1995

A Differential Overview of Self-Directed Low Back Exercise Programs

Micheal G. Bateman
University of North Dakota

A DIFFERENTIAL OVERVIEW OF SELF-DIRECTED LOW BACK EXERCISE PROGRAMS

by

Micheal George Bateman
Bachelor of Science in Physical Therapy
University of North Dakota, 1995

An Independent Study

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Physical Therapy

Grand Forks, North Dakota
May
1995

This Independent Study, submitted by Micheal G. Bateman in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Faculty Preceptor)

(Graduate School Advisor)

(Chairperson, Physical Therapy)

PERMISSION

Title	A Differential Overview of Self-Directed Low Back Exercise Programs
Department	Physical Therapy
Degree	Master of Physical Therapy

In presenting this Independent Study Report in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work, in her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Independent Study Report.

Signature Michael G. Bateman

Date 4/10/95

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I would sincerely like to thank the staff and faculty at the University of North Dakota Physical Therapy program for all their guidance throughout my years there. I especially want to thank Beverly Johnson for her understanding and assistance with my paper.

A very special thank you goes to my parents, family, and fiance for all their support and encouragement.

ABSTRACT

Patients with low back pain represent a large percentage of the population frequenting today's clinics. Despite the high prevalence of low back pain in today's clinical setting, it is considered one of the most difficult diagnoses to treat. While practitioners in the field of physical therapy employ a diversity of evaluation and treatment techniques, they all share one common denominator, the goal of limiting pain while improving function and quality of life. Many therapists subscribe to a treatment approach which involves the patient in active individualized self-treatment exercises. Controversy exists as to which treatment approach is most effective and whether an individual or eclectic approach to low back pain is most advantageous.

The purpose of this study is to provide a differential overview of the principles, techniques and approach of three low back exercise programs most often used in today's clinical setting. These include Dynamic Muscular Lumbar Stabilization, the McKenzie Method and Williams Exercises. Through a comprehensive review of the literature, a discussion of the intervetebral disk and lumbopelvic anatomy is presented followed by an in depth description of the clinical usefulness and rationale of each treatment approach. A conclusion as to the significant role that each respective program plays in today's clinical environment is also made.

CHAPTER I

INTRODUCTION

Low back pain will affect approximately 80 percent of the adult population at some point in their lifetime.[1,2] Studies reveal that low back pain has an annual incidence of 5 percent of the adult population, is prevalent in 15 to 20 percent, and has a rate of recurrence of 75 percent.[1] Recent research has indicated that low back pain is the most common cause of activity limitation amongst US citizens under the age of 45, and is ranked third for those between ages 45 and 65.[2] The literature also points out that for every 100 low back patients at ages 25-44, an average of 28.6 work days are missed annually due to low back pain.[2] While the frequency of low back pain has not increased in recent years, disability resulting from this pathology has significantly increased. Low back pain ranks fourth as criteria for social security disability payments.[1] It is also estimated that one fourth to one half of all patients seen in physical therapy clinics are low back pain sufferers.[3] These numbers translate into approximately 20 to 30 billion dollars in direct and indirect costs in the United States annually.[1]

Despite the high prevalence of low back pain in today's clinical setting it is considered one of the most difficult diagnoses to treat. While practitioners in the field of physical therapy employ a diversity of evaluation and treatment techniques, they all seem to share one common denominator, the goal of limiting pain while improving function and quality of life. Many therapists subscribe to a treatment approach which involves the patient in active individualized self-treatment exercises. Controversy exists as to which treatment approach is most effective and whether an individual or eclectic approach to low back pain is most advantageous. This should not be surprising considering that research indicates that 50 percent of low back patients improve within one week without treatment; at two weeks, 80 percent improve; and one month up to 86 percent and after 3 months more than 90 percent of patients show improvement with or without intervention.[1,4] Although these numbers bode well for those who recover spontaneously, for those who suffer with acute or chronic back pain, a solution to the problem is often aggressively sought after.

A number of conservative treatment approaches are utilized in today's clinical environment - including rest, cold and/or heat applications, traction, mobilization, manipulation, injection therapy, educational back schools and various exercise protocols emphasizing stabilization, flexion and/or extension respectively. The purpose of this study is to provide a differential overview of the principles, techniques and approach to three low back exercise programs most often used in today's clinical setting. These include Dynamic Muscular Lumbar Stabilization, the McKenzie Method and Williams exercises. Through a comprehensive review of the literature, an in depth description of the clinical usefulness and rationale of each treatment approach will be presented. A conclusion as to the significant role each respective program plays in today's clinical environment is also made.

