient then assumes a neutral posture and again performs sustained extension at the obstructed end range that is now encountered after a greater range of motion. With each cycle, any discomfort at the obstructed end range would occur further and further into the range of motion as the obstructed end range moves along, again in a stepwise pattern.

On occasion, obstructed end ranges resolve rapidly and almost spontaneously without any special effort needed. In other cases, an increase of loading intensity (cycles or overpressure) may be necessary, after which the obstructed end range rapidly "gives way." The stepwise pattern just described may not occur if the obstructed end range "retreats" so rapidly that it appears to "melt away." If loading at an obstructed end range causes its rapid retreat, *accompanied by a symptomatic marker*, the phenomenon may be construed mistakenly to represent symptoms during mechanically unimpeded motion. It should be recalled in these cases, however, that initial examination revealed a mechanically impeded end range before aggressive loading tactics were pursued.

McKENZIE ASSESSMENT OF MECHANICAL AND SYMPTOMATIC RESPONSES TO LOADING

The McKenzie approach is that of assessing the responses, reactions, or effects of spinal loading. During the initial encounter with the patient, this assessment is performed by evaluating the history, posture, and quality of movement of the patient, and by using dynamic and static testing procedures.

History

In addition to the usual history taken regarding neck and back complaints, the McKenzie assessment makes particular inquiries regarding the following:

- Are symptoms constant or intermittent?
- What is the topography of symptoms?
- Are symptoms better or worse with any of the following?
  - Bending
  - Sitting
  - Rising from sitting
  - Standing
  - Walking
  - Lying

— Rising from lying
— When still —
On the move

Inquiries regarding whether patients are better or worse with activities of daily living yield clues regarding the loading effects that movements and positionings have on mechanical and symptomatic responses. Certain activities load the spine within the movement plane direction of flexion (bending, sitting), whereas other activities have the relative effect of loading the spine in the movement plane direction of extension (standing).

Posture

On initial examination, the patient's sitting and standing postures are noted. This information reveals how the spine is habitually subjected to static loading by the patient. An inquiry may also be made as to what posture the patient assumes at home or at work.

Quantity and Quality of Movement

The patient is asked to perform a single movement for each movement plane direction examined. The examiner concentrates on mechanics (quantity and quality of movement), not on symptoms. At this point, the examiner also does not concentrate on mechanical responses to loading. Quantity and quality of movement refers to the ability to achieve end range with curve reversal and without deviating from the intended movement plane.

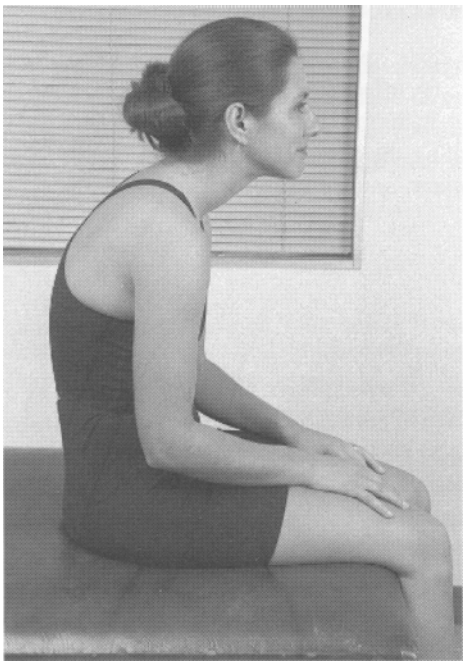


Fig. 12.3. Cervical protrusion.

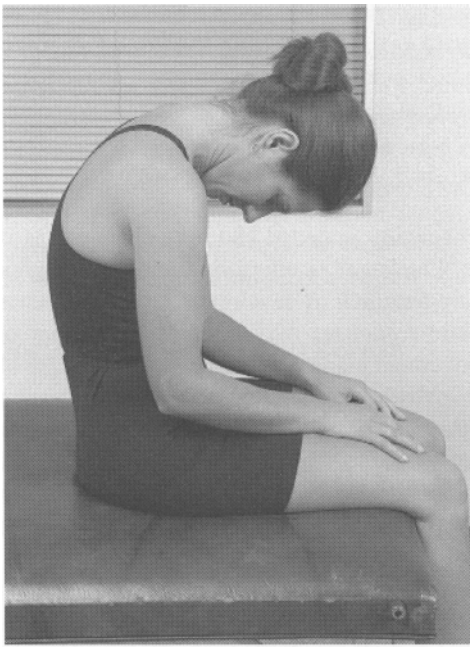


Fig. 12.4. Cervical flexion.

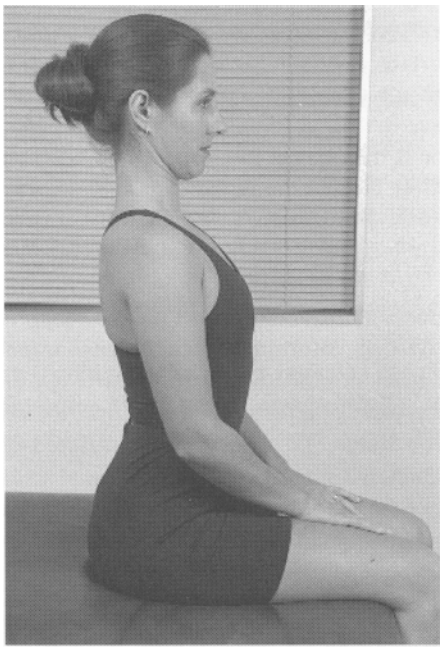


Fig. 12.5. Cervical retraction.

Modifications from typical range of motion studies include adding protraction and retraction to the cervical spine examination and replacing rotation and lateral flexion with side gliding movements to the lumbar spine examination.

CERVICAL SPINE STUDIES

- Protrusion (Fig. 12.3)
- Flexion (Fig. 12.4)

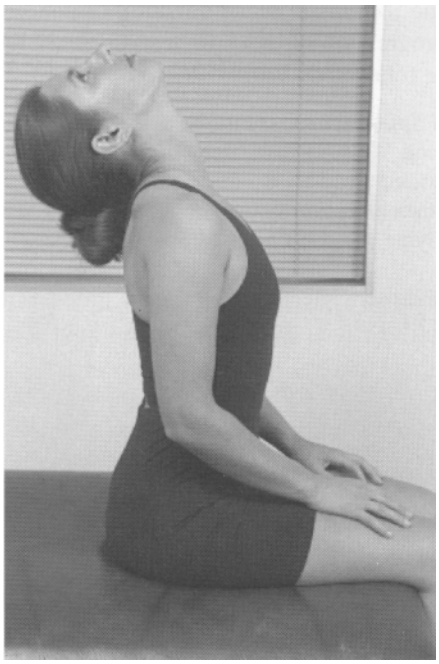


Fig. 12.6. Cervical extension.

- Retraction (Fig. 12.5)
- Extension (Fig. 12.6)
- Side-bending right
- Side-bending left
- Rotation right
- Rotation left

LUMBAR SPINE STUDIES

- Flexion (Fig. 12.7)
- Extension (Fig. 12.8)
- Side-gliding right (see Fig. 12.2)
- Side-gliding left (Fig. 12.9)

The movement plane directions evaluated for both the cervical and lumbar spines are those within which the clinically presenting antalgic postures occur. The movements required to achieve these antalgic postures are thought to be of value for both assessment and therapeutics of the respective spinal areas. Complaints, assessment, and therapeutics are, therefore, connected by similar mechanical considerations.

Dynamic and Static Tests

After quantity and quality of movement is assessed by the performance of single movements in each movement plane direction, dynamic and static tests are performed. These tests load the spine in a more aggressive manner than the single repetitions used to evaluate quality of movement. The patient is monitored closely concerning the mechanical and symptomatic responses to dynamic and/or static loading, especially concerning the most peripheral symptomatic complaints.

The mechanical and symptomatic responses that occur as a result of one or two movements may change significantly after further repetition of the same movement. The effects of loading in a certain movement plane direction are revealed best by repetition or sustained static loading. Dynamic loading or sustained positioning (static loading) better demonstrates mechanical and symptomatic responses to loading than does one movement or a moment's positioning, which may give a false first impression.

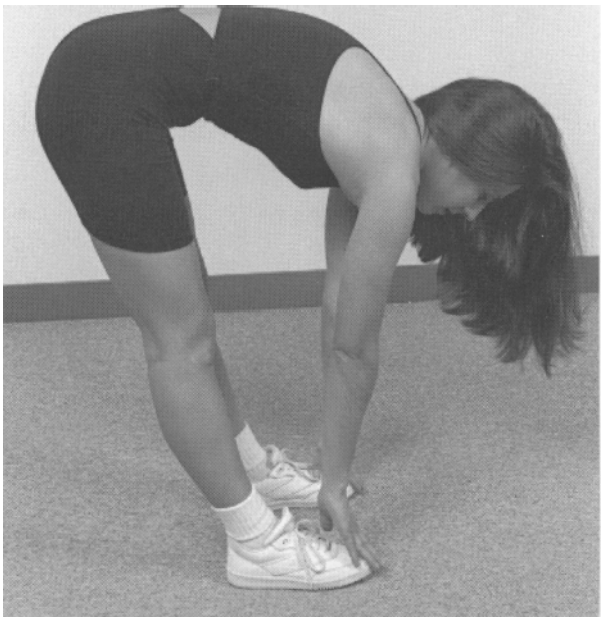


Fig. 12.7. Lumbar flexion.

