

Exercise in the Management of Chronic Back Pain

Thomas E. Dreisinger, PhD, FACSM

Pure HealthyBack, Orlando, FL, and Therapy Advisors, Tucson, AZ

ABSTRACT

Background: Chronic back pain is one of the most common and expensive medical conditions facing today's population. Its costs are estimated to be as much as \$100 billion in the United States alone. Causation is poorly understood and healthcare providers share little common language concerning this pain. In addition, costly medical diagnostic tests are performed that do little to inform treatment. In the era of evidence-based medicine, back pain healthcare providers must find better ways to communicate with one another.

Methods: The key to better communication is measurement within the context of an evidence-based, protocol-driven clinical rehabilitation model. Measurement is the key to better communication among providers treating spinal pain. Measurement means acquiring both patient-reported outcomes (PROs) and clinician-based outcomes (CBOs).

Results: Musculoskeletal strengthening of the lumbar and cervical extensors has been shown to significantly reduce pain and provide successful clinical results for patients suffering from chronic back and neck pain. Lumbar strengthening has been successful because it is a safe exercise, it is prescribed based on pretreatment evaluation, and it provides objective measurements.

Conclusion: Without measurement, clinical results rely more on opinion than on objectively prescribed courses of treatment. Although indirect measures (PROs) are typically presented in clinical papers and clinical reviews, they are not often used in normal physical therapy practices. Adding direct patient-performance measures (CBOs) creates a much clearer clinical picture. The key to understanding the value of clinical practice

and its predictable impact on patient treatment is objective measurement.

PREAMBLE: SETTING THE STAGE

The United States healthcare system has found itself in the unenviable position of being on a pathway to bankruptcy. The US gross domestic product (GDP) is \$15.6 trillion, with healthcare accounting for nearly \$3 trillion of that figure,^{1,2} and healthcare costs are rampantly rising. Much of the practice of musculo-skeletal medicine is far from evidence-based, and costs for the management of back pain in the US also continue to escalate, by as much as \$100 billion.³ In addition, the direct costs and the indirect expenditures of absenteeism, as well as presenteeism (lost productivity while still on the job), are estimated to be even greater.⁴ The effects of the Patient Protection and Affordable Care Act are still somewhat uncertain, with one clear exception. Practices will be required to provide objective, evidence-based treatments with measurable outcomes.⁵ The National Institutes of Health (NIH) has been in the process of completing and implementing its Patient Reported Outcomes Measurement Information System (PROMIS)⁶ that was created to make the acquisition of patient-reported outcomes as painless and cost effective as possible. The operative words here are “as painless and cost effective as possible,” because any clinical monitoring system faces incorporation challenges. However, clinical monitoring is important because clinicians need to ask legitimate questions, such as “How much physical therapy and chiropractic treatment is placebo?” Although language like this tends to cause offense to certain patient or clinical populations, the question is meaningful. Rational treatment must have a conceptual framework, standardized assessment/treatment, and a common therapeutic protocol.

Not all back pain is the same. Some back pain—identified as a red flag—should *not* be treated with exercise and requires a much more careful medical workup. Red flag pain may present as unrelenting constant pain that gets worse when the patient lies down, interferes with sleep, and/or accompanies an unanticipated weight loss. Origins of the pain might

Address correspondence to
Thomas E. Dreisinger, PhD, FACSM
Pure HealthyBack
10612 N. Laughing Coyote Way
Oro Valley, AZ 85737
Phone: (248) 835-5697
Email: ted@purehealthyback.com

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include a tumor, cauda equina syndrome, infection, or spinal fracture. Although red flag pains require serious consideration, only 1%-4% of patients presenting with back pain have red flag conditions.⁷ Patients with red flag pain and those who might present with complicated and/or restrictive comorbidities in addition to back pain are beyond the scope of this paper.

INTRODUCTION

Exercise for health and disease management is not a new idea. Claudius Galen's (129-210 AD) influence regarding what has been called the "six things non-natural" (clean air, healthy food, appropriate sleep, good working bowels, balanced passions, and proper exercise)⁸ informed physicians well into the 19th century to include exercise as an important part of their medical practices.⁹ Not until the late 1800s, when western medicine and healthcare became more focused on "sick care and disease," did the emphasis on health slip into the background of medical practices.¹⁰

In the 1960s, the American population changed its focus to overall well-being. Heart disease was a public epidemic, smoking and excessive alcohol consumption were seen as deterrents to good health, and people began, once again, to take an interest in their own health. Although the focus on health seemed to be a new phenomenon, US society had only taken a break from a historical tradition of recognizing physical activity as an important aspect of good health.¹¹ Exercise received much more emphasis as healthcare began to find a balance within the monolith of "disease management and rest" that had dominated medicine in the United States for more than 80 years.¹¹

