



Low Back Patterns of Pain: Classification Based on Clinical Presentation

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Abstract

The ubiquitous presence of low back pain with its multiple natural histories makes classification difficult. Any categorization begins by defining the essential elements of the problem to build a structure that reflects the values of the organizer, values determined by experience, personal concerns, and a point of view. Although a grouping of back pain patients based on responses to a particular treatment may be as valid as one based upon the varying degrees of socioeconomic impact produced by the pain, any classification's ultimate value depends on the interests of the user. Patterns of pain focuses on the initial presentation delineated by a specific set of questions in the history and confirmed by selected features of the physical examination. History divides mechanical low back pain into four distinct syndromes while the physical examination further delineates two of these patterns. A pattern of mechanical low back pain can be defined by the location of the dominant pain (back or leg), the consistency (constant or truly intermittent), and the effect of flexion on the symptoms. Response to flexion separates two cohorts of intermittent leg dominant pain patients with very different clinical scenarios and treatment demands. The physical examination divides back dominant pain patients needing

only a straightforward treatment strategy from those who require more complex supervision. Additional questions and tests highlight or eliminate sinister, nonmechanical pathologies. The classification both directs initial management and provides a reasonable prognosis for speed and completeness of recovery.

Keywords

Mechanical low back pain · History · Physical examination · Classification · Clinical presentation · Patterns of pain · Referred pain · Radicular pain

Introduction

Low back pain is a human condition. Virtually everyone will, at some time in their lives, suffer pain in the lower back. Those that remain permanently pain free are the exception. Numerous studies have reported a lifetime incidence over 80% (Balagué et al. 2012). Nearly all will suffer from symptoms arising from minor mechanical spinal malfunctions associated with aging and natural degeneration. The pain can be intense but the pathology is overwhelmingly benign (Deyo and Weinstein 2001). Emphasizing the nonthreatening nature of the problem, however, belies its massive impact. A study on the global burden of

disease in 2013 found back pain to be the most frequent cause of disability for over half the world's population (Global Burden of Disease Study 2013 Collaborators 2015).

Medicalizing the condition has led to unfortunate consequences, shifting attention from the ubiquitous mechanical causes of pain to rare, albeit more sinister, pathologies. This misdirection is reflected in numerous attempts at a pathology-based classification. How clinicians organize a problem establishes their diagnostic probabilities and assigns priorities for investigations and treatment. To concentrate on the possibility of serious pathology, like malignancy, means screening every back pain sufferer for something present in less than 1% of cases (Henschke et al. 2009). Individual clinical features implying an ominous condition, called Red Flags, have poor accuracy. The Red Flag of night pain, frequent among back pain sufferers, can be raised as a source of concern. In one study of nearly 500 patients, 40% had night pain but not one had serious pathology (Harding et al. 2005). Algorithms beginning with a check for Red Flags are popular and no one can deny the value of a thorough history but that route can lead to unnecessary testing and unwarranted patient anxiety, and may not provide the anticipated certainty (Downie et al. 2013). From a wider perspective, identifying a pathophysiological pain source is possible in only 10–15% of cases, ultimately leading in most cases to the counter-productive diagnosis of “non-specific” back pain (Krismer et al. 2007).

Classification Options

Treatment Response

Attempts to improve specificity and thereby offer therapeutic guidance have classified low back pain on the patient's reaction to specified mechanical treatments. Results show slight improvement as might be expected from the circular nature of the cohort construction; patients who did well following a particular maneuver were classified, after treatment, as suitable for that category (Fritz et al. 2003). One problem in using this sort

of classification in primary care is the requirement that the clinician be able to properly perform the classifying techniques, direction-specific or trunk-stabilizing exercises or spinal manipulation (Brennan et al. 2006). Even when the determination was made by trained physical therapists, over 30% of the subjects could not be clearly classified (Stanton et al. 2011).

Time Based

Classifications can be time based but even here there remains considerable variability and disagreement. There is no consensus on the length of time back pain must be present before it shifts from acute to chronic and no defined duration for the pain-free interval that distinguishes a new attack from a continuing chronic condition. To address this lack of consistency, the classic designations of acute and chronic have been replaced with more broadly inclusive terms such as “persistent” or “recurrent” (Norton et al. 2016). However, neither set of definitions offers immediate clinical guidance for treating the patients in pain.

Administrative

Administrative classifications typically use the tenth revision of the International Statistical Classification of Diseases and Related Health Problems, Clinical Modification (ICD – 10 – CM) codes to either identify relevant pathologies or support a diagnosis of “nonspecific” back pain. The nonspecific categories include such divergent entities as kissing spines and lumbago, the former a description of putatively abnormal anatomy and the latter an antiquated name for low back pain first used in 1684 to describe “pain in the muscles of the loins” (Oxford English Dictionary 2019). In a comprehensive review of administrative data on health-care utilization, Norton identified and validated four distinct groups of patients: one cohort with immediate total recovery, one with frequent relapses but with little ongoing healthcare utilization, and two groups with high

continuing demand – one for therapeutic interventions and the other for medication (Norton et al. 2016). Significantly the groupings were unrelated to either the patients' demographic or clinical characteristics; the classification had no prognostic value. Retrospectively identifying the amount of resource consumption offers no prediction of that outcome nor identifies those patients at risk.

Risk of Chronicity

STarT Back categorizes patients by predicting their risk of chronicity (Hill et al. 2008). This classification has shown promise in directing primary care by identifying those people most likely to develop persistent problems. It was developed in England and uses a short simple questionnaire that takes into account pertinent physical findings while emphasizing a psychosocial subscale gauging bothersomeness, catastrophizing, fear, anxiety, and depression. It characterizes patients as a low, medium, or high risk of chronicity and recommends appropriate intensive therapy. A study by Foster assessing the results found modest overall improvements in patients' outcomes with a more targeted use of health care resources and without increased costs (Foster et al. 2014). The authors noted that the mean difference in patient disability in their study was less than that in the original trial, a fact they attributed to the higher proportion of low-risk patients and the variability in physician engagement. The magnitude of the second problem, the variability of physician engagement, and its negative impact on generalizability was highlighted by the MATCH study at Kaiser Permanente in Washington State. In spite of extensive training for both the participating primary care physicians and physical therapists the trial showed no statistically significant differences in patient outcomes or health care use between the intervention and control groups (Cherkin et al. 2018). Several factors may account for this lack of success including limited access to suitable treatment for the high-risk patients but, regardless of the reason, using the classification did not alter practice patterns. Further, it was never designed nor intended to direct immediate management.

Anatomic

Many, if not most, clinicians believe initial treatment must be determined by and directed toward the source of pain. A pathoanatomic classification seems obligatory. But, unless that treatment is an invasive procedure, management involves the entire patient not just a local painful structure. In cases where the cause of the pain is obscure and the clinical symptoms raise no concerns for an urgent or serious condition, seeking a structural diagnosis simply to fill a physical or pathological category is heading down the wrong track. It promotes needless investigations and excessive imaging. With current technology it is almost always possible to find an aberration in the spine. Whether the identified pathology is the reason for the patient's back pain is an entirely different question. The false positive rate for MRIs of the spine in middle aged patients approaches 90% (Wnuk et al. 2018). Employing MRI as a screening tool to locate abnormalities without a clinical indication has a strong iatrogenic effect, offers no benefits and degrades the outcome (Webster et al. 2013).