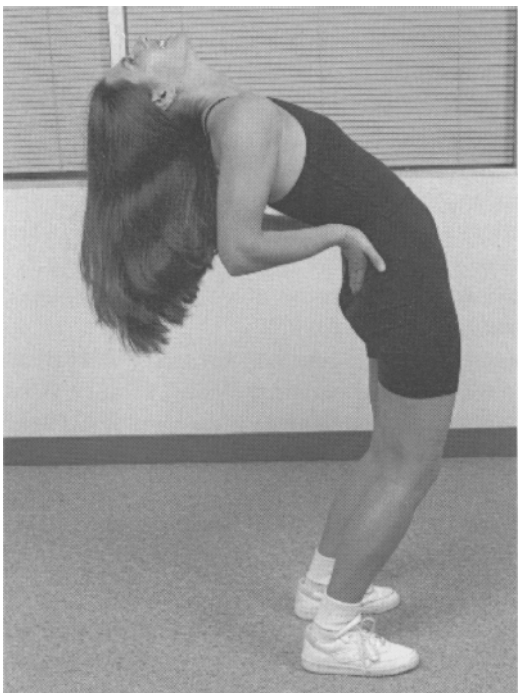


Fig. 12.8. Lumbar extension.

Cervical Spine

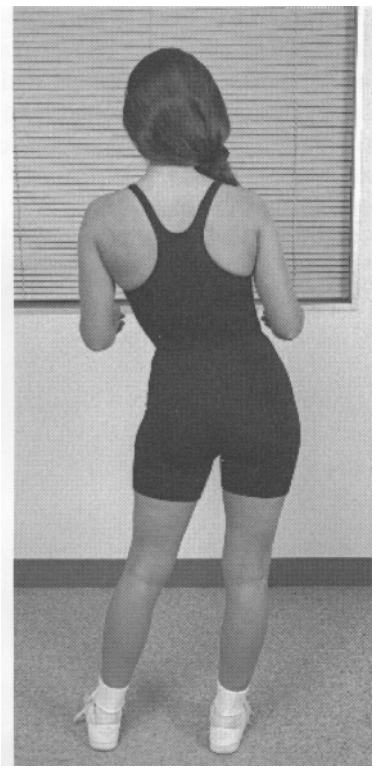


Fig. 12.9. Left lateral shift as a result of side-gliding left.

Dynamic loading in sagittal movement plane directions is typically explored first, unless the patient has significant antalgia in a coronal movement plane direction, in which case, the coronal movement plane is explored first. If the patient appears amenable to therapeutic spinal loading strategies in the sagittal movement plane, dynamic or static loadings tests in other movement planes are usually not pursued.

If a clear clinical picture is not revealed, dynamic loading in the coronal plane is explored, which entails lateral flexion for testing the cervical spine, and side-gliding movements for the lumbar spine.

Should loading in the coronal plane not provide satisfactory answers, the transverse movement plane is explored. For the cervical spine, this process entails rotation, whereas for the lumbar spine, rotation is performed side-lying combined with flexion. This lumbar movement is typically loaded at end range and is a static test.

Static loading tests generally are used when dynamic tests do not provide a clear preferred loading strategy. As with dynamic testing, the sagittal plane is explored first. Other movement planes and static tests are secondary considerations to sagittal dynamic testing.

DYNAMIC TESTS

Dynamic testing proceeds by performing a single motion within the movement plane direction being studied, followed by repetitive motion in the same movement plane direction. The clinician closely monitors how mechanics and symptoms respond during motion, at end range, and after the dynamic

- Flexion sitting
- Retraction sitting
- Retraction-then-extension sitting
- Retraction lying (head off edge of treatment table) (Figs. 12.10 and 12.11)
- Retraction extension lying (head off edge of treatment table) (Fig. 12.12 and 12.13)

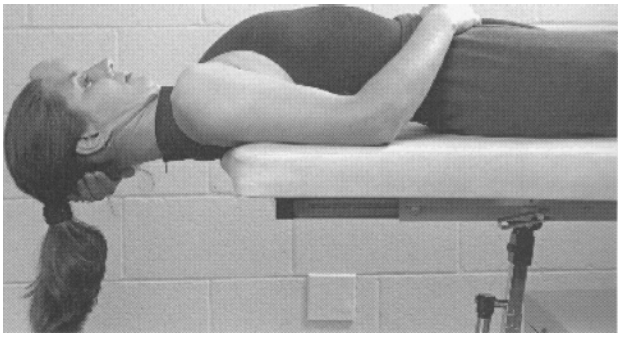


Fig. 12.10. Retraction lying.

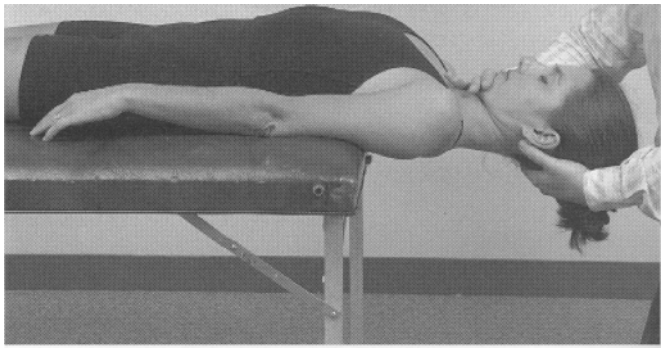


Fig. 12.11. Retraction lying with clinician overpressure.

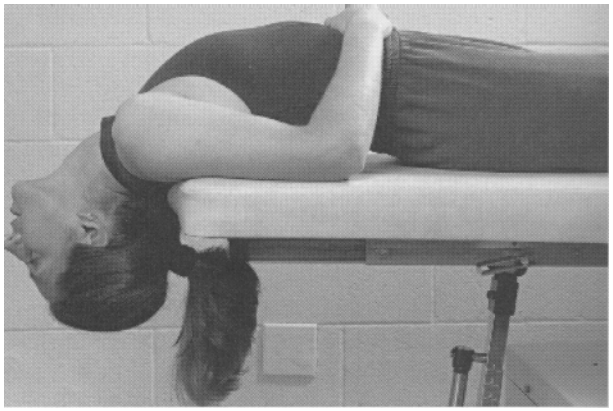


Fig. 12.12. Retraction-then-extension lying.

if ***required:***

- Protrusion sitting
- Retracted side-bending right sitting (Fig.12.14)
- Retracted side-bending left sitting
- Retracted rotation right sitting (Fig. 12.15)
- Retracted rotation left sitting

Lumbar Spine

- Flexion standing
- Extension standing
- Flexion in lying (supine knee to chest) (Fig. 12.16)
- Extension in lying (prone "McKenzie" press up) (Fig. 2.17)

if ***required:***

- Side-gliding right standing or prone extension with right lateral shift (Fig. 12.18)

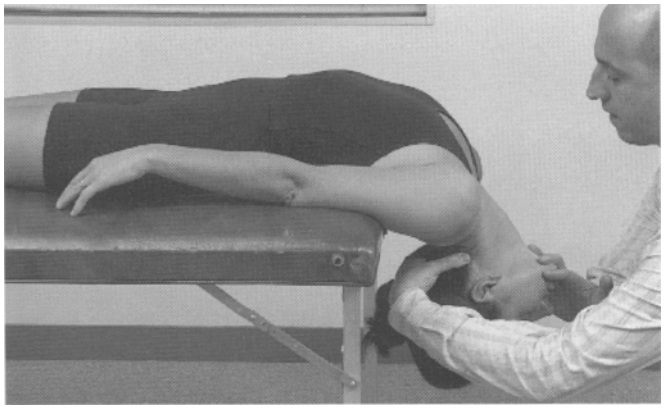


Fig. 12.13. Clinician traction-retraction-extension lying.

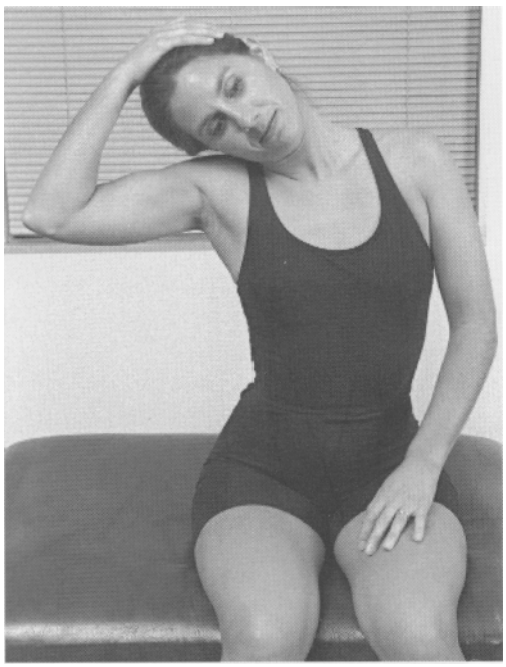


Fig. 12.14. Retracted side-bending right sitting.