CHAPTER II

THE LUMBOPELVIC ANATOMY

The Intervertebral Disk & Low Back Pain

Lumbar disk disease is a progressive series of pathophysiologic events, that begins with asymptomatic fragmentation and fissuring within the intervertebral disk.[5] It can progress gradually until the nucleus pulposus herniates through annular fibers of the disk into the spinal cord or intervertebral foramen, with subsequent nerve root compression.[5] The progression of lumbar disk disease and its contribution to low back dysfunction can be explained, in part, by the natural degenerative process of the spine with advancing age.[6] Other precipitating factors in the progression of lumbar disk disease include the following: a history of back trauma; isolated trauma through excessive or prolonged torsion, extension or flexion of the spine; poor posture and body mechanics; vigorous exercise of more than 15 years, or in persons over the age of 20; sedentary work, obesity and cigarette smoking.[5,6,7] Patients with symptomatic lumbar disk disease can present clinically with low back pain, radicular pain, referred pain, changes in sensation, leg muscle weakness or some combination of the above. Neurological deficits are most commonly localized to the L5 or S1 nerve roots since these are the levels of maximum lumbar movement. Surgery is considered only when symptoms have not significantly diminished after 6 weeks of conservative therapy.[5,6,7,8,9,10,11,12]

Despite the fact that lumbar disk disease accounts for only a small percentage of the patients with low back pain, the percentage of low back patients with underlying disk pathology is significant. It is, however, estimated that the annual medical costs for treatment of lumbar disk disease alone reach approximately 5 billion dollars annually.[5] With only 5 to 10 percent of these patients candidates for surgical disk repair, a large percentage of patients with lumbar disk disease are faced with conservative treatment measures to alleviate symptoms and restore function.[5,6,7,8] A basic knowledge and understanding of the disk, its properties and role in low back dysfunction are necessary for proper intervention.

Disk Anatomy, Physiology and Biomechanics

The intervertebral disk can be described as having two components, the nucleus pulposus and the annulus fibrosis. The cartilaginous end plates, although developmentally a part of the vertebra, are intimately related to the intervertebral disk both anatomically and mechanically. The nucleus pulposus is normally confined within the annulus, occupying the posterior-central aspect of the disk.[6,7,9] It is composed mostly of ground substance and a loose array of collagen fibers.[7,9] The tissues of the nucleus are continually changing in appearance with advancing age.[9] They lose their original homogeneous, gelatinous character and acquire a dry fibrous appearance. As the disk becomes drier, there is a gradual decrease in elasticity and in the ability to store energy and distribute loads. These tissue changes are prompted by the normal avascularity of the disk, the natural degenerative process that comes with aging, the decrease in water content of the nucleus pulposus (from 90% the first year of life to 74% by the eighth decade of life), and from diminished nutrition to the disk.[7,9] Without a blood supply, the components of the intervertebral disks and the cartilaginous end plates rely on the daily cycles of loading and unloading for the passive diffusion of nutrients to the disk. This lack of direct blood supply also shows the tissue healing process when the disk is injured. There is, however, experimental evidence that indicates when an intervertebral disk is injured, an immediate "self sealing" mechanism allows the disk to maintain its biomechanical properties in response to compression load forces.[14]

The annulus fibrosis consists of concentric layers made up of densely bundled collagen and fibrocartilage.[7,9] Each layer of the annulus is bound to another with the collagenous fibers maintaining an oblique orientation.[7] In the lumbar region, the structure of the annulus is narrower and thinner posteriorly.[6,7,8] With advancing age (from 15 to 45 years old), the annulus fibrosis naturally degenerates causing circumferential and radial tears that progress peripherally.[6,7] As a result, the posterior longitudinal ligament becomes a narrow band, leaving the posterolateral area of the annulus fibrosis uncovered.[9] Consequently, most disk protrusions occur in the posterolateral area of the disk. Disk loading occurs throughout activities of daily living and is complex, with a combination of forces such as compression, bending and torsion acting upon the disk. Rotation is responsible for shear force upon the disk, while flexion, extension and lateral flexion of the spine produce mainly tensile and compression forces.[12] Experimentally, bending and torsional forces have been found to be the most damaging to the disk.[14] The resultant intradiskal pressure varies with activities, some being significantly higher than others. In 1976 Nachemson[10] quantified intradiskal pressures of various positions. The supine position, for example, has the least pressure measurement of 24 psi. Other examples show how body mechanics can effect intradiskal pressure. For instance, lifting 20 kg correctly (with knees bent and back straight) produces an intradiskal pressure of 240 psi, while incorrect lifting (knee straight and back bent) of 24 kg produces a pressure of 380 psi. These examples only reinforce the importance of patient education that includes instruction on correct body mechanics with ADLs and maintaining good posture.[10]