Nonspecific

The prevailing medical paradigm dictates that we must establish a cause before we can treat. In the overwhelming majority of back pain patients, however, no pathoanatomic diagnosis is possible (Koes et al. 2006). This pain, designated as "nonspecific," is neither the product of recognizable structural defects or deformities in the spine nor the result of identifiable pathologies including trauma, tumor, systemic disease, or local infection. It denotes pain arising from spinal structures, not pain referred to the back but arising from known causes in other parts of the body or within a sensitized central nervous system. While there is no agreement on the particular pain generator within the spine, there is widespread consensus among clinicians that "nonspecific" back pain is mechanical back pain produced by nothing more sinister than minor mechanical malfunctions, the inevitable consequence of normal wear and

tear (Maher et al. 2017). The potential severity of the pain does not reflect the benign reality of the underlying problem but the intensity of the problem can justify immediate treatment. Deferring therapy to conduct unnecessary and predictably futile investigations to isolate the site of the pain is ill-advised.

A Syndrome Approach

From the patient's perspective back pain is never nonspecific; the symptoms are never vague and the mechanical characteristics are obvious. Mechanical pain is pain produced by movement or position and relieved by rest or a change in posture. The pain fluctuates with activity. Again from the patient's perspective, the primary reason for seeking professional help is to relieve that pain. With a definitive diagnosis out of reach the clinician's decisions must be rely on something else. There is another option. In 1987 the Quebec Task Force noted, "Distinct patterns of reliable clinical findings are the only logical basis for back pain categorization and subsequent treatment." (Spitzer et al. 1987). The therapy can be built on the patient's clinical presentation, on a mechanical syndrome. A syndrome is a constellation of signs and symptoms that consistently appear together and respond predictably to treatment. Reluctance to base treatment solely on the clinical picture is understandable but, in the case of mechanical back pain, unjustified. A syndrome has an undetermined but definite etiology; its invariable presentation is not random chance. The only difference between a syndrome and a disease is, in fact, the former's lack of an agreed etiology. Once the cause of a condition becomes known the syndrome becomes a disease. For "nonspecific" mechanical back pain, discovering the exact source of the symptoms would obviously not alter the clinical picture nor diminish the value of already proven effective non-surgical treatment.

A classification that can offer clinicians immediate guidance in the initial management of back pain rests on typical mechanical syndromes or patterns drawn from the history and physical

examination without additional imaging or investigations. It should identify unusual presentations and highlight potentially serious features. By emphasizing the regular mechanical patterns, which comprise about 90% of the low back pain presentations in a primary care setting, the classification renders the few sinister presentations plainly visible (Chien and Bajwa 2008). Detecting Red Flags becomes a by-product, not the purpose, of the assessment.

This Patterns of Pain classification has been validated and proven successful. For nearly 50 years, it has been the basis of back pain treatment at the CBI Health Group in its more than 170 rehabilitation clinics across Canada (Hall et al. 2009). It is the foundation of the Saskatchewan Spine Pathway. Instituted in 2011 the Pathway has produced substantial cost savings and improved patient satisfaction with spine care across the province (Wilgenbusch et al. 2014). In 2012, the Ontario Ministry of Health and Long-Term Care launched a pilot project, again using this pattern classification of clinical presentation, to develop the Inter-professional Spine Assessment and Education Clinics (ISAEC), a network of spine triage clinics. The program proved so successful that in 2018 the Ministry expanded it across the entire province. The Ontario Ministry also funded an online aid for primary care practitioners, the CORE (Clinically Organized Relevant Exam) Back Tool. It offers a concise method of separating patients with back or leg pain into those who require further investigation or referral and those whose straightforward mechanical picture encourages management by the primary care provider. This differentiation is made using the same mechanical syndrome classification (Alleyne et al. 2016).

Four Patterns of Pain

Mechanical back pain can be divided into four, clearly delineated patterns of pain identified on history (see Table 1) and confirmed or refuted with the physical examination (see Table 2). Each pattern suggests an initial course of treatment, the outcome of which either supports or rejects the

Table 1 The essential components in a “patterns of pain” history

Number	Category	Question	Objective
1	Pattern	Where is your pain the worst?	Discriminate between back dominant (referred) pain and leg dominant (radicular) pain
2		Is your pain constant or intermittent?	Obtain a precise account of the pain’s consistency and whether or not it ever completely disappears
3		Does bending forward make your typical pain worse?	Determine the effect of flexion on the pain given in answer to Question One
4	Mandatory	Since the start of your pain, has there been a change in your bladder or bowel function?	Consider possibility of an acute cauda equina syndrome
5	Function	What can’t you do now that you could be before you were in pain and why?	Estimate the required treatment intensity; the reason for the impairment should be the pain given in answer to Question One
6	Additional	What positions or movements relieve your typical pain?	Identify features that may assist with management
7		Have you had this pain before?	Establish context for the current episode and the likelihood of further recurrences
8		What treatment have you had and did it work?	Previous successful treatments for the same pattern should be effective again
9	Inflammatory	If you are under 45 years old do you have periods of morning back stiffness lasting longer than 30 minutes?	Screen for spondyloarthritis

Table 2 The essential components in a “patterns of pain” physical examination

Procedure	Optimum Position	Objective/Technique
Observation		Assess general activity both before and during the examination. Back specific elements: gait, contour, color, surgical scars
Movement	Standing	Observe flexion and extension for rhythm of movement and reproduction of the typical pain
	Lying prone	If the patient reports pain on standing flexion evaluate the response to ten prone passive extensions
Nerve root irritation tests	Lying supine	Examiner lifts the patient’s straight leg. Nerve root irritation reproduces or exacerbates the typical leg dominant pain. May be performed with patient sitting
	Lying prone	Femoral stretch reproduces the anterior thigh dominant pain. Examiner extends the patient’s straight leg. Perform when indicated by history
Nerve root function tests	Detailed in Table 3	Check muscle power or tendon reflexes involving L3, 4, 5, and S1
Upper motor neuron tests	Sitting	Identify spinal cord involvement by plantar response or sustained ankle/ patellar clonus
Saddle sensation	Lying prone	Screen for cauda equina syndrome with light touch to the S2 dermatome, midline between the upper buttocks

Positive findings may prompt further, more comprehensive testing. When suggested by the history additional investigations can include the hips, abdomen, peripheral pulses, or sensation

pattern diagnosis. The classification is constructed to be integrated into early patient management; inconsistencies within the history, between the

history and the physical examination or in the anticipated course of treatment for the selected pattern will alert the clinician to potential problems.

History

Question One

The history begins with three pattern questions: questions designed to define the characteristics of the four patterns. The first question is “Where is your pain the worst?” This is not the same as asking the patient “Where do you hurt?” The latter question encourages vague and rambling answers that may not only divert focus from the major symptoms but shift attention to irrelevant details. The important distinction is between back or leg dominant pain. In this classification, back dominant pain is pain felt most intensely in one or more of the following locations: low back, upper buttocks, coccyx, over the greater trochanters (Tortolani et al. 2002). Back dominant pain can occasionally extend to the groin and genitals. This pain is referred pain, pain arising within the musculoskeletal structures of the spine but felt some distance from the source. The concept of referred pain has been recognized for over 100 years but there is still no consensus as to the mechanism by which the pain spreads other than agreement that it does not involve direct irritation of the peripheral nerves (Bogduk 2009).

Back dominant referred pain can radiate into the legs and may extend well below the knee to include the foot (Hill et al. (2011). The clinically important issue is establishing where the patient’s pain is most excruciating. Although referred pain can involve the leg, the site of the most severe pain is always somewhere in a band around the lower back, upper buttocks, hips, and groin.

Complicating the recognition of back dominant pain is the fact that areas of referred pain can become locally tender (Smythe 1986). Palpating the trochanteric region may elicit local discomfort misdiagnosed as bursitis. Tenderness over the upper buttock can be falsely attributed to pushing on a painful piriformis muscle. Palpable “trigger points” over the posterior iliac crest are another example of local findings without local pathology. Occasional temporary symptomatic relief following injection of a local anesthetic further compounds the diagnostic confusion.