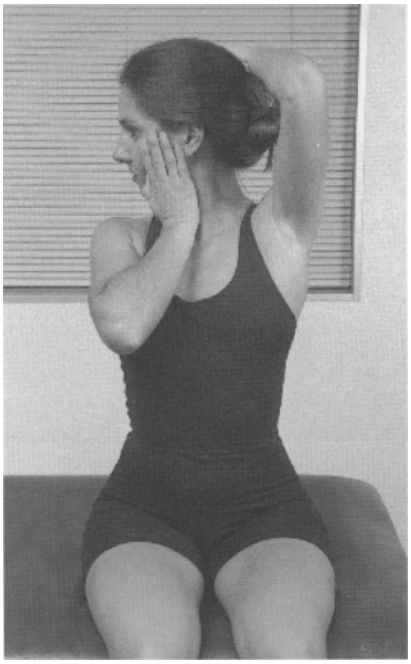


Fig. 12.15. Retracted rotation right sitting.

- Side-gliding left standing (see Fig. 12.9) or prone extension with left lateral shift

STATIC TESTS

Static loading is often used as an *ancillary* test to confirm dynamic testing or to further explore the effects of loading when dynamic testing yields no definitive conclusion. In particular, headaches of cervical origin often require sustained static loading to diagnose or treat the syndrome pattern involved. Choices for static testing follow.

Cervical Spine

- Protrusion
- Flexion
- Retraction (sitting or supine)
- Retraction then extension (sitting, prone, or supine)
- Retracted side-bending right or left
- Retracted rotation right or left

Lumbar Spine

- Sitting slouched (Fig. 12.19)
- Sitting erect (Fig. 12.20)
- Standing slouched
- Standing erect
- Lying prone in extension
- Long sitting
- Lateral shift right or left
- Rotation in flexion

USE OF OVERPRESSURE

Overpressure may be used in combination with dynamic and/or static testing, permitting further end range positioning.

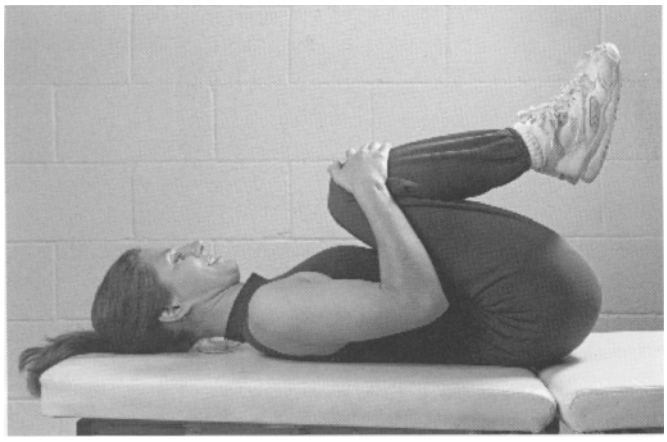


Fig. 12.16. Flexion in lying.

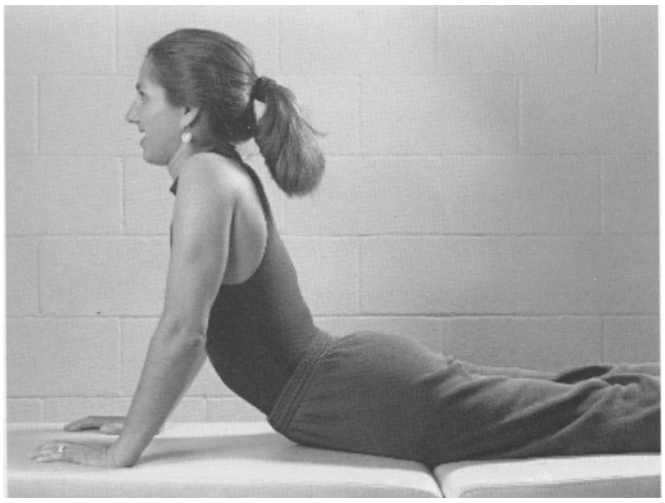


Fig. 12.17. Extension in lying.

Such overpressure may be patient generated or clinician generated (Figs. 12.21 to 12.23).

Spine-Related Responses Versus Behaviors

A response may be defined as the reaction elicited by a stimulus. In the McKenzie approach, the stimulus is mechanical (spinal loading), and the response is the mechanical or symptomatic reaction.

The McKenzie approach distinguishes between conditions that demonstrate beneficial responses to mechanical loading stimuli and those that either do not respond or demonstrate detrimental responses. Needless to say, it may not be fruitful to pursue mechanical therapies in cases that show no or detrimental responses to spinal loading strategies.

Regarding terminology used to describe mechanical and symptomatic responses to spinal loading, *behavior is* often used interchangeably with *response.* Behavior, however, is considered a broad term used to connote all the mechanical and symptomatic responses to a particular loading strategy.

A loading tactic may be considered a loading stimulus. A loading strategy is considered the sum of stimuli. A response is a reaction to loading stimuli (tactic or strategy), whereas behavior refers to the sum of responses.

The McKenzie approach recognizes behavior patterns as syndromes amenable to mechanical loading strategies.

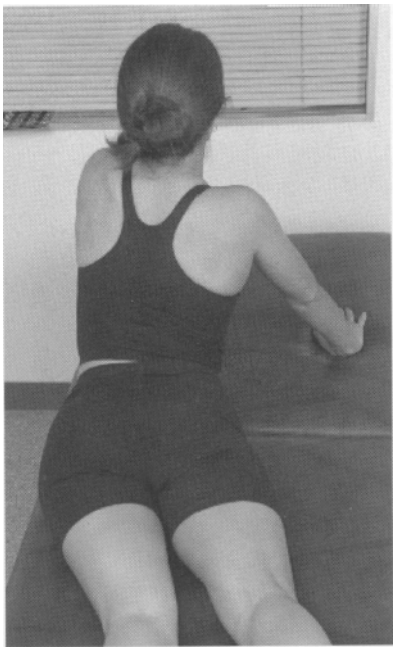


Fig. 12.18. Prone extension with right lateral shift.

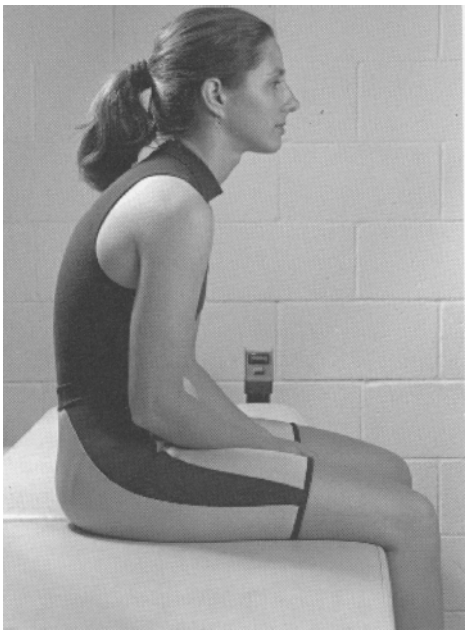


Fig. 12.19. Sitting slouched.

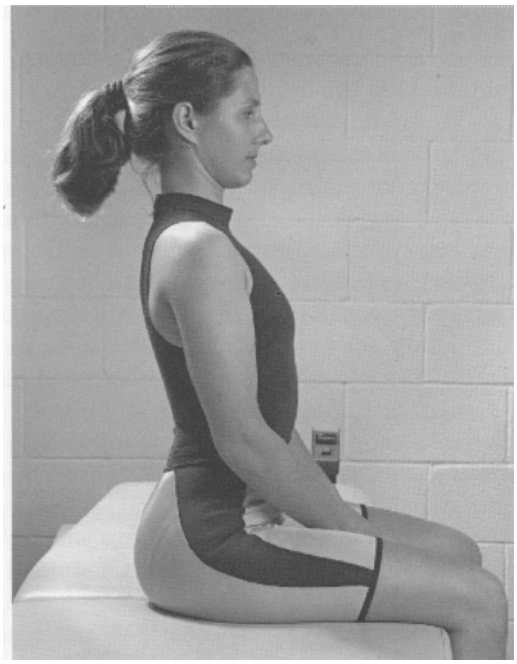


Fig. 12.20. Sitting erect.

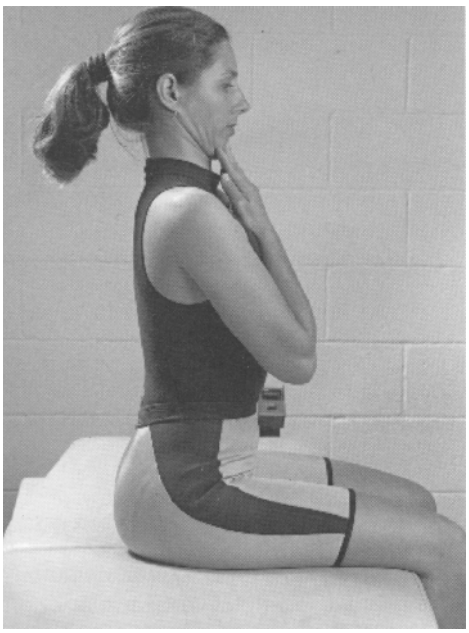


Fig. 12.21. Cervical retraction with patient overpressure.