Today, exercise is recognized for its importance to healthy lifestyles, longevity, quality of life, mental health, and the management of many chronic diseases, including low back pain.¹²⁻¹⁶ Exercise is the only meaningful way to increase functional capacity.¹⁷ Questions about exercise relate to its place (ie, alone or in combination with cognitive or biopsychosocial strategies) rather than its value.¹⁸⁻²⁰

Systematic reviews for the management of acute, subacute, and chronic back pain have provided recommendations for more, rather than less, activity in recovery.^{21,22} Thirteen countries and 2 international groups, in addition to subgroups within professional societies, insurance companies, and other stakeholder agencies, have published clinical guidelines for the management of low back pain.²²

For the acute back pain patient, early activation towards normality that includes exercise should begin in the primary care setting. Unfortunately, a large percentage of primary care physicians do not

recommend exercise to their back pain patients,^{23,24} and the reasons why, other than lack of time, are somewhat unclear. Some general practitioners cite patient interests overriding their clinical judgment, even when practitioners know the importance of recommending increased activity.²⁵ This patient-practitioner conflict suggests a need for better methods of communicating the value of being active. Skillful practitioners are able to discover the patient's own motivations and align them with appropriately active treatment goals.²⁶

Good evidence supports the use of exercise-directed therapy for patients with chronic back pain—generally within the context of a rehabilitation setting.^{21,27,28} When compared with other therapeutic approaches, exercise demonstrates positive results by itself and in combination, for example, with cognitive interventions. Aggressive exercise is also cost effective in reducing disability.^{29,30}

WHAT TO TREAT

Pain may be the reason people seek medical care, but function rather than pain is treated in restorative physical therapy. Insurance companies in the United States do not pay for pain reduction—they pay for increases in function³¹ because pain cannot be effectively measured and treatment options are limited to medication, cognitive intervention, or surgery. Pain reduction may occur as the result of physical therapy, but functional improvement is the goal both for the insurer and the clinician.

Function is objectively measurable and can be deliberately increased through treatment. Studies have demonstrated the positive effects of aggressive exercise.^{29,30} Exercise has also favorably compared with surgical intervention³²⁻³⁴ and in some cases eliminated the necessity for surgery.³⁵ These findings indicate that clinical therapy should include appropriately aggressive exercise. Exercise is the centerpiece of treatment for the management of all complex pain syndromes, including spinal pain.³⁶

TREATMENT

A rational clinical treatment program should contain 4 elements: (1) a pragmatic framework, (2) a standardized assessment and treatment methodology, (3) a common therapeutic protocol, and (4) a cost-effective model. Objectively measured therapeutic exercise lends itself to this kind of structured treatment program.

In a pragmatic framework, exercise should follow the principle of progressive overload (increasing intensity, frequency, or duration of movement to exceed normal activity levels). The exercise-science literature contains numerous evidence-based protocols under the construct of progressive overload that

apply well to the clinical treatment for increasing spinal function.^{12,37}

Standardized assessment and treatment methodologies are critical if functional improvement is to be measured in a meaningful way. Standardized tests are available and should be applied for scientific inquiry and for clear communication among clinical colleagues. The American College of Sports Medicine publishes such testing and prescription methodologies.^{12,37,38} Alternately, if objective measurement is simply for internal clinical use (eg, patient motivation or clinician communication), any number of fitness testing resources (ie, for flexibility, endurance, and strength) are available.^{39,40}

Within physical therapy practices with more than one clinician, each clinician often assesses and treats patients differently. A common therapeutic protocol helps provide a foundation of treatment, enhancing a broader clinical understanding of patient care. Agreement among clinicians, at the very least within a practice, to common therapeutic protocols can be very helpful.

Cost effectiveness impacts society by decreasing overuse of the healthcare system and medical procedures, as well as reducing the overall economic burden of medical care. Using a framework for creating efficiencies in the treatment of spinal care can have an impact on larger social issues. Social cost factors are particularly important in the United States where two-thirds of spinal costs are due to decreased wages and productivity and healthcare is rapidly approaching 18% of the GDP.⁴¹

THE IMPORTANCE OF MEASUREMENT

Measurement as a means of clarifying understanding is a time-honored practice. Plato suggested to Euthyphro, “Suppose that we differ about magnitudes, do we not quickly end the differences by measuring? ... And we end a controversy about heavy and light by resorting to a weighing machine?”⁴²

Mathematician and physicist William Thomson (Lord Kelvin) expressed it more bluntly, “When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, your knowledge is of a meagre and unsatisfactory kind.”⁴³