Leg dominant pain represents radicular pain originating from direct irritation of one of more

of the roots of the sciatic or femoral nerves and carried along the nerves into the legs. Radicular pain is pain most intense anywhere at or below the gluteal fold. Pain in the lowest three centimeters of the buttock is considered leg dominant as is pain felt most strongly in the thigh, calf, ankle or foot. Referred back dominant pain can extend to the foot and leg dominant radicular pain may not go below the knee. The demarcation point is the lower buttock, not the knee joint.

Getting a patient to choose the site of the dominant pain can be challenging. Back dominant pain frequently involves the leg and leg dominant pain can be accompanied by pain in the back. Asking the patient to pick only one area when they both hurt may give the erroneous impression that the examiner is not interested in the whole problem and the patient may be unwilling to relinquish any part of the complaint. They refuse to choose or describe them as equally painful. But the pattern of pain classification demands identification of the predominant pain location. The best solution is simply to change the question. Instead of asking, “Where is the pain the worst?” say, “If I could stop only one of your pains, in the back or in the leg, which one would you want me to stop?” The natural reply to this question might be, “I want you to stop them both,” but this is a very different conversation from one that tries to determine only which one hurts more. Now the clinician can acknowledge that the patient does indeed have two significant painful areas and that both deserve attention. It is no longer a matter of which pain to treat but merely a decision of which pain to treat first.

In the infrequent situation where the patient still cannot choose between the back and the leg pain, the correct option is to pick the “worst case” scenario. Since leg dominant pain reflects nerve involvement and therefore has the potential, no matter how slight, to be associated with significant neurological impairment leg pain takes precedence. It is prudent throughout the history and physical examination to consider the more serious alternative, bearing in mind that no matter how excruciating the pain, 95% of back pain patients suffer from a benign mechanical condition.

Question Two

The second pattern question in the history addresses consistency. Is the dominant pain constant or intermittent? For fear of minimizing the problem to the examiner, many patients are reluctant to admit the pain ever stops. When asked directly, “Is your pain constant?” they respond, “Yes” and once committed patients may be unwilling to change the answer. A correct report of the pain’s consistency is essential to assign the pattern. To obtain an accurate report the clinician must give the patient “permission” to relate the all the details, including moments of spontaneous improvement, without appearing to diminish the seriousness of the complaint. The clinician needs to frame the question in a way that does not minimize the patient’s concerns. The question is best asked in two parts. The first part lays out the conditions under which the pain might stop: the best time of day or the best situation. These suggestions must be accompanied by a statement that the clinician is fully aware of the severity of the pain and the fact that, even though it may briefly disappear, it will always return. If the patient, however reluctantly, admits the pain does disappear there must be a second follow-up question. “Does that pain disappear completely? Is it totally gone?” There is only one correct answer to describe intermittent pain, “Yes.” The patient must state unequivocally that the pain entirely disappears. Any other answer such as “nearly,” “almost,” “mostly,” or “feels much better” is considered as constant pain. The decision to accept the pain as intermittent must take into account the level of analgesic medication; regular narcotic use means the pain must be considered constant. When there is any doubt, the general principle when using this classification is for the clinician to select the more serious option, in this instance constant pain.

This practice is critically important when assessing consistency. Truly intermittent back dominant pain is never the result of spinal malignancy or active spinal infection. Both of these sinister pathologies can produce pain that fluctuates with position or movement but even in the best circumstances, the pain never disappears

completely. Whether the pain is constant or intermittent is such an influential factor that the clinician should repeat the patient’s words exactly then ask the patient to verify that was what was said. The power of these questions, properly asked and answered, is enormous. At first contact and without any additional investigations, they can eliminate the possibility of two devastating pathologies. Constant pain clearly doesn’t confirm malignancy but it does leave the slight possibility of a more serious condition. In this case, it would be appropriate to ask about a history of cancer in the preceding 5 years. Recognizing the fact that the overwhelming majority of back pain whether constant or intermittent is nonthreatening, constant pain still requires further questioning. Truly intermittent back dominant pain permits reassurance that the problem is almost certainly a benign mechanical condition.

Question Three

The third and final pattern question is deliberately direct: “Does bending forward make your typical pain worse?” This is the critical part of the broader open-ended question, “What makes your pain worse?” Understanding the aggravating factors aids planning treatment but knowing the effect of flexion on the typical pain does more. It completes the identification (along with location and consistency) of the principal pain pattern, a pattern which provides direction for the entire therapeutic regimen. The pain under consideration, the typical pain, is the dominant pain given as the answer to the first question. Bending forward may produce discomfort in other areas, like behind the knees from tight hamstrings, but these observations should not distract the examiner from the primary complaint.

Question Four

The fourth question is mandatory since it addresses the only true emergency in low back pain: the acute cauda equina syndrome. Interference with the second, third, and fourth sacral

nerve roots, typically from an acute large central lumbar disc rupture, can lead to denervation of the urinary bladder and the rectal sphincter producing the classic triad of a period of urinary retention with eventual overflow, fecal incontinence, and altered perineal sensation (Fraser et al. 2009). Failure to surgically decompress the sacral nerves within the first 48 hours can lead to permanent loss of normal bowel and bladder function, so early recognition is a crucial part of the back examination and, therefore, of the patterns of pain classification.

To avoid confusion with preexisting genitourinary problems and to retain focus on recent onset back and/or leg pain, the fourth question is framed, “Since the start of your current pain has there been a change in your bowel or bladder function?” The temporal limitation keeps the history centered on recent events and avoids a lengthy discussion about prior problems. Another key is the emphasis on change rather than on symptomatic details. A multiparous woman may have longstanding urinary incontinence but that is not a change and therefore not relevant to the current painful episode. Cauda equina syndrome is an extremely rare condition. Most practitioners will spend their entire careers without seeing one so recalling the clinical picture and remaining vigilant for a cauda equina syndrome with every back patient may be unrealistic. Missing the diagnosis is not a matter of negligence as much as it is a matter of extreme improbability. But routinely asking every back pain sufferer if there has been a change in bowel or bladder activity should become a habit and all the clinician needs to remember is “no change. . .no problem.” Any change triggers concern and the opportunity to review the relevant information. Constipation is prevalent and, while distressing, not a sign of ominous pathology. It is, however, a recent change from normal function and so worthy of mention and consideration.

Question Five

Question Five concerns the level of impairment. “What can’t you do now that you could do before

you were in pain and why?” The degree to which the pain interferes with the patient’s daily routine dictates treatment intensity. A pain that occasionally limits a recreational activity does not merit the same degree of medical involvement as one that prevents regular employment. Asking about the reason for the impairment, “. . .and why?,” is a check on the validity of the patient’s reports. The cause of the functional limitations in the answer to Question Five should be related to the same pain that the patient reported answering Question One. If the reason for the patient’s restrictions is not the dominant pain then treatment is likely to be misdirected. If the patient says back pain is the problem but reports that it is the leg pain which prevents activity or a return to work, this inconsistency must be resolved before proceeding. The patient may have misunderstood the question, the clinician may have misinterpreted the answer or the problem may not be a straightforward mechanical complaint.

Question Six

The next question enquires about relieving factors, what the patient does to reduce or stop the typical pain. The options should be compatible with, that is opposite to, those things which make the pain worse. Mechanical pain is predictable and consistent in its reaction to physical stress. A constant level of pain, unaffected by changes in posture or activity, strongly suggests a nonmechanical etiology. Only the effect of flexion is necessary for pattern determination but the response to other movements or positions is always considered in the selecting the appropriate mechanical therapy.

Questions Seven and Eight

The next two questions involve prior episodes of pain. The first asks if there have been any previous attacks of the same pain, the second deals with any earlier treatment. Both relate to the patient’s existing pain as identified by Question One. Back pain is a recurrent complaint

and the pattern of pain can change over time (Donelson et al. 2012). Someone suffering a first attack should be cautioned that further episodes are likely. For those with a history of back or leg pain, knowing the outcome of past treatment should influence the current management. If the pattern of pain of a former attack was the same pattern as the present one then treatment that worked in the past will presumably work this time. Conversely if a treatment failed before there is little reason to try it again.