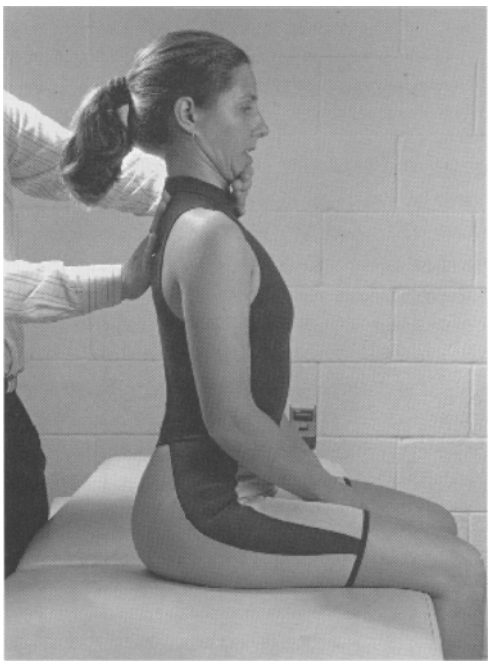
THREE SYNDROME PATTERNS

The clinical reasoning intrinsic to the McKenzie approach organizes mechanical and symptomatic responses to loading into three syndrome patterns. These patterns describe a discrete set of mechanical spinal conditions that respond to loading strategies in a specific manner.

Clinical Reasoning and Utility

The syndrome patterns do not encompass all spinal complaints and conditions, but rather define spinal conditions that respond to the mechanical influence of loading strategies in a predictable manner. Retrospectively, these conditions are considered mechanical spinal disorders after they prove amenable to mechanical methods. Spinal complaints that do not respond to, or are made worse by, the mechanical influence of loading strategies are screened out, including those conditions that may represent mechanical disorders not amenable to loading, psychogenic entities, inflammatory conditions, or those of even more pernicious causation. In these conditions, responses to mechanical loading strategies are atypical, lacking, or detrimental.

Fig. 12.22. Cervical retraction with clinician overpressure.



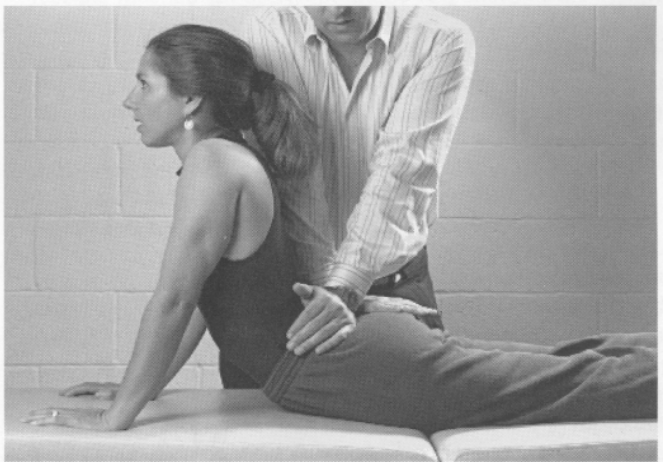


Fig. 12.23. Extension in lying with clinician overpressure.

Table 12.1 Summary of the Three Syndrome Patterns

	Mechanical or Symptomatic Responses	Frequency of Complaints (Responses)	Point of Response Elicitation	Rate of Response Elicitation	Response Persistence after Loading Cessation	Rate of Syndrome Resolution	Responses During Motion	Responses at Mechanically Unimpeded End Range	Responses at Mechanically Impeded End Range	Movement Plane Specific Responses	Preferred Loading Strategies	Reasons for Patient Failure
Postural	Symptomatic only	Intermittent	Sustained end range	Delayed onset after sustained end range positioning	None	Weeks	None	Symptomatic	None exist	Movement plane direction specific	Avoid symptoms	Ignorance, fatigue, self-conscious
Dysfunction	Symptomatic and mechanical	Intermittent	Restricted end range	Immediate at restricted end range	None	Months	None	None	Mechanical and symptomatic	Movement plane direction specific	Pursue symptoms	Avoiding symptoms
Derangement	Symptomatic and mechanical	Intermittent or Constant	During motion, obstructed or unobstructed end range	Immediate or delayed, during motion, at obstructed or unobstructed end range	Often persists	Days	Yes	Mechanical and symptomatic	Mechanical and symptomatic	Loading in one movement plane direction may effect another	Pursue centralization, avoid peripheralization	Avoiding symptoms of centralization

Pathoanatomic Syndrome Nomenclature

The syndrome patterns are identified by recognizing groupings or categories of mechanical and symptomatic responses to loading, not the pathoanatomic basis for them. Nonetheless, the syndromes have been named according to the hypothesized pathoanatomic basis for their behaviors. While these hypotheses are the McKenzie system's "best guess," it is important to remember two salient points regarding the pathoanatomic titles for these syndromes. The first is that the syndromes are grouped according to responses and *not* pathoanatomy. If research proves the McKenzie pathoanatomic hypotheses erroneous, the observed grouping of responses will remain as empiric fact. The second point is that the pathoanatomic titles of the syndromes help the clinician remember the configuration of complaints so named. It also helps *both* the clinician and the patient to remember the rules surrounding treatment of the syndromes.

Because the utility of the system rests in its ability to organize, classify, and predict associated mechanical and symptomatic responses to loading strategies, it may be granted that the pathoanatomic conclusions are *as if* conclusions.

The pathoanatomic titles for the syndromes are the postural, dysfunction, and derangement syndromes. These syndrome patterns are summarized in Table 12.1.

Postural Syndrome

P.S. MECHANICAL AND SYMPTOMATIC RESPONSES

Symptomatic responses characterize this syndrome. No mechanical responses are noted.

P.S. FREQUENCY OF RESPONSES (COMPLAINTS) The

frequency of responses is intermittent. P.S. POINT OF

RESPONSE ELICITATION

Responses are elicited at a mechanically unimpeded end range, usually in one movement plane direction only.

P.S. RATE OF RESPONSE ELICITATION

This syndrome exhibits delayed onset of symptoms in response to sustained static loading at end range. Sustained positioning at end range must be assumed for a relatively long period of time (e.g., 20 minutes) before symptoms are elicited. The delayed onset of symptoms in response to sustained static loading may not be evident during the initial examination because of failure to provide adequate static loading time for the delayed onset response to occur.

P.S. RESPONSE PERSISTENCE AFTER LOADING CESSATION

Symptomatic responses elicited after sustained static loading at end range resolve once that loading tactic is terminated. This behavior is typical of the Postural Syndrome and con-tributes to the intermittent nature of complaints.

P.S. RATE OF SYNDROME RESOLUTION

The characteristic responses of the Postural Syndrome may take weeks to change with proper therapy. This period of time may be required before it is possible to sustain positioning at the culpable end range absent a symptomatic response. Changes in the end-range symptomatic response, characteristic of this syndrome, cannot be accomplished during the initial evaluation.

P.S. RESPONSES DURING MOTION

Curve reversal and the ability to achieve mechanically unimpeded end range without deviation from the intended movement plane direction are fully preserved. No symptoms occur during motion. The centralization or peripheralization responses are never noted during motion.

P.S. RESPONSES AT MECHANICALLY UNIMPEDED END RANGES

There is no deviation from the intended movement plane directions. The symptomatic responses occur only after sustained loading at the culpable mechanically unimpeded end range. Over-pressure does not change symptoms significantly. Symptoms are central, bilateral, or unilateral, depending on the nature of the sustained end range positioning. The centralization or peripheralization responses are never noted. Responses that do occur do not persist after loading ceases.

P.S. RESPONSES AT MECHANICALLY IMPEDED END RANGES

Mechanically impeded end ranges do not exist in the Postural Syndrome.

P.S. MOVEMENT PLANE-SPECIFIC RESPONSES

Loading in the symptomatic movement plane direction does not result in mechanical or symptomatic responses within the opposite or within other movement plane directions. Loading in the opposite direction of the symptomatic movement plane direction, or in another movement plane, does not *directly affect* the mechanical or symptomatic responses of the symptomatic movement plane direction.

Avoiding loading at the symptomatic end range is therapeutic in and of itself. Loading in all other movement plane directions is equally therapeutic, inasmuch as they all avoid the symptomatic end range, although they have no *direct* therapeutic benefit.

P.S. PREFERRED LOADING STRATEGY

In the Postural Syndrome, avoiding the symptomatic end range is of paramount importance. Pursuing symptoms at the culpable end range is detrimental. When the symptomatic end range is avoided over a period of time, symptoms at end range are more difficult to elicit, and eventually the Postural Syndrome resolves. When static loading at the symptomatic end range is frequently pursued, it perpetuates the syndrome

and may diminish the delay regarding elicitation of symptoms. Constant vigilance regarding avoidance of the symptomatic end range is required to resolve this condition, which generally is accomplished over a period of several weeks.

P.S. REASONS FOR FAILURE OF PATIENT STRATEGIES

When patients do not successfully resolve this syndrome on their own, it is because they are not avoiding the symptomatic end range for long enough periods of time. Postural correction is required, and the patient must be vigilant to avoid the postural habit that holds the spinal joint at the "offending" end range. Patients may feel too awkward or be too concerned about their appearance if this requires them to maintain an up-right, neutral, sitting posture. The patient may experience a sense of fatigue in the corrected sitting position, or may experience new discomfort when performing proper sitting posture. The Postural Syndrome is a mechanical problem for which pain or antiinflammatory medication is inappropriate and ineffective. It has a specific mechanical correction—to *avoid* the symptomatic end range.