Objective measurement should be used for multiple reasons. Normative data are highly valuable, leading to better clinical understanding and to further research. A second and often overlooked reason is patient motivation. Humans are interested in where they fit in to whatever category they find of interest. Studies in the area of exercise compliance focus on this human aspect.⁴⁴⁻⁴⁶ Actuarial health tables provide data related to height, weight, body mass index,

cholesterol, blood sugar, and physical performance. Patients want to know how they are faring in rehabilitation. When they can be shown increases in endurance, strength, range of motion, or flexibility over their baseline, they feel a sense of accomplishment—helpful for keeping patients motivated through their course of treatment. Measurement can be used both to encourage patients and to demonstrate they have plateaued and are no longer candidates for treatment. Measured exercise provides a broader and more coherent clinical narrative from which therapeutic management may be refined.

CLINICAL OUTCOMES

The majority of measures reflecting changes in back pain are patient reported in the following general categories: symptoms, function, and quality of life. The use of patient-reported outcomes (PROs) in clinical trials reflects the attention given to patients’ evaluation of their healthcare.

In the late 1980s and early 1990s, few of these measures were available. Examples include analog pain scales, the Oswestry Disability Index (measure of function), and the Short-Form Quality of Life (SF-36) survey. The difficulty in quantifying nondichotomous data in spinal care has led to a proliferation of outcome measurement tools that, as Chapman reported, “suggest a high degree of sophistication ... or a general helplessness in the face of overwhelming odds” and an “incomplete resolution of the attempts at quantifying many aspects of ‘health-related quality of life.’”⁴⁷ The difficulty in agreeing on a common measurement criterion has created, in the clinical setting, more opinion than fact.

Clinician-based outcomes (CBOs) are another kind of data. CBO assessments reflect objective physiologic or biomechanical changes such as endurance, muscle strength, range of motion, and measured activities of daily living (eg, functional capacity testing). They differ from PROs because they do *not* involve patient perceptions; rather, they measure performance. CBO assessments provide objective evidence of restoration of function required by third-party payers, in addition to timely feedback to the patient.

Unfortunately, most clinicians do not use outcomes in their practices. Lee indicated that fewer than 10% of all healthcare practices in the United States collect any kind of outcomes data—either PRO or CBO.⁴⁸

WHAT KIND OF EXERCISE?

According to the US Bureau of Labor Statistics, only an estimated 13%-20% of people over the age of 15 participate in regular lifestyle physical activity, with variations based on regional habitat.⁴⁹ Chronic back

pain patients in general are less physically active than the majority of the population, meaning most chronic back pain patients come to therapy with very low physical capacities from a lifestyle that is inhibited by the nature of their pain. The goal of therapeutic intervention is to return patients to the normal activities of daily living—sitting, rising, bending, twisting, lifting, walking, and climbing—by enhancing strength, flexibility, endurance, and balance. Only resistance (strength) training has been shown to result in increases in all 4 of these at the same time.⁵⁰⁻⁵³ Resistance training is safe, efficient, and easy to quantify, and it has been shown to reduce kinesiophobia,²⁰ depression,⁵⁴ vertebral fractures,⁵⁵ and recidivism rates.⁵⁶ Resistance training also increases the integrity of connective tissue within the muscles, joint cartilage, tendons, and ligaments and enhances bone mineral content.⁵⁷ Because of its multifactorial contribution to overall health in the chronic spinal patient, generalized resistance strengthening should be part of any rehabilitation program focused on functional restoration.

STRENGTH TRAINING

Progressive overload has been called the mother principle of exercise training. The 3 elements of prescribed exercise are the activity's frequency (how often), intensity (how hard), and duration (how long). Under the progressive overload principle, these 3 elements are manipulated to gradually increase the amount of work performed until maximal exercise potential is reached. Regardless of therapeutic activity, the principle of progressive overload governs the ability to increase one's capacity to perform daily living activities. Any exercise overload will cause functional capacity to increase, but adjusting intensity provides the biggest gains in performance capability. Applying greater resistance through progressive sessions results in increased lean muscle mass, decreased body fat, and increased work capacity (function).⁵⁸

If baseline measurements are recorded before patients begin a program of progressive exercise, patients readily see improvements during their clinical restoration program, as well as their overall functional improvement when they complete the program.

Exercise machines are the optimal way to determine the effects of progressive resistance exercises. They permit measurement of effort, both visually and physiologically. Exercise machines are also safe in that they limit free axial movement, thereby reducing the potential for injury. Free weights are less expensive and also effective but their use must be more carefully supervised. Strengthening exercise should be performed slowly to minimize the possibility of injury from the acceleration forces of rapid lifting.