Question Nine

A final question, about unusually prolonged morning back stiffness, addresses the possibility of inflammatory spondyloarthropathies such as ankylosing spondylitis or psoriatic arthritis. This symptom is relevant in young and middle-aged patients but of little significance in the elderly. If the patient is under 40, ask “When you get up in the morning do you have stiffness in your back lasting more than half an hour?” At about 5%, this group of illnesses is the second most frequent cause of back pain after mechanical malfunctions (Weisman et al. 2013). Including a screening question for inflammatory spinal conditions along with the mechanical classification questions encompasses over 95% of patients presenting with back or leg pain.

These nine questions, particularly the first five, are the core of the back assessment. It is not the purpose of this classification to limit the scope of the inquiry but rather to sharpen the evaluation so that the essential elements are not overlooked or obscured by irrelevant detail. The clinician can and will ask for additional information. There are, for example, no questions about potential mechanisms of injury. In a study of over 11,000 patients presenting with nontraumatic, non-specific back pain two thirds of those without a need to know (claiming worker’s compensation or initiating a lawsuit) could not identify any cause for their pain. Spontaneous onset accounted for over 60% of cases (Hall et al. 1998). Moreover, regardless of the purported mechanism, all those

with a mechanical presentation could be assigned a pain pattern and it was the pattern, not the precipitating event, that directed treatment. Obviously discovering the mechanism is relevant in situations where liability must be established or where there is a history of significant impact. Supplementary questions should be included whenever the pain is constant and nonmechanical or when there is suspicion of a serious underlying pathology. Progressive neurological deficits, unexplained weight loss, recent infection, disproportionate night pain, or unexplained constitutional symptoms are all reason for concern.

History determines the pattern. The physical examination confirms or refutes the choice. The examination is not an independent activity but rather an integral part of the assessment. It is directed by the information obtained from the history and any inconsistencies between the patient’s story and the observed findings, just like inconsistencies within the history, must be resolved in order to clearly establish which pattern will direct treatment. Like the nine points comprising the history, the limited number of tests in the physical examination does not constitute a comprehensive evaluation but are the minimum required to corroborate the selected mechanical pattern while eliminating sinister pathologies. The final examination may incorporate additional steps but must include these components.

Physical Examination

To minimize discomfort and speed the examination, the patient should be assessed in a progression of positions selecting the optimum position for each test. Someone with back pain may take several minutes to lie down. Asking them to get up again for another test prolongs the examination and aggravates the pain. Start with the patient standing then sitting then lying down. Some procedures may be done best with the patient kneeling or sitting on a chair with feet on the floor. Using the chair before sitting on the edge of the examining table is both more efficient and more comfortable.

Observation

The physical examination starts with observation and observation starts before the actual examination. How the patient sits or moves or interacts before the formal assessment starts provides information about normal levels of activity and discomfort. Observe the patient's gait. Inspect the back for deformities, discoloration, and scars from previous surgery. Subtle changes in alignment are generally irrelevant. It is the overall contour or obvious areas of redness and swelling that matter.

Palpating along the spine for areas of tenderness is helpful to elicit sites of acute inflammation but plotting the areas of painful muscle tension is of little diagnostic value. Back dominant pain is referred pain and the location of the muscle tenderness is not necessarily the same as the location of the pathology; a painful L4-5 disc may not hurt at the L4-5 level.

Movement

Assessing spinal movement involves recording the rhythm and the reproduction of the typical pain. The physical examination confirms the history and patients who say that bending forward causes their usual pain should report the same pain when they bend forward for the examiner. The one important exception, which can cause confusion, is the patient who reports back pain only after sitting for a prolonged period. Patients whose pain is produced exclusively by a flexed posture and never by flexion movement should be identified on history and a proper interpretation of the lack of pain with movement on physical examination will support, not contradict, the patient's story.

Normal flexion of the lumbar spine follows a smooth progression cephalad from the pelvis without a catch or hitch. The actual range of movement is less important and, unless the measurement is one of a series, of minimal diagnostic significance. The ability to touch the fingers to the floor has more to do with the length of the arms and the flexibility of the hips than it does

with the range of movement in the spine. The range of lumbar extension is similarly inconsequential. The important finding is the exacerbation or relief of the typical pain. To avoid apparent spinal extension produced by bending the knees and to better isolate movement to the low back have the patient stand with the front of the legs against the back of a chair or the examining table. Place the hands on the buttocks and not in the small of the back.

One of the three elements of Pattern recognition is the effect of flexion on the typical pain so the physical examination focuses on sagittal movement. Noting pain on rotation or side-bending (pain which may be present in all four patterns) can be useful in choosing treatment strategies but because these movements do not distinguish between the four mechanical presentations they are not used to establish a pattern.

Prone Passive Extension

When the patient reports feeling the typical pain on bending forward, the physical examination includes prone passive extensions. This maneuver, popularized by physiotherapist Robin McKenzie and referred to as a "sloppy push-up," can have a rapid beneficial effect on flexion-aggravated pain and may ultimately become part of a pain control strategy (Donelson and McKenzie 1992). It has no role in evaluating or treating pain that is not made worse with flexion movement. If used, prone passive extensions are ordinarily carried out at the end of the examination while the patient is lying prone on the examining table. With the hands and palms down and slightly above the head, the patient uses the arms to raise the upper body. The action is passive for the back since all the muscular exertion is in the arms; the paraspinal muscles remain relaxed. At the same time, as the torso is pushed up the hips must remain down on the table. The key to a proper sloppy push-up is to have the elbows fully extended and locked at the same time as the front of the pelvis is in contact with the table. The first error is to allow the hips to stay down by

keeping the arms bent. Raising the head and shoulders but not fully extending the elbows engage the back muscles and negate the passive nature of the technique. The second mistake is to allow the hips to rise as the elbows fully extend, as with the conventional push-up exercise. Keeping the spine straight prevents the necessary low back extension. Modifying the patient's hand placement achieves both objectives simultaneously. The more the hands are advanced above the head, the more the arms can be extended without elevating the trunk to the point where the hips are lifted. The quality of the prone passive extension is gauged by the impact on the level of pain not by the distance the sternum is lifted above the bed. The stiffer the spine, the more the hands must be moved above the head. Although the final location of the hands and the amount of lordosis in lumbar spine of a supple young woman are very different from the hand placement and sag in the rigid spine of an old man, the amount of pain relief may be the same. Once the patient has found the proper starting point, suitable for the degree of spinal mobility, he or she slowly repeats the passive extension, pausing briefly between repetitions but without holding the fully elevated position. Compare the level of typical pain (usually using an 11 point scale of 0 to 10) before the first sloppy push-up to the level of pain at the end of five repetitions. Depending upon the clinical response, another set of five may be required.

Nerve Root Irritation

Straight leg raising (SLR) is a classic test for sciatic nerve root irritation. Lifting the leg with the knee extended puts tension on the nerve and causes the roots to slide through the intervertebral foramen. SLR is widely employed and surprisingly poorly understood. The test is positive only with the reproduction or exacerbation of the patient's typical leg dominant pain – not any leg pain just the patient's preexisting leg dominant pain. The patterns of pain classification rests on distinguishing back dominant referred pain felt in the leg from leg dominant radicular pain that may have associated but secondary pain in the back.

The straight leg raise is a test for radicular pain. A proper interpretation is vital to choosing a correct pattern. If the patient has never had leg dominant pain, the patient cannot have a positive test. You cannot reproduce or exacerbate a pain the patient never had. It is impossible to have a positive straight leg test in a patient with back dominant pain.