P.S. HYPOTHESIZED PATHOANATOMY

When joints are held at end range, whether they are extremity joints or spinal joints, noncontractile structures such as ligaments and joint capsules are stressed. An example is the bent finger illustration. If the index finger is hyperextended, discomfort is experienced almost immediately. If it is held just short of the point of immediate discomfort, discomfort would be experienced within 20 minutes. No pathologic condition need exist for this abnormal stress to cause discomfort in a normal joint. These principles applied to the spine are proposed as the origin of Postural Syndrome symptoms, which occur when spinal joints are held at end range for a prolonged period of time.

P.S. RELATED TERMINOLOGY

The particular Postural Syndrome is named according to the movement plane direction of which the offending sustained position represents the end range. The particular Postural Syndrome, therefore, is named in reference to the particular end range at which static loading occurs. Some examples are: sustained extension, sustained flexion, sustained right lateral shift, and/or a combination of movement plane directions.

Sustained extension of the lumbosacral spine may be experienced during poor standing posture, especially in pregnant patients or those with a "beer belly." In addition, sustained extension *of* the upper cervical spine is experienced commonly with the poor sitting posture *of* head protraction.

Sustained flexion of the lower cervical, thoracic, and lumbosacral spine commonly occurs with poor, slouched sitting postures.

A sustained lateral shift may be seen when all weight rests on one leg in a standing position, thereby shifting the thorax and pelvis in opposite directions within the coronal movement plane.

P.S. SUMMARY INCORPORATING HYPOTHESIZED PATHOANATOMY

When noncontractile, ligamentous, capsular, etc. structures are held at sustained end range for long periods *of* time, symptoms develop in what is *a mechanically unimpeded* normal spinal joint structure subjected to abnormal stresses. Release *of* the abnormal stress on these structures is accompanied by immediate symptomatic relief. As this abnormal stress *of* static loading at end range occurs with greater frequency and/or duration, discomfort is easier to elicit. The condition develops slowly, and the pain is intermittent be-cause it is experienced only when spinal joint structures are held at sustained end range for a prolonged period.

Examination reveals no loss of motion or deviation of movement, i.e., no abnormal mechanical responses. In addition, no symptoms occur during movement or at end range on examination. To provoke symptoms, the joint must be held at end range for a prolonged period. Therefore, the traditional examination of patients with "pure" Postural Syndromes reveals no objective or subjective findings.

Nevertheless, these patients may report having had symptoms in multiple areas of the spine, which occur because of holding multiple areas at end range. These patients are not hysterical, nor are they hypermobile. The best therapeutic avenue is one of avoiding symptoms (sustained end range) for a period of time long enough for the offended tissue to extinguish the symptomatic response to sustained end-range loading.

Dysfunction Syndrome

Dy.S. MECHANICAL AND SYMPTOMATIC RESPONSES

Symptomatic and mechanical responses characterize this syndrome.

Dy.S. FREQUENCY OF RESPONSES (COMPLAINTS)

Responses are intermittent.

Dy.S. POINT OF RESPONSE ELICITATION

Responses are elicited at a mechanically impeded end range of the *restricted end range* variety.

Dy.S. RATE OF RESPONSE ELICITATION

The Dysfunction Syndrome exhibits an immediate elicitation of symptomatic and mechanical responses at the *restricted end range* when sufficient loading overpressure is present.

Dy.S. RESPONSE PERSISTENCE AFTER LOADING CESSATION

Mechanical and symptomatic responses elicited immediately when loading at the restricted end range resolve once that loading tactic is terminated. This behavior is typical of the

Dysfunction Syndrome and contributes to the intermittent nature of complaints.

Dy.S. RATE OF SYNDROME RESOLUTION

The characteristic responses of the Dysfunction Syndrome may take as long as 6 to 20 weeks to resolve. Changes in the mechanical and symptomatic responses characteristic of the syndrome cannot be accomplished during the initial evaluation.

Dy.S. RESPONSES AT MECHANICALLY IMPEDED END RANGES

Restricted end range usually occurs in only one movement plane direction. If it occurs in more than one movement plane direction, responses at the individual restricted end range have no effect on each other. Mechanical and symptomatic responses occur immediately at the restricted end range only. These responses do not persist after loading at the restricted end range ceases. Any deviation from the intended movement plane direction occurs at the restricted end range only. Restricted end range may be accompanied by the subjective perception of mechanically impeded end range. If discomfort *is not present* at the restricted end range, overpressure creates it, but this discomfort resolves when loading at the restricted end range ceases. If discomfort *is present* at the restricted end range, overpressure increases it, but again, this increased discomfort resolves when overpressure at the restricted end range ceases. The centralization response does not occur. If the peripheralization response occurs, it is experienced only during motions containing a component that achieves the restricted end range of the flexion movement plane direction. Typical of the dysfunction pattern, symptoms that peripheralize do not persist after cessation of loading at the restricted end range of flexion.

Dy.S. MOVEMENT PLANE-SPECIFIC RESPONSES

Loading in the symptomatic movement plane direction does not result in mechanical or symptomatic responses within the opposite movement plane direction or other movement planes. Conversely, loading in the opposite direction of the symptomatic movement plane direction, or in another movement plane, has *no effect* on the mechanical or symptomatic responses in the symptomatic movement plane direction.

Frequent static or dynamic loading at or to the restricted end range helps resolve the syndrome over time. Static or dynamic loading in the opposite direction of the same movement plane, or in another movement plane, serves no therapeutic benefit. The only therapeutic action is that of pursuing the symptomatic premature end range. All other movements or positionings are equally ineffective regarding resolution of the syndrome.

Dy.S. PREFERRED LOADING STRATEGY

In the Dysfunction Syndrome, pursuing the symptomatic restricted end range is of paramount importance. Avoiding the symptomatic restricted end-range perpetuates the syndrome and perhaps permits the mechanically limited end range to become more restricted in the future. Daily frequent and repetitive motion to the symptomatic end range is required to resolve this condition, which generally occurs slowly over 6 to 20 weeks.

Dy.S. REASONS FOR FAILURE OF PATIENT STRATEGIES

Patients may avoid the restricted end range because of the discomfort involved as well as the proprioceptive cue of reaching the limits of motion. In so doing, they avoid "therapeutically beneficial" restricted end-range discomfort and perpetuate the Dysfunction Syndrome.

Pain or anti-inflammatory medication cannot correct the mechanical problem underlying this syndrome, which re-quires restricted end-range loading for its resolution.

Dy.S. HYPOTHESIZED PATHOANATOMY

As a result of chronic postural habits that avoid bringing spinal joints to certain end ranges, or as the result of tissue damage leading to scar formation, *adaptive shortening* or dys*function* of tissue may occur. A loss of elasticity occurs causing *restriction* of spinal movement. If a perfectly normal elbow is cast in a flexed position for 1 month, the ability to extend it is restricted when the cast is removed, an example of the dysfunction behaviors just described.

Scar tissue, which shortens over time, may form at the site of disk derangement or spinal surgery. After significant derangement or surgical intervention, an *adherent nerve root* may develop, exhibiting the typical mechanical and symptomatic responses of the dysfunction syndrome. The adherent nerve root condition may involve the peripheralization of symptoms to an extremity without an associated "centralization response." This peripheralization response occurs at the *restricted end range* of the flexion movement plane direction only. Other special conditions must accompany this end-range flexion to elicit adherent nerve root responses: e.g., extended knee for the lumbar spine and lateral flexion of the cervical spine combined with shoulder abduction. The peripheralization response noted with the adherent nerve root does not remain after the precipitating loading actions cease. Treatment is fashioned according to the preferred loading strategy for dysfunction: i.e., evoking the discomfort at end range, which, in this case, involves peripheralization of symptoms.

Dy.S. RELATED TERMINOLOGY

The particular Dysfunction Syndrome is named according to the movement plane direction limited by *restricted end range.* Examples include the following:

- Extension dysfunction
- Flexion dysfunction (includes "adherent nerve root")
- Right rotation dysfunction
- Left rotation dysfunction
- Right lateral flexion dysfunction
- Left lateral flexion dysfunction

- Right side-gliding dysfunction
- Left side-gliding dysfunction

Typically, rotation and lateral flexion dysfunctions apply to the cervical spine, whereas the side-gliding dysfunctions apply to the lumbosacral spine.

Because of the predominance of flexion in the industrial lifestyle, extension dysfunctions develop commonly in the lower cervical spine and lumbosacral spine by middle age. Because of poor sitting posture, protraction of the head occurs, which involves extension of the upper cervical spine. Flexion dysfunction of the upper cervical spine commonly occurs as a result.

Dy.S. SUMMARY

The cause of the syndrome is shortened, nonelastic structures that restrict spinal movement. Resolution involves stretching these structures. The loss of range of motion or deviation from the intended movement plane direction results from inelasticity. Avoiding symptoms only perpetuates the syndrome and may, in fact, slowly enable it to develop further by approximating the ends of structures that are then permitted to shorten further. Frequent and repetitive elicitation of discomfort is required to improve quality of movement. Peripheralization to the extremity occurs only when the healing process subsequent to disk injury or surgery results in the tethering of neurologic structures, which limits and is challenged by the movement plane direction of flexion. Therefore, adherent nerve root is a subcategory of flexion dysfunction.