Vertebral Anatomy, Physiology and Biomechanics

As previously mentioned, the mechanical loading and unloading of the intervertebral disk is important in maintaining its health. The cartilaginous end plates, although part of the vertebral body, have an important role in maintaining disk health. Made up of hyaline cartilage, end plates serve as semi-permeable membranes, allowing passive diffusion of nutrients to the disk.[7,9,12] The end plates also act as a barrier that minimizes the loss of ground substance from the intervertebral disk.[7] Two consecutive vertebrae and their intervening soft tissues form what is known as the functional unit of the spine. The anterior portion is comprised of two superimposed vertebral bodies, the intervertebral disk and longitudinal ligaments. The posterior portion consists of the vertebral arches, the intervertebral joints formed by the facets, the transverse and spinous processes, and various ligaments (ligamentum flavum, posterior longitudinal, interspinous and supraspinous ligaments). The vertebral canal is formed by the vertebral bodies and arches which protect the spinal cord from injury.[12]

The facet joints are responsible for approximately 16 percent of the weight bearing load in the standing position, while the vertebral body-intervertebral disk-vertebral body interface bear the remaining 84 percent.[7] Typically, the vertebral bodies and disks of the lumbar spine are the largest, and they bear the brunt of the axial load. The spinous processes are thick and horizontal, while the transverse processes are slender and horizontal. The articular facets lie in the sagittal plane, with the superior facets facing medial and posterior and the inferior facets facing anterior and lateral. The exception is the transitional vertebrae L5, where the inferior facets are more in the coronal plane. Flexion and extension are relatively free in the lumbar spine, this is due to the positioning of the facets and the large size of the disks. During flexion and extension, approximately 12 degrees of motion occurs in the sagittal plane at the level of L1-L2 interspace, increasing to 20 degrees at the level of L5-S1 interspace. Rotation is limited due to the facet positioning in the sagittal plane, while collectively 20 to 30 degrees of lateral bending to each side is noted in the lumbar region.[12,14]

Lumbopelvic Musculature and Biomechanics

There are 29 muscles that originate or insert into the pelvis.[7] Twenty of these muscles link the pelvis with the femur and the remainder link the pelvis to the spine. This implies that significant forces can be generated through the pelvis and lumbar spine from a variety of different muscles, ligaments and angles. Developing muscular control of lumbopelvic movement prevents end-range use, repetitive microtrauma and injury.[7,12,14] This muscular control is the goal of physical therapists and most exercise regimens in today's clinical setting. It has been shown that the spinal column alone, without muscular support cannot support normal physiologic loads.[7] Therefore the goal of any active exercise program is to educate and strengthen the patient to maintain their functional range of motion and to facilitate proper movement patterns that control, prevent, or eliminate mechanical stress to the spine.

The muscles of the lumbopelvic region work to provide stability, eliminate shear forces and reduce excessive loading of the intervertebral disk and spinal segments.[7,16,17] A basic knowledge of the musculature and their individual contributions to stabilization of the lumbar spine is important. We begin our discussion of the lumbopelvic region with the thoracolumbar fascia. Although the thoracolumbar fascia is a non-contractile tissue, it can be engaged dynamically due to the contractile tissues attached to it or contained within it. Active or passive tension is imparted to the fascia with contractions of the latissimus dorsi, internal oblique and transversus abdominis.[7] Contraction of abdominal muscles of posterior thigh muscles tightens the fascia as does forward bending and flexion of the lumbar spine. The latissimus dorsi muscle influences lumbopelvic mechanics due to its attachment to the fascia, thoracic and lumbar spinous process and sacrum.[7]

The erector spinae muscles consist of two parts, the superficial and deep portions. The superficial erector spinae function eccentrically to control descent of the spine in forward bending, concentrically to extend the spine, and isometrically to control the position of the trunk in relation to the pelvis.[7,12,16,17] The deep erector spinae assist in reducing shear of the lumbar vertebrae and manage the lumbar lordosis. The deep erector spinae also work with the psoas major muscle to create stability. The multifidus muscles run in a lateral to medial direction from the transverse processes to the spinous processes above the lumbopelvic region and run superior and medial to attach to the spinous processes of the lumbar and sacral vertebrae. The muscle is thick and prominent in this region and helps to counteract flexion and shear during forward bending and is also strong spinal extensor. It may also contribute to spinal stability by squeezing the vertebrae together and locking the vertebral assembly. The intersegmental