Much of the confusion and misapplication of the straight leg raising test arises because the test is interpreted without regard for the history. Because any leg pain is incorrectly taken as a positive finding, posterior leg discomfort from hamstring tightness is misinterpreted as a positive test. To avoid this mistake some physicians consider the SLR to be positive only if pain is produced below 60°, an elevation that does not tense the hamstring muscles. Interpreted correctly the test is positive at any elevation if it reproduces the leg dominant pain identified on the history. The level at which the typical leg pain is produced is a measure of neural irritation. Pain felt at a few degrees of elevation (or even when the knee is extended without lifting the leg) indicates acute inflammation while typical pain that occurs only at 80° or 90° degree, though still a positive test, suggests that the nerve root is well on the way to recovery. SLR is passive; the examiner lifts the patient's extended leg. To minimize confusion with hamstring pain, the contralateral leg can be fully flexed, rotating the pelvis and relaxing the posterior thigh muscles.

A positive SLR indicates radicular, leg dominant pain so the reproduction of back pain cannot be a positive result. Considering both back and leg pain to be a positive test is incompatible with the very definition of the maneuver – a test for nerve root irritation not the presence of mechanical back dominant pain.

The femoral stretch test is designed to assess irritation of the roots of the femoral nerve. It is the reverse of the straight leg raise; the patient lies prone and the examiner lifts the straight leg extending the hip and putting tension on the femoral nerve in the anterior thigh. For most patients, this causes back pain, which is not a positive test. Whether or not to do a femoral stretch depends on the patient's history. Femoral nerve radicular pain

is constant in the lower anterolateral thigh and only when this is the chief complaint is the test necessary.

Conduction Deficit

Patients with purely back dominant pain should not have nerve conduction deficits, but since the purpose of the physical examination is to disprove as well as to support the pattern provided by the history, every patient should have a screen of nerve function (see Table 3). This is not intended as a complete neurological examination but simply a quick check on the roots that supply the lower limbs: L3, L4, L5, and S1. The examiner should select one test for each root. A more comprehensive investigation may be necessary if there is an abnormality in the screening exam or when dictated by the history as in cases of leg dominant pain.

Typical choices include the knee reflex for L3 and L4, strength of great toe extension for L5, and the power of great toe flexion for S1. If these are normal bilaterally, no further tests may be

necessary. Additional investigations include quadriceps power for L3 and L4; ankle dorsiflexion strength, hip abduction power, and heel walking for L5; ankle reflex, plantar flexion strength, gluteus maximus muscle tone, and toe walking for S1.

Upper Motor Neuron Involvement

Any evidence of spinal cord involvement negates a mechanical pattern diagnosis. Upper motor neuron tests must be part of every examination. Conditions as diverse as a spinal cord meningioma or multiple sclerosis can present as apparently mechanical patterns in the low back, distinguished only by the findings of upper motor pathology: the upgoing toe of a positive plantar reflex, sustained knee, or ankle clonus. One of the goals of the history in this presentation-based classification is to immediately rule out more ominous causes of back pain. A concordant, properly performed physical examination is an indispensable second step to establish the safety and validity of this approach.

Table 3 Nerve root function tests

Optimum position	Procedure	Roots tested	Technique
Gait	Heel walking	L4, L5	Minimum five steps with maximum forefoot elevation
	Toe walking	S1	Minimum five steps with maximum heel elevation
Standing	Trendelenburg test	L5	Examiner's hands on the patient's iliac crests. Assess hip abductor power for the leg on which the patient stands. Contralateral pelvic elevation is the marker. A normal examination is symmetrical elevation
	Toe raises	S1	Ten times bilaterally, then ten times on each leg. Balance by holding the examiner's hands
Kneeling	Ankle tendon reflex	S1	Patient kneels on the chair seat. Tap ankle tendon. Reinforce by squeezing the chair back
Sitting Feet on floor	Ankle dorsiflexion	L4, L5	Elevate forefoot against resistance from the examiner's hand on the mid-foot
	Great toe elevation	L5	Elevate great toe against resistance from the examiner's thumb
	Great toe flexion	S1	Keep the great toe flexed and resist pull from the examiner
Sitting Legs free	Patellar tendon reflex	L3, L4	Tap patellar tendon. Reinforce with the Jendrassik maneuver
	Quadriceps power	L3, L4	Patient extends the knee against resistance
Lying prone	Gluteus maximus tone	S1	Palpate buttocks as patient alternately tenses and relaxes. Repeat ten times

Saddle Sensation

This is particularly true of the test for saddle sensation. Cauda equina syndrome is the only diagnosis associated with low back pain where failed recognition on the initial assessment leading to even a short treatment delay can have devastating consequences. Hence Question Four, “Since the start of your current pain has there been a change in your bowel or bladder function?,” is mandatory. Testing light touch in the S2 area, midline between the upper buttocks, not only adds an important physical finding, but, when routinely incorporated into the standard back examination, the test itself becomes a prompt to ask the question. Using a tissue or a cotton swab to judge light touch in one outlying area of the perineum is clearly not definitive, and genuine concern will lead to further investigations including a digital rectal examination. But the test is quickly and easily done, noninvasive and, perhaps most importantly, focuses on cauda equina syndrome, a rare diagnosis that otherwise might not be considered.

Additional Tests

Beyond the six core components of observation, movement, root irritation, nerve function, upper motor neuron involvement, and saddle sensation, the history may suggest further examinations. Ruling out hip pain, a confounding complaint, or checking peripheral pulses in patients with claudication are familiar examples.

Pattern Identification

Combining the history and the physical examination allows classification into one of four mechanical patterns of pain, two of which are subdivided (see Table 4). The patterns are derived from signs and symptoms arising from the underlying mechanical malfunctions but a pattern diagnosis does not require establishing a specific pathoanatomic diagnosis. In some cases, shifting attention from the clinical syndrome to a putative

pain generator misleads treatment. Just recognizing a pattern allows valid predictions about symptom duration and the patient’s response to selected mechanical therapy. Failure to follow the anticipated course mandates early reassessment and this rapid appreciation of a negative outcome is one of the merits of the system. Back dominant patients constitute the overwhelming majority of the patient population and Pattern 1 is the most frequent presentation.

Pattern 1

Pattern 1 is back dominant pain with pain felt most intensely in the low back, upper buttocks, coccyx, over the flanks, or in the groin; the exact location of the pain should agree with the history. The pain is increased in flexion and may be constant or intermittent. Pattern 1 is the only pattern where the consistency of the pain can vary. The physical examination should support the history so the patient reports the described dominant pain to be increased pain in flexion. The classification defines Pattern 1 as pain worse **in** flexion not **with** flexion. A few Pattern 1 patients have no pain with flexion movement but have pain only after periods of sustained flexion posture. They experience back dominant pain after prolonged sitting; sitting is a flexed posture. In this situation, unless the clinician is prepared to let the patient sit in the examining room for an hour or two, the physical assessment will be negative. A few forward bends will have no effect. For most Pattern 1 patients, however, the typical back pain will be present with both movement and position.

Because Pattern 1 is referred pain without direct involvement of the peripheral nerves, the physical examination will show no signs of nerve root irritation or a loss of normal nerve function associated with the current pattern. An independent defect, such as an absent Achilles tendon reflex from a previous tendon rupture or a long resolved episode of S1 radiculopathy, should not confuse the pattern designation. Single findings – a change in bladder function, for example – should be noted and may significantly change management but it is the combined results of the

Table 4 Patterns of pain

Pattern number	Dominant site	History	Physical examination	Additional features	Subclassification
1	Back	Pain in flexion Constant/ Intermittent	Pain in flexion Neurologically normal	May have pain with extension May have unrelated neurological findings	PEP Decrease pain within ten properly performed prone passive extensions
					PEN No change or increase pain within ten properly performed prone passive extensions
2	Back	No pain in flexion Intermittent	No pain in flexion Neurologically normal	Pain with extension May have pain relief with flexion May have unrelated neurological findings	
3	Leg	Constant	Positive irritative and/or conduction findings	Pain with flexion and other movements or positions	
4	Leg	Intermittent	May have positive irritative and/or conduction findings		FA Flexion aggravated
			Negative irritative findings May have conduction loss	Pain with activity in extension Conduction loss may be transient	FR Flexion relieved

entire history and physical, not the individual components, that decide the pattern.