For didactic purposes, this syndrome has been described as displaying symptomatic responses at a restricted end range that cease once loading at that end range ceases. For all in-tents and purposes, this description is true. To differentiate this syndrome from the Derangement Syndrome, however, one must be cognizant of the possibility of a symptomatic response that will not cease should overstretching occur. Such symptomatology is considered evidence of an inflammatory response to overstretching and damaging tissue. The potential inflammatory response to overstretching shortened tissue must be kept in mind to differentiate this contingency from the constant symptomatic response attributable to mechanical factors of the Derangement Syndrome.

Derangement Syndrome

De.S. MECHANICAL AND SYMPTOMATIC RESPONSES

Symptomatic and mechanical responses characterize the Derangement Syndrome.

De.S. FREQUENCY OF RESPONSES (COMPLAINTS)

Responses may be intermittent or constant. De.S.

POINT OF RESPONSE ELICITATION

Responses are elicited at mechanically impeded end range(s) of the *obstructed end range* variety, at mechanically unimpeded end range(s), during midrange motion, or during midrange static loading.

De.S. LOADING TIME REQUIRED TO ELICIT A RESPONSE

The Derangement Syndrome may exhibit immediate elicitation or delayed onset of symptomatic and mechanical responses at the obstructed end range, at mechanically unimpeded end ranges, during motion, or with midrange static loading.

De.S. RESPONSE PERSISTENCE AFTER LOADING CESSATION

Responses or behaviors elicited as a result of loading at an obstructed end range, at a mechanically unimpeded end range, during midrange motion, or with midrange static loading may remain after the loading tactic responsible is terminated. This persistence is typical of the *Derangement Syndrome* which is the only syndrome with constant symptoms, especially those of peripheralization.

De.S. RATE OF SYNDROME RESOLUTION

The characteristic responses of the Derangement Syndrome may change rapidly and radically during the time provided for the initial evaluation. Resolution of this syndrome may be possible within a matter of days.

De.S. RESPONSES DURING MOTION

The obstructed end range may be significant enough to prevent curve reversal. An obstructed end range exists in at least one movement plane direction, and may exist in multiple movement plane directions. Deviation from the intended movement plane direction or symptoms during motion may be noted. The centralization or peripheralization responses may be noted during motion.

De.S. RESPONSES AT MECHANICALLY UNIMPEDED END RANGES

Deviation from an intended movement plane direction and/or symptoms may occur. Overpressure may change mechanical and/or symptomatic behavior. The centralization response does not occur; the peripheralization response may occur.

De.S. RESPONSES AT MECHANICALLY IMPEDED END RANGES

Obstructed end ranges may occur in a single or in multiple movement plane directions. If an obstructed end range occurs in more than one movement plane direction, responses at the individual obstructed end range may affect each other. Mechanical and symptomatic responses may be elicited immediately or exhibit delayed onset as a result of loading at the obstructed end range. Deviation from the intended movement plane direction may occur at the obstructed end range as well as at the unimpeded end range. Loading at the obstructed end range may be accompanied by the subjective perception of a mechanically impeded end range.

If discomfort *is not present* at the obstructed end range, overpressure may create it, and this discomfort may then exhibit a centralization or peripheralization response. If discomfort *is present,* overpressure may increase or decrease it, as well as precipitate a centralization or peripheralization response. The centralization or peripheralization responses may occur at obstructed end ranges. Centralization occurs only in movement plane directions (during motion or at end range) that contain the "key" obstructed end range.

De.S. MOVEMENT PLANE-SPECIFIC RESPONSES

Loading in a symptomatic or asymptomatic movement plane direction may change mechanical and/or symptomatic responses of the opposite movement plane direction or of another movement plane direction. These changes may be therapeutically beneficial or detrimental.

In the Derangement Syndrome, the therapeutically beneficial loading action to pursue involves loading at the "key" obstructed end range. In other words, if there is more than one obstructed end range, loading at one obstructed end range may be therapeutically beneficial, whereas loading at another may be therapeutically detrimental or neutral. If there is only one obstructed end range, that is the "key." Avoiding therapeutically detrimental obstructed end ranges, movement plane directions, or other loading tactics is of paramount importance in resolving this syndrome.

In general, the *centralization response is* noted as a result of loading motions toward or static loading at the "key" obstructed end range. Symptoms generally do not occur during motion within the movement plane direction that leads to the "key" obstructed end range, especially after the first few cycles of dynamic loading are accomplished. As discussed previously, a rapidly retreating obstructed end range may mimic symptoms during motion, when in fact symptoms are occur-ring at a rapidly resolving obstructed end range.

The *peripheralization response is* noted as a result of loading motions toward or at end ranges that do not contain the key obstructed end range. These end ranges may be mechanically unimpeded or may contain obstructions that are not reduced as a result of loading and, in fact, may become worse.

De.S. PREFERRED LOADING STRATEGY

Pursuing and avoiding certain loading tactics, as well as the order in which they are accomplished, is critical in the care of this syndrome.

In general, symptomatic responses are pursued if characterized by the centralization response and avoided if characterized by the peripheralization response. The "key" obstructed end range is the one that exhibits the centralization response when pursued. Avoided are obstructed end ranges, mechanically unimpeded end ranges, or loading within movement plane directions that evidence the peripheralization response. Avoidance of loading tactics that elicit the peripheralization response is not sufficient, as loading at the key obstructed end range may still not be accomplished.

The preferred loading strategy revolves around reducing the key obstruction. This effort may be accompanied by the rapid resolution of symptoms, or by the temporary increased symptomatology of the centralization response, after which symptoms resolve.

Phenomena related to the resolution of derangements exhibit varying degrees of complexity. The simplest case involves only one obstructed end range in the sagittal plane, which is the key obstructed end range. The centralization response may be noted at the obstructed end range. The peripheralization response is elicited typically by means of loading within the opposite movement plane direction. Peripheralization by means of loading in the movement plane direction opposite to that of the obstructed end range may be elicited immediately or by delayed onset; i.e., mechanically unimpeded flexion may peripheralize, whereas extension to the obstructed end range centralizes. The less common, but opposite simple sagittal pattern, may also be found.

More complex situations entailing multiple *obstructed end ranges,* of which only one is the key, may mandate an initial preferred loading strategy within a coronal or transverse movement plane. Consider a case involving an obstructed end range in one sagittal movement plane direction, as well as an obstructed end range in one coronal movement plane direction. In such cases, it is possible that loading in both the unimpeded and obstructed sagittal movement plane directions elicits the peripheralization response. Loading in the coronal or transverse movement plane is at first required to elicit the centralization response. Subsequently, loading in the sagittal plane becomes necessary for further resolution of the syndrome.

It is possible in cases involving multiple obstructed movement plane directions, for loading at a single (key) obstructed end range to resolve all obstructions, without requiring the sequential end range loading just described.

De.S. REASONS FOR FAILURE OF PATIENT STRATEGIES

The centralization response that occurs at the key obstructed end range may entail a significant increase or creation of central symptoms, which patients understandably avoid. Because the centralization response is associated with an increase of more central spinal symptoms, patients may choose the therapeutically detrimental strategy of pursuing loading tactics that diminish spinal discomfort, even though lesser peripheral symptomatic complaints and significant mechanical disorders are perpetuated.

De.S. HYPOTHESIZED PATHOANATOMY

The model for this syndrome is the derangement of intradiscal material or substance, whether it is solid (nuclear, annular), liquid (water, electrolytes, etc.), or gaseous (e.g., nitrogen). The behavior of symptoms and mechanics changes according to migration and/or accumulation of intradiscal substance or material in the anterior, posterior, or lateral aspects of the intervertebral disk space.

Imagine a simple case in which intradiscal material deranged in a posterior direction, causing obstructed end range to extension. Flexion would remain unobstructed but would further promote this posterior derangement, eliciting peripheralization during, or at the end range of, the derangement-promoting flexion movement plane direction. The *centralization response* would accompany extension with overpressure, as the derangement becomes reduced. The reverse case could be imagined as well.

Consider a more complex situation in which intradiscal material migrated in a posterolateral direction; flexion may further this migration. An obstructed end range could exist not only for extension, but also for side-gliding as well. If the lateral component is significant, extension may only serve to squeeze this material more to the side. In this case, both the mechanically unimpeded flexion and the obstructed extension could elicit the peripheralization response. Loading in the coronal (side-gliding) or the transverse movement plane direction (rotation) may be needed to reduce the key lateral obstruction and elicit the centralization response. After this step, the previously avoided extension component becomes the key obstruction, and loading in extension may be needed to further promote the centralization response. The lateral component has been reduced sufficiently, and the task is then to re-duce the posterior component.

When disk material has migrated, both posteriorly and laterally, obstructed end ranges exist in the respective sagittal and coronal movement plane directions. If loading in the movement plane direction of extension reduces both of the obstructed end ranges, the lateral component is not considered *relevant.* If loading in the coronal movement plane direction *is required* first, the lateral component of disk migration is considered *relevant* to a loading strategy involving a nonsagittal movement plane.

RELATED TERMINOLOGY

Postural Syndrome terminology is predicated on the positioning that precipitates symptoms. Dysfunction Syndrome terminology is predicated on the movement of the person that precipitates symptoms. Derangement Syndrome terminology refers, in part, to the *anatomic* direction of intradiscal derangement. In contrast to the Postural and Dysfunction Syndromes, *two* classification systems are used to organize Derangement Syndrome phenomena.