In addition, the weight lifted should provide enough resistance to cause optimal adaptive changes in muscle. Although therapeutic programs emphasize patient performance of functional activities, muscles cannot be meaningfully strengthened through dynamic functional movements. For example, if a tennis player used a heavily weighted racquet to increase his or her strength of service, the momentum of the swing alone would put the joint, at the axis of rotation, in danger. The intensity of resistance needed to meaningfully strengthen the arm using a weighted racquet would risk significant injury because of acceleration/deceleration forces and directional changes in movement of the racquet. For safety reasons, a much less intense functional exercise load (ie, a normally weighted tennis racquet) would need to be used. Functional movement with the tennis racquet is helpful for proprioceptive movement patterns but not for optimal strengthening.

Motivational issues also detract from gains in function when patients are not given specific, measurable goals. Therapy that is time based or centered on unmeasured exercise provides little feedback to the patient. Without specific strategic goals (prescribed exercise based on quantitative assessment), most patients require cheerleading or they will perform exercise at the lowest level of their capacity. In home exercise programs, for example, without time and distance guidelines, patients will engage in progressively less intense exercise.⁵⁹ A parallel example is that of motivating students to learn. Instructors use any number of strategies to encourage successful learning, but without goal-oriented strategies and feedback, most students will not do well.⁶⁰ Similarly, without a program of measured activity and demonstrated progress, patients find little to motivate them to perform persistent exercise.

SPINAL STRENGTHENING

Although the clinical literature reports of outcomes of core stabilization exercises have been equivocal,⁶¹⁻⁶⁴ lumbar extensor strengthening has been shown to be an effective (as good as or better than standard physical therapy) therapeutic tool.^{65,66} Lumbar extensor strengthening is more valuable than the standard of care because it provides measurable physiologic adaptation to the therapy. Indeed, a progressive resistance spinal strengthening exercise program has been instituted within the Ochsner Health System (TE Dreisinger, D Feurtado, J Karazim, unpublished data, 2013). The program's preliminary outcomes have demonstrated significant patient gains in measured strength, range of motion, and patient-reported function, as well as decreases in disability scores for both lumbar and cervical patients.

Both computed tomography and magnetic resonance imaging scans have revealed that lumbar extensors (and in particular the multifidus) show greater atrophic changes with more severe back pain.⁶⁷ Dickx et al, using a modified Roman chair, induced pain in healthy backs by unilateral injection of hypertonic solution that led to bilateral hypoactivity in both erector spinae and multifidi.⁶⁸ Parkkola et al showed that patients with chronic low back pain (CLBP) have greater fatty infiltration and less muscle mass in their lumbar extensors.⁶⁹ This muscle composition is relevant because multifidus fibers show a natural degree of atrophy in individuals with no history of back pain, as well as in patients with CLBP,⁷⁰ suggesting that the lumbar extensors and the multifidi may be more atrophic in CLBP patients. MacDonald et al demonstrated that unilateral atrophy of the multifidi, occurring in the once-symptomatic side, persists even when no longer symptomatic.⁷¹ In two studies, Hides et al observed patients with first-time onset of unilateral back pain and found rapid atrophy of the multifidus on the symptomatic side.^{72,73} The atrophy persisted even after spontaneous resolution of symptoms in those patients who did not exercise following recovery from pain.

Rissanen took muscle biopsies before and after aggressive back extensor strengthening in patients with a history of chronic back pain.⁷⁴ He demonstrated increased diameter of type 2 multifidus fibers and significant increases in strength.⁷⁴ The preexercise and postexercise biopsies demonstrated morphologic adaptation of the multifidi to strengthening in these individuals. This study verified observations made by Mooney et al regarding the importance of aggressive resistance training of the lumbar extensor muscles in patients with CLBP.⁷⁵ Their data showed changes in the myoelectric activity of the lumbar extensors as strength and range of motion increased. In addition, Leggett et al, in a multicenter study, showed strengthening the lumbar extensors led to a reduction in reuse of the healthcare system by 87% after 1 year.⁵⁶ Their data also demonstrated increases in quality of life and reduction in perceived pain.

CONCLUSION

Exercise is an important strategy in the management of back pain regardless of whether the pain is acute or chronic. Among the various exercise strategies used, resistance (strength) training is the most efficient. However, without an objective baseline measure leading to prescription of the appropriate dose of exercise (ie, intensity, duration, and repetition of activity), patient improvement is completely subjective. Without measurement, clinical results rely more on opinion than on objectively

prescribed courses of treatment. Although indirect measures (PROs) are typically present in clinical papers and clinical reviews, they are not often used in normal physical therapy practices. Adding direct patient-performance measures (CBOs) creates a much clearer clinical picture. The key to understanding the value of clinical practice and its predictable impact on patient treatment is objective measurement.

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