Pattern 1 PEP

The change produced by repeated prone passive extensions (the technique is described in detail as part of the physical examination) separates Pattern 1 into two groups. Patients who experience pain reduction within ten repetitions are considered **Prone Extension Positive** or **PEP** patients. For these patients, prone extension is a positive experience. They demonstrate a clear directional preference for unloaded extension and therefore are an easy population to treat. The maneuver used to assess their pain becomes the mainstay of their self-treatment. A few positively responding PEP patients encounter a phenomenon called “centralization” (Aina et al. 2004). As they repetitively extend the lumbar spine, the site of their dominant pain changes in character and

sifts toward the midline of the low back, frequently becoming more intense. The change in location toward the center of the back, in spite of the increased pain, is a positive sign and indicates the sloppy push-ups will shortly begin to reduce the typical symptoms. The new central discomfort is always transient. To properly employ this classification a clinician must recognize the favorable significance of centralization.

Pattern 1 PEN

Patients who fail to improve within ten repetitions of the sloppy push-up or whose increased pain prevents any further attempts are labeled **Pattern 1 PEN**, **Prone Extension Negative**. For this cohort, the prone passive extension is a negative event and they have neither an obvious directional preference nor a straight path to pain control. Ten repetitions were picked as the demarcation between PEP and PEN because doing ten sloppy

push-ups or less should be relatively easy physically and the immediate pain relief highly motivating. That number therefore separates those who should have little difficulty maintaining the routine from those who may not be able to engage and would benefit from alternate strategies, supervision and continued encouragement.

History determines the pattern but the distinction between PEP and PEN is made by the physical examination and specifically by the pain response to repeated prone passive extensions. Having pain on standing extension is not diagnostic. Patients with discomfort in both standing flexion (Pattern 1) and standing extension may still readily respond to unloaded passive movements. During the first few attempts, a sloppy push-up can be uncomfortable and questioning patients about their level of pain as they are performing the maneuver may give the wrong answer; arching a stiff spine can be unpleasant. Estimating pain relief should wait until after the first five push-ups. PEP patients may report initial discomfort but experience relief once the first set is completed.

Pattern 2

Pattern 2 is also back dominant pain. The pain is always intermittent and is never worse in flexion. Constant pain or any pain in flexion marks the patient as Pattern 1. It is not a question of the amount of pain but simply whether there is any pain at all. Pattern 1 patients may have more discomfort on standing extension than they do when they bend forward but flexing also causes recognizable typical discomfort. In contrast, Pattern 2 patients like to bend forward since flexing can reduce or even abolish the back pain; in no circumstance does flexion make their typical pain worse. Although extension aggravates the pain, it is the effect of flexion, the fact that bending forward never increases the symptoms, which, along with the pain location and consistency, define Pattern 2.

Physical examination of the Pattern 2 patient shows back dominant pain aggravated on

extension and never increased, at least unchanged and sometimes abolished, in flexion. The site of the pain matches that described in the history. As with Pattern 1, the neurological examination is either normal or any findings are unrelated to the current episode of pain.

Pattern 3

Pattern 3 is leg dominant and therefore represents radicular pain. In the patterns of pain classification, leg dominant pain begins in the lower buttock about 3 cm above the gluteal fold and can be worse anywhere from that point downwards in the thigh, calf, ankle, or foot. The pain is constant and even though it may fluctuate it never disappears completely. This pattern covers “sciatica,” a label used so indiscriminately that it has lost much of its diagnostic value. True sciatica describes only radicular pain arising from compression/inflammation of the roots of the sciatic nerve: L4, L5, S1. In practice, however, the term is incorrectly used any time a patient complains of leg pain, as when the more frequent mechanical back dominant pain briefly spreads into the lower limbs. One of the advantages of using this classification is the precision of the definitions. Because of the inflammatory etiology, Pattern 3 pain must be constant. Because the pathology lies within the lumbar spine, the leg pain is altered by spinal movement or posture. This pattern also covers the femoral nerve roots (L2, L3, L4) since the resulting constant anterior thigh pain is also radicular.

To support the history and confirm Pattern 3, the physical examination must show evidence of either nerve root irritation or conduction loss (diminished power, reflexes, sensation) or both. A majority of cases will show evidence of irritation – a positive straight leg raise – without localizing signs. Some will have both irritation and a focal loss of nerve function, locating the involved spinal level. Rarely there will be a significant conduction loss without irritative findings. A totally normal physical examination is inconsistent with a diagnosis of Pattern 3.

Pattern 4

The format of Pattern 4 differs slightly from the other three. It uses the same three basic questions but the designation depends on only the first two. Any patient with leg dominant intermittent pain is Pattern 4. The third item, the effect of flexion on the typical pain, subdivides the pattern; it uses the same three features in a different way.

Pattern 4 FA

If the intermittent leg dominant pain is increased by bending forward the patient is classified as Pattern 4 **Flexion Aggravated**, Pattern 4 **FA**. This is an unusual clinical picture seen occasionally with a resolving Pattern 3: constant radicular leg pain. Typically as the leg symptoms subside the pain becomes back dominant and the patient reverts to Pattern 1. Presumably, if there has been continued interference with normal nerve function, the leg pain remains the major complaint. Since acute inflammation is no longer the primary cause of pain, the complaints become intermittent. Since a flexed posture raises tension on the exiting roots, bending forward heightens the discomfort. Pattern 4 FA has been attributed to post-inflammatory scarring, an “adherent” nerve root, or to intrinsic damage within the nerve itself but the classification does not demand detailed identification of the pathology. Treatment is chosen according to the clinical presentation and confirmed by the patient’s successful achievement of the predicted outcomes.

Findings on the physical examination can vary but, obviously, must include reproduction of the patient’s typical leg dominant pain in flexion. There may be indications of residual inflammation or a focal conduction deficit. Since extension minimizes root compression, arching backwards or a gentle sloppy push-up should decrease the pain.

Pattern 4 FR

When flexion diminishes the intermittent leg pain, the patient is a Pattern 4 **FR**, **Flexion**

Relieved. This is the clinical picture of neurogenic claudication, a common diagnosis in the older population. Because the symptoms result from vascular compromise of the nerve roots, they are radicular, that is, leg dominant. Because the impact of ischemia varies with activity and posture, the pain is intermittent. Because flexion increases the available space within the intervertebral foramina allowing improved blood supply, sitting or bending forward can eliminate the symptoms. Again it is location, consistency, and the effect of flexion that dictate the Pattern classification. The symptoms are brought on by walking, which is exercise with the back extended, so the differential diagnosis includes intermittent claudication secondary to impaired peripheral circulation. The conditions can coexist making a definitive diagnosis difficult (Nadeau et al. 2013) There are several distinguishing signs, such as the location of the dominant pain above or below the knee (neurogenic claudication/Pattern 4 FR is usually worse in the thigh) however the most reliable differentiating factor is the neurogenic claudicant’s need to flex for symptom relief. This is the reason for the “shopping cart sign,” the patient’s ability to shop comfortably in a supermarket while being unable to walk any distance outside, because the shopping cart permits ambulation in sustained flexion. The history may include what patients describe as a temporary “loss of balance,” which is actually a transient motor weakness disrupting normal gait caused by an ischemic nerve root.

The signs and symptoms of Pattern 4 FR, neurogenic claudication, normally disappear at rest so the physical examination can be normal. This is not an inflammatory pathology so the root irritation tests, like the straight leg raise, will be negative. Infrequently long standing cases with substantial vascular impairment may have a permanent focal motor loss.