Similar to the Postural and Dysfunction Syndromes, the first method describes derangements based strictly on the behavior of mechanics and symptoms in response to loading tactics, and names these behavior patterns by pathoanatomic inferences—derangement *behavior nomenclature.* The second method refers to the presenting symptom topography and deformities, in addition to the derangement behaviors—derangement *behavior-topography-deformity (BTD) nomenclature.*

Derangement Behavior Nomenclature. This terminology is descriptive of the anatomic direction in which the intradiscal derangement is thought to have occurred. Stated another way, it is descriptive of behaviors noted *as if* derangement of intradiscal material occurred in the described anatomic direction.

The Derangement Syndromes are named according to the hypothesized anatomic direction in which disk material traveled and caused an obstructed end range: anterior, posterior, and lateral derangements.

Anterior derangement describes behaviors *as if* anterior migration of intradiscal material occurred. An accumulation in the anterior compartment of the disk makes flexion mechanically difficult to perform. In extreme cases, lordosis is fixed and irreversible. Extension promotes the migration of material to the anterior compartment. Extension may be accompanied by peripheralization of symptoms during motion or at end range as a result of deranging material anteriorally. Any limitation of extension would be due to intolerance of symptoms but not to mechanically impeded end range. Peripheralization generally does not occur below the knee because the nerve radicals are not affected by distortion of the anterior aspect of the annulus. Flexion is obstructed and accompanied by symptoms at obstructed end range. Flexion to obstructed end range with overpressure is accompanied by the centralization response corresponding to a redistribution of intradiscal material to a more central location, resulting in improved biomechanics as well.

Posterior derangement describes behaviors *as if* posterior migration of intradiscal material occurred. An accumulation in the posterior compartment of the disk makes extension mechanically difficult to perform. In extreme cases, kyphosis is fixed and irreversible. Flexion promotes the migration of materials to the posterior compartment. Flexion may be accompanied by peripheralization of symptoms during motion or at end range as a result of deranging material posteriorally. Any limitation of flexion would be due to intolerance of symptoms but not to mechanically impeded end range. The peripheralization could extend below the knee, because the nerve radicals or spinal cord may be affected by distortion of the posterior aspect of the annulus. Extension is obstructed and accompanied by symptoms at obstructed end range. Extension to obstructed end range with overpressure is accompanied by the centralization phenomena, during which intradiscal material redistributes to a more central location, resulting in improved biomechanics as well.

Lateral derangement may occur alone or in combination with anterior or posterior derangement; most frequently, it occurs in combination with the latter. Unilateral symptoms, especially if they peripheralize, are assumed to have a lateral component. If dynamic and/or static loading in the sagittal plane centralizes symptoms, it is not considered a "relevant" lateral component, i.e., the "key" obstructed end range is in the sagittal plane. If the unilateral techniques of side-gliding or rotation are required to centralize symptoms, it is considered a relevant lateral component, i.e., the lateral component is the "key" obstructed end range. With a relevant lateral

component, it is thought that an accumulation of intradiscal material to one side or the other of the coronal plane is sufficient to require a unilateral loading technique. When there is a "relevant" lateral component, movement in the sagittal plane not only may fail to elicit the centralization phenomena. but also may actually elicit the peripheralization response if further lateral migration of intradiscal material results. After rotation or side-gliding is performed to reduce the lateral component in these cases, the situation may require sagittal plane techniques to reduce the central anterior or posterior derangement.

An accumulation of disk material in the lateral compartment resists side-gliding to that side because of the obstructed end range. In extreme cases, a list or lateral shift is fixed and irreversible. Side-gliding in the movement plane direction of the patient's lateral shift has the potential of promoting the further migration of intradiscal material, accompanied by peripheralization of symptoms during motion or at end range as a result of deranging material more laterally. Any limitation of movement in the direction of the lateral shift relates to intolerance of symptoms and not to a mechanically impeded end range. Peripheralization may occur be-low the knee because the nerve radicals are easily affected by lateral distortions of the annulus when a posterior component is present as well. Side-gliding in the movement plane direction opposite to the lateral shift is obstructed and accompanied by symptoms at the obstructed end range. Side-gliding to the obstructed end range with over-pressure is accompanied by the centralization response corresponding to a redistribution of intradiscal material to a more central location, resulting in improved biomechanics as well.

Derangement Behavior-Topography-Deformity (BTD) Nomenclature. This terminology uses a numeric system, labeling various derangement presentations from 1 through 7.

The first subclassification of the derangements is according to their *behavior,* as described previously. Derangements 1 through 6 are posterior derangements, Derangement 7 is an anterior derangement.

Derangements 1 through 6 are arranged in couplets, with the odd numbers describing symptom *topography,* and the subsequent even-numbered derangements describing the same symptom topography accompanying a fixed deformity (antalgia or deviation) of the spine, preventing curve reversal. Therefore, the derangement number indicates its behavior, symptom topography, and presence or lack of deformity.

This derangement nomenclature is defined as follows:

Derangement One:
- Central or symmetric symptoms about the spine
- Rarely shoulder/arm or buttocks/thigh symptoms
- No deformity

Derangement Two:
- Central or symmetric symptoms about the spine
- With or without shoulder/arm or buttocks/thigh symptoms
- With deformity of kyphosis

Derangement Three:
- Unilateral or asymmetric symptoms about the spine
- With or without shoulder/arm or buttocks/thigh symptoms
- No deformity

Derangement Four:
- Unilateral or asymmetric symptoms about the spine
- With or without shoulder/arm or buttocks/thigh symptoms
- With deformity of torticollis or lumbar scoliosis

Derangement Five:
- Unilateral or asymmetric symptoms about the spine
- With or without shoulder/arm or buttocks/thigh symptoms
- With symptoms extending below the elbow or knee
- No deformity

Derangement Six:
- Unilateral or asymmetric symptoms about the spine
- With or without shoulder/arm or buttocks/thigh symptoms
- With symptoms extending below the elbow or knee
- With deformity of acute kyphosis, torticollis, or lumbar scoliosis

Derangement Seven:
- Symmetric or asymmetric symptoms about the spine
- With or without shoulder/arm or buttocks/thigh symptoms
- Deformity of accentuated lordosis may or may not be present

The "couplet" system of symptom topography, without and with deformity, does not extend to the anterior derangements. An anterior derangement with central symptoms, unilateral symptoms, without deformity or with deformity, is classified as a derangement seven. The BTD nomenclature is reduced to behavior nomenclature only for anterior derangements, which are assigned the number 7.

PARTIAL PATTERNS OF DERANGEMENT

One distinguishing feature of the Derangement Syndrome is the exhibition of partial patterns. Because of the complex mechanical and symptomatic responses associated with the Derangement Syndrome, the absence of some of the typical derangement responses does not diminish the ability to recognize this syndrome. Examples of partial behavior patterns of derangement are as follows:

- Peripheralization response persists without the ability to elicit a centralization response
- Peripheralization response persists after sustained end range loading only; no peripheralization elicited during movement
- Centralization response persists without the ability to elicit a peripheralization response
- Peripheralization response resolves without any clear pattern of centralization response
- No peripheralization, centralization, or other symptom changes; however, mechanical responses occur
- No mechanical responses occur; however, symptomatic responses do occur

SUMMARY

The goal in the Derangement Syndrome is to reduce the derangement of intradiscal material by having it migrate back

toward the center of the disk space. Obstructed end range in purely anterior or posterior derangements occurs in one movement plane direction. Obstructed end range can exist in more than one movement plane direction with either relevant or nonrelevant lateral components. If obstruction to movement in the coronal plane is eliminated by loading in the sagittal plane, the lateral (coronal) component is not considered relevant.

Intermittent symptomatic responses with a Derangement Syndrome may involve repetitive reduction and derangement of disk material in response to the patient's movements and positionings during the day. A constant symptomatic response involving the Derangement Syndrome represents a mechanical displacement of disk material not reduced by the usual movements and positionings of the patient. Prescriptive loading (a preferred loading strategy) at the key obstructed end range is often successful in reducing Derangement Syndromes in these latter cases.

Relationships Between Syndromes

In a sense, the preferred loading strategy for the Derangement Syndrome combines those of the Postural and Dysfunction syndromes, inasmuch as certain discomforts must be avoided and certain discomforts must be pursued. Typically, a mechanically unimpeded end range is avoided while a mechanically impeded end range is pursued. Therefore, the sharp distinction made between the syndromes may be, instead, diffuse lines of demarcation; certain properties of one may merge into the other.

MIXED SYNDROMES

In the previous descriptions of syndromes, each is presented as if it exists "by itself." In clinical practice, multiple syndromes may coexist, and all three may be seen in one patient.

SIMILAR SYMPTOMS, DIFFERENT RESPONSES

The importance of investigating mechanical and symptomatic responses to loading tactics cannot be overemphasized. Information concerning a single mechanical or symptomatic response to a single loading tactic is not the necessary and sufficient condition by which to diagnose a syndrome. Symptoms associated with sitting may be attributable to a postural syndrome of sustained flexion, a flexion dysfunction syndrome, the promotion of a posterior derangement, or the reduction of an anterior derangement. Symptoms associated with standing may be associated with a sustained extension postural syndrome, an extension dysfunction, the promotion of an anterior derangement, or the reduction of a posterior derangement. A thorough investigation of mechanical and symptomatic responses to loading helps to differentiate among these possible causative factors.