Using a syndrome-based classification, Pattern 4 FR, reflecting the patient’s clinical findings avoids several diagnostic pitfalls and mistakes. One of the most common is misusing spinal stenosis, a description of spinal anatomy, as a diagnosis. A small spinal canal may be asymptomatic and the

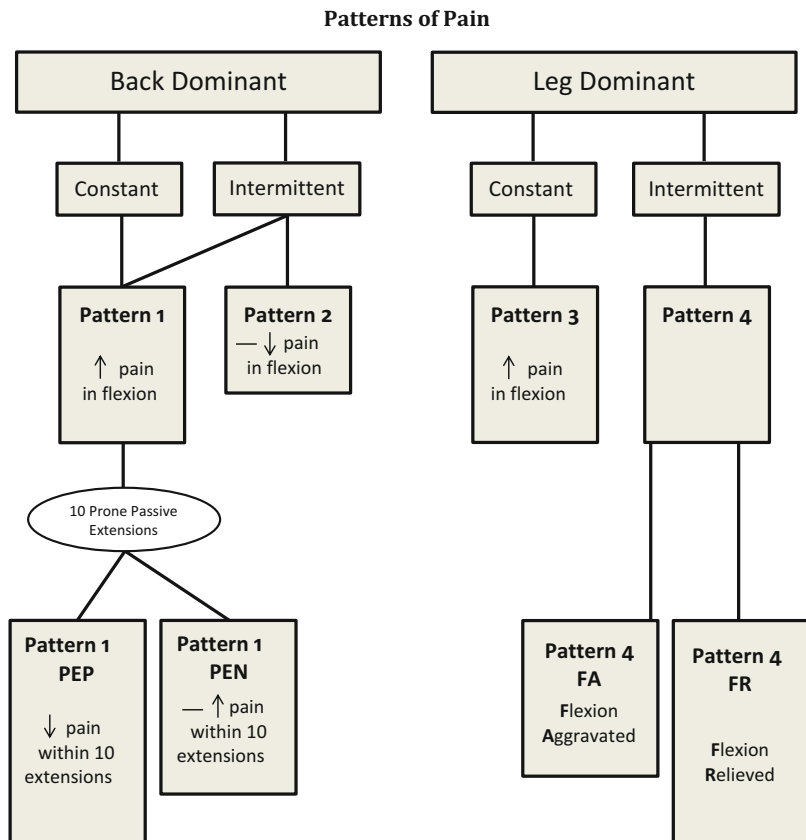
measurements of canal diameter on a CT scan are not indications for surgery. Concentrating on the clinical picture, the signs and symptoms that drive treatment rather than focusing on an anatomical variant that may or may not be problematic, keeps the clinician on the right path. This is especially important when treating the elderly patient where both back pain and spinal stenosis are prevalent and both are the result of progressive facet joint degeneration with boney encroachment into the canal. A history of walking limited by pain that disappears with bending forward suggests neurogenic claudication. This supposition will be reinforced by the inevitable identification of spinal stenosis on imaging. But without knowing the location of the dominant pain that assumption may be incorrect. If leg pain is the reason for the impairment then Pattern 4 FR is a reasonable diagnosis. If, however, the pain is back dominant the problem is not nerve root ischemia from canal

stenosis but rather mechanical Pattern 2 pain possibly arising from the facet joints. The former might benefit from surgical decompression. The latter will only be made worse.

Pattern Directed Care

Patterns of Pain is a robust, comprehensive classification. Its permutations cover every possible presentation of mechanical low back pain including those with predominantly neurological symptoms (see Fig. 1). A patient's patterns can change and some patterns may coexist. It is not possible for a patient to have both patterns of back dominant pain at the same time, but someone with Pattern 1 back pain can certainly develop constant leg dominant symptoms from nerve root inflammation following a sudden disc rupture or intermittent leg pain from recurrent root ischemia. The

Fig. 1 Patterns of pain



clinical syndromes arise from the underlying pathology but use of the patterns is not tied to a physical diagnosis. Determining a pattern or patterns offers a course of action and usually removes the need for further investigation. Familiarity with the patterns renders the outliers immediately visible and instigates appropriate additional measures. Most mechanical patterns can be managed without recourse to surgery. Non-invasive approaches address the whole patient, not just the pain generator. The anticipated positive response to a therapy chosen by the pattern validates the choice. The goals are pain control and recovery of function not cure. In contrast to nonoperative care, surgery obliges an unequivocally identified, well-defined anatomical target. The aim of an operative intervention is to resolve a local problem, which may be producing widespread symptoms. But in either case, it is the patient's clinical situation, the pattern of the back or leg pain, which shapes treatment.

Principles of Nonsurgical Management

The general principles of nonsurgical management begin with education: advice to the patient about the benign nature of mechanical back pain and the many simple things that can be done every day to reduce the impact of the pain. Patients want to understand the reasons for the pain and need to be reassured that the situation can be controlled. They want assurance that the clinician is capable of successfully managing care and sensing uncertainty in the care provider can make patients less willing to follow sensible recommendations to increase activity in spite of the pain. Offering concrete suggestions related to a recognized pattern rather than resorting to banal platitudes instills confidence in both the patient and the health care provider.

Since the intent is primarily to stop the pain there is a role for purely symptom-relieving procedures. Counter-irritation with heat or cold is hardly a new idea but remains useful. Either modality can be administered professionally as ultrasound or interferential current or self-applied using a hot pack or bag of frozen vegetables. Their

application is totally empirical and may be helpful in any pattern.

Correcting posture will change the way the spine is loaded and alter the amount of pain. The correction should be guided by the pattern of pain. Back dominant pain aggravated by flexion will be eased by increasing the lumbar lordosis. Each pattern offers a selection.

Direction-specific movements are at the heart of mechanical therapy. Many are uncomplicated and easily performed, their value determined by their beneficial effect on the pain. Except in Pattern 1 PEN or cases of severe, radicular, leg dominant Pattern 3 pain, pattern-directed repetitive movement should be the first treatment option. Clinicians must prescribe these maneuvers with the same precision and emphasis as they do medicinal remedies. Suggesting they can be done whenever it is convenient or when the patient can find the time belittles their importance and excuses noncompliance.

Analgesic medication should follow not precede mechanical therapy. The pain reduction achieved by changing position or repetitive direction-specific movement usually exceeds that produced by taking a pain pill. Using an analgesic as an adjunct to mechanical treatment is often efficacious but medication should be the second tier. There is no place for opioid medication in the management of Pattern 1 or Pattern 2 pain. No matter how severe, successful control of uncomplicated mechanical back pain can be achieved by physical methods and nonnarcotic analgesia.

Pattern 1 PEP

Patients classified as Pattern 1 PEP (prone extension positive) quickly gain pain control through a variety of activities. Putting one foot up on a footstool arches the low back and reduces the pain. Sitting with a firm foam lumbar roll at about waist level between the spine and the chair back maintains lumbar lordosis. Locating the roll at the correct height places it where it has the most positive influence on the typical pain. The patient is encouraged to make the final adjustments. The

roll must be large enough to change sitting posture and that makes it uncomfortable. The question is not, “Does that feel comfortable?” but “What does that do to your typical pain?” It is not uncommon for patients, at the same time, to complain of the discomfort and report that the typical pain has disappeared. Once the pain has been controlled, comfort follows rapidly. A night roll, a firm foam roll longer than the one used in sitting, can be prescribed to treat morning back pain resulting from sleeping on a poor mattress. Side lying provides no support for the spine between the ribcage and the pelvis. The resultant lateral sag can be painful. Placing the roll at waist level across the line of the body reduces the stress and diminishes the discomfort. Once again patients may initially find the lump uncomfortable so focusing on the typical back pain and setting expectations are important. Placing a pillow between the knees reduces tension on the low back and may ease pain but to do that the pillow must be large enough to influence spinal posture. It requires something thick enough to raise the upper leg to the point that the knee is higher than the hip. A couch cushion can be more effective than a pillow off the bed. If the patient finds that standing extension relieves the back pain, then standing extension can be added to the regimen but the decision to use standing extension must be based on the patient’s history and confirmed on the physical examination. Allowing the patient to use ineffective standing extensions rather than the demonstrably helpful prone extensions simply because it is too inconvenient to lie down at work misses the point of mechanical therapy.

The key to treating Pattern 1 PEP is the prone passive extension. By definition, a PEP patient experiences pain relief within ten repetitions. Self-treatment is repeating the same exercise in the same way for the same number of times that produced improvement during the assessment. Sessions are scheduled frequently throughout the day, hourly at first. Putting the activity on a timed basis and recording each result allows the patient to appreciate that it is the prone extensions and not something else producing progress. As pain control is established the number of session decreases. Prone passive extensions are treatment

not prophylaxis; when the patient is pain free, there is no reason to continue. A return of the symptoms should trigger a return to the exercise.

Pattern 1 PEN

Pattern 1 PEN (prone extension negative) patients have no direct route to pain control so treatment can be challenging. Because this is Pattern 1, back pain aggravated in flexion, the ultimate goal is pain control through repetitive prone extensions. Because these patients initially have too much pain on extension to do sloppy push-ups their management must begin somewhere else. The same things that work for Pattern 1 PEPs, a footstool, lumbar or night rolls, a large pillow between the knees should help here as well but with less benefit.

The best ways to start may be to prescribe periods of scheduled rest. Similar to scheduled movement, the duration, frequency, and positions are clearly stated and based on their effect on the patient’s pain in the examining room. The length of the rest period is determined by the amount of time the pain remains reduced and selecting the position simply depends on which one works best. The Z-lie is usually the most effective but that choice and the duration of rest are governed by the patient’s reports on the pain. For the Z-lie the patient is supine with the lower legs and feet on the seat of a chair or bench and the buttocks underneath. Both the hips and knees are flexed more than 90° so that the thighs are drawn up over the abdomen; generally the greater the tuck the greater the pain relief. Adding a pillow under the head and/or the buttocks may further improve the result. The clinician should experiment with all the factors – the feet on the chair, the distance the buttocks are under the seat, the height of the pillows – to find the best combination. At each modification, the patient is quizzed about the level of pain.

Another useful maneuver is having the patient lie prone over three or four pillows. They are placed in front of the pelvis and adjusted up or down to the most efficacious location. This is, obviously, very different for the Z-lie but can be

equally advantageous. The optimum posture depends on the amount of pain reduction but pain control usually improves as the number of pillows increases. As the pain subsides the pillows are sequentially removed.

Managing Pattern 1 PEN is a continuum from rest, typically in flexion, to movement in extension, to a Pattern 1 PEP routine. For the patient with constant back dominant pain where all movement hurts, rest in the way that affords the greatest amount of pain relief is the sensible place to begin. This is frequently the Z-lie. As the symptoms subside movement can be introduced. This can be an unloaded flexion such as knees-to-chest stretches. Paradoxically, although Pattern 1 is aggravated in flexion, most Pattern 1 PEN patients find when starting treatment that unloaded flexion is more comfortable than bending backwards. With increased mobility, treatment progresses to extension: first unmoving, like prone over pillows, then with movement, then the sloppy push-up. The art of managing these patients is choosing how far back along this continuum to begin and how quickly to move forward from static flexion to active extension.

Two other groups qualify as Pattern 1 PEN. The prone passive extension is purely sagittal and involves a full range of movement. Some patients respond only to asymmetrical activity and therefore don't improve with straight line extensions. Others gain relief only with midrange movement and are unable to reach end range. In both instances, ten repetitions of the standard prone passive extension fail to provide pain relief and the patients require modified treatment plans.

Pattern 2

Patients classified as Pattern 2 are never worse in flexion and the back dominant pain is always intermittent. Mechanical therapy is flexion. Except for using a large pillow between the knees when the patient lies down to relax the paraspinal muscles, everything else promotes bending forward. This is easily accomplished in sitting. The patient sits with the knees more that

shoulder width apart and bends forward lowering the upper body between the legs. Flexion can be increased by grabbing the ankles and pulling down. To return to an upright posture the patient places the hands on the knees and pushes, using the arms, not the back muscles, to raise the torso. For standing flexion, the patient places one foot on a bench or chair seat, puts the hands on the elevated thigh, and bends forward to rest the chest on the hands. To straighten up the patient pushes with the arms keeping the back relaxed. The mechanical prescription describes the technique, gives the number of repetitions and specifies the frequency during the day. Pattern 2 responds rapidly and the pain relief is sustained.

Pattern 3

Constant leg dominant pain is managed without movement. Pattern 3 radicular pain results from nerve root inflammation so in the acute phase scheduled rest is most appropriate. Similar to Pattern 1 PEN, the other pattern where scheduled rest is the logical first step, the duration and the spacing of the rest periods are dictated by the patient's pain. Unlike Pattern 1 PEN, the patient with severe radicular pain may need to spend much of time, 30 minutes out of each hour, resting. Several positions can decrease the pain. The Z-lie is the best choice. The setup is the same as described for Pattern 1 PEN, but the deciding factor is now the level of leg pain. The constant leg pain cannot be abolished but the amount can be substantially reduced by slight changes in alignment. Providing precise instructions for a method to achieve some relief also gives the patient a sense of control over a frightening situation, control that can be as beneficial as the mechanical changes. Lying prone over pillows may ease the leg pain. The amount of pain reduction governs the number of pillows; there is no progression to lying flat. The decision to use a Z-lie or to rest prone over pillows is purely pragmatic; the patient is encouraged to experiment. Other options include lying prone on the elbows or even on the hands and knees. Whatever works best is the preferred selection.

As the inflammation and the leg dominant pain subside patients can begin a movement-based routine either as a Pattern 1 PEP or PEN or as a Pattern 4 FA, flexion aggravated.

Pattern 4 FA

The two Pattern 4 categories represent two very different pathologies. The intermittent leg dominant pain of Pattern 4 FA, possibly from residual root impairment or scarring, responds to mechanical treatment. Because the pain increases with flexion, treatment resembles that for Pattern 1, but since the source of the pain is neurogenic rather than purely mechanical, the approach is gentler. The footstool, lumbar roll, and large pillow between the knees can all reduce the leg symptoms. Unloaded back extension, prone over pillows, or extension movements like the sloppy push-ups, may offer relief. The aim of treatment is to diminish the intensity and/or the frequency of the recurrent leg pain so whichever combination works is the best one to use. As with all mechanical therapy, sessions should be specific and repeated frequently during the day.

Pattern 4 FR

The key to managing the symptoms of neurogenic claudication, Pattern 4 FR (flexion relieved), is posture. Flexion increases access to the exiting nerve roots, improving circulation to limit or prevent the symptoms. Maintaining spinal flexion requires strong abdominal muscles so therapy is directed at improving core strength and function. A pelvic tilt is the foundational exercise. Tightening the abdomen rotates the pelvis forward, flattens the lumbar spine, and increases the size of the intervertebral foramina. Performing a pelvic tilt lying down with the knees bent and the feet planted firmly on the floor is relatively easy; maintaining the tilt while walking takes endurance. Core strengthening programs often incorporate using equipment like the Swiss exercise ball or techniques like the one-arm dumbbell bench press, things that are well beyond

the ability of the average octogenarian. Pattern 4 FR is most commonly an affliction of the elderly, and although core fitness is a valid principle, in practice it may be impossible to achieve. The affected patient population may not be able to make the long-term commitment to exercise necessary to gain improvement. It is for this reason, not because of a lack of understanding of what mechanical therapy is required to improve function in neurogenic claudication that surgical decompression may be the preferred treatment option.

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