The *peripheralization response* may occur during the Dysfunction Syndrome or during the Derangement Syndrome. It does not occur during the Postural Syndrome. The peripheralization response with a Dysfunction Syndrome rarely persists after cessation of the loading action that precipitates it, and this loading action typically has a component of flexion to end range. In the Derangement Syndrome, peripheralization may occur at any point of a movement plane that promotes the derangement, and peripheral complaints typically persist after being elicited. The peripheralization response of derangement is typically associated with centralization responses. The peripheralization response of dysfunction is not.

APPROPRIATENESS OF MANIPULATION

Manipulation, within the McKenzie approach, is considered inappropriate in movement plane directions that do not possess mechanically impeded end ranges. Therefore, manipulation is inappropriate for the Postural Syndrome. Only postural correction is warranted.

Regarding the Dysfunction Syndrome, manipulation may be contraindicated at first, because of the danger of overstretching shortened tissue. Symptomatic responses to loading persist only when shortened tissue is stretched too fast or too far, causing tissue injury that results in chemical, nonmechanical inflammatory pain. During a manipulative thrust on a patient with a Dysfunction Syndrome, the operator may feel as if he or she has "bounced off' as a result of the resistance offered by shortened structures. In the Dysfunction Syndrome, manipulation is appropriate only after the adaptive shortening has been reduced significantly. Manipulation is in-appropriate as a main form of therapy in this syndrome be-cause of the need to stretch this tissue repetitively during the course of the day over many weeks. This effort is best accomplished by patients themselves.

The Derangement Syndrome best represents the chiropractic concept of the manipulatable lesion or subluxation. Movement of the intradiscal substance results in asymmetric relationships of joint surfaces. The supposition that the disk is responsible for this disrelationship was noted by Gonstead.4,4 although the criteria on which he predicated manipulation were radiographic findings and not the mechanical and symptomatic responses to loading the spine. The mechanical and symptomatic responses to end-range loading mobilizations (taking the slack out) performed by the patient *or* the clinician predict what the responses will be to manipulation according to similar loading strategies. A lack of response or a detrimental response to patient-generated or clinician mobilizations argues against performing the manipulation, which would represent the same loading strategy, albeit with greater force. Radiographic evaluation or the palpation of "sticky joints" does not afford the clinician this same information. The McKenzie approach recommends manipulation only after self-generated movements have been explored fully and evidence partial therapeutic responses. Loading intensity is then increased by means of clinician overpressure (taking the slack out) and frequency of loading (repetitions) to "test the waters" as to the potential benefit or detriment of manipulative

thrusts. It is important to note that the movement plane direction of the manipulation contemplated is determined by mechanical and symptomatic responses to loading, including patient-generated movements, patient reports concerning centralization, and both patient and clinician observations concerning mechanical observations.

Lastly, regarding the relationship to chiropractic, the McKenzie approach does not claim to be the first or only approach to include the movement plane direction of extension as a therapeutic possibility. Reinart referred to extension exercise technique, therapy, and theory at least as early as 1962. The distinguishing feature of the McKenzie approach is not the advocacy of extension in selected cases, but the fact that treatment is predicated on mechanical and symptomatic responses to loading. In many cases, extension is indicated; however, in many cases, movements *other than* extension are what is required. The McKenzie approach is equated incorrectly with an exclusive predilection for extension. The approach makes no a priori, dogmatic conclusions about what every spine needs, which is perhaps the greatest virtue of its clinical reasoning.

APPROPRIATENESS OF PROGRESSIVE RESISTANCE EXERCISES

The McKenzie approach permits a thorough exploration of which movement plane directions may be pursued and which must be avoided, based on the mechanical and symptomatic responses to spinal loading. A progressive resistance exercise program is often possible much sooner than would otherwise be permitted because the clinician possesses a clear understanding of how a patients' spine reacts to movement and positioning at the outset of such a program.

THE McKENZIE APPROACH AND DEMANDS OF REHABILITATION

The McKenzie approach distinguishes itself among other rehabilitation methods as being useful to patients with either acute or chronic spine-related complaints. As such, it is often an appropriate first step before considering passive therapy or other activity therapies. When explored first, it often proves passive therapy is gratuitous and safely guides the course of subsequent activity therapies, such as strengthening routines.

"Rehabilitation," to some, equates to therapy in general, *any* kind of therapy. Used in this manner, the term loses its intended meaning and is even applied to passive methods, such as hot packs and ultrasound. Rehabilitation is not *any* means to functional ends, but signifies *functional* means to functional ends.

The key concepts defining rehabilitation relate to establishing an individual's skill to be able to "maintain a maxi-mum level of independent functioning such as self care and employment."' In rehabilitation, the actions of the patient are of paramount importance. Guidance is provided by the practitioner, but the burden of treatment involves what the patient *does,* and not what is *done* to the patient.

Functional restoration,' work conditioning, and work hardening' programs use this strict definition of rehabilitation. The approach stresses the physical and psychologic advantages of rehabilitation defined as activity.

The physical advantages of these programs involve reactivating the individual who may have become fearful of movement and consequently deconditioned.[10] The psycho-logic advantage is to reverse or prevent abnormal illness behavior," helping the patient identify with societal and worker roles rather than the role of a patient as "a passive receptacle of care."'

Functional restoration, work conditioning, and work hardening programs are used on chronic cases. Often patients are referred to such programs after passive methods, medication, or no therapy at all (the tincture of time) fail to resolve the chronic condition. In these circumstances, passive care has not helped the individual, but may have actually "encouraged musculoskeletal morbidity."

Patients presenting to "rehabilitation" centers with acute conditions often receive passive therapy initially.[13] This therapy continues until the demands of an activity program (e.g., progressive weight resistance) can be tolerated without harm. The disadvantage of such initial passive care is that it may ultimately serve a purpose contrary to that of the physical and psychologic goals of rehabilitation. Passive therapy, if introduced first, has the potential of "spoiling" the patient's chances of progressing to unassisted, active functional activities as therapy," and increases the possibility of the development of abnormal illness behaviors." Some authors' state that much low back disability is iatrogenic and results from the medical prescription of rest for simple backache that is based on the misconception that inflammation or other pathologic change plays a significant role as a causative factor.

A rehabilitation approach in the acute phase can provide the physical and psychologic benefits of functional restoration and work conditioning/hardening programs that are used to treat chronic disorders. It can, thereby, prevent the need to re-solve chronic conditions by not letting them develop in the first place. The McKenzie approach satisfies these requirements. It provides self-treatment activity techniques tolerable during the acute phase that entail the physical and psycho-logic benefits of more expensive and lengthier rehabilitation programs. It may even prevent the need for such subsequent rehabilitation programs, as it employs many of the same physical and psychologic principles.

If functional restoration or work conditioning/hardening programs are needed subsequently, the initial use of the McKenzie protocols is likely to enhance the possibilities of their success, because these programs are a conceptually consistent continuum from the initial acute care activity therapy. Through its physical effect, the McKenzie approach addresses the mechanical nature of the patient's disorder. Through its teaching of mechanical principles of self-treatment, it is consistent with the principles of rehabilitation that prevent the development of abnormal illness behavior.

The patient learns that therapeutic movement and positioning may be accompanied by increased pain with improved function, and that certain pains are not to be avoided. Congruent with the strictest rehabilitation principles is the "hands off' first approach. If results are limited, the application of passive approaches is always possible, but the control of treatment is returned to the patient as soon as possible.

Regarding the mechanical and physiologic principles of rehabilitation, the McKenzie approach makes activity and self treatment possible during the acute phase, permitting continuous, relatively passive spinal motion to be strategically performed by the patient. These movements enhance the organization of "new" tissue along the lines of stress, with the formation of flexible scar tissue." Tasks are introduced on a demand-graded basis.

If McKenzie activity therapy is dispensed during the acute phase, fear of pain and the signs of pain avoidance or illness behaviors are not encouraged, and the protracted treatment intervention for patients with chronic disorders is avoided. That it is of potential benefit during the acute phase should not subtract from considering McKenzie protocols as the logical first step for the treatment of chronic conditions, for the same reasons just given. If strength training is not needed for treatment of a chronic condition, the McKenzie protocol represents a relatively quick and inexpensive alternative.

The McKenzie protocol is an excellent intervention to prevent physical and psychologic complications of injuries. It includes individuals taking an active, responsible role in rehabilitation appropriate to their level of functioning, improvement in physical functioning rather than simply concentrating on symptomatic relief, safety practices, maintaining the worker role through minimal time away from the work place, activity control of symptoms as opposed to symptomatic control of activity, and an attempt to avoid use of analgesics or passive treatment methods.

As stated elsewhere:

> "By reducing the use of therapist's technique in the initial stages of treatment and maximizing patient technique, the patient will recognize that his recovery is largely the result of his own efforts. Few patients fail to assume responsibility for active participation in their treatment, providing the instruction and education process is firmly and vigorously pursued."[1]
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> "If there is the slightest chance that a patient can be educated in a method of treatment that enables him to reduce his own pain and disability using his own understanding and resources, he should receive that education. Every patient is entitled to this information, and every therapist should be obliged to provide it."[1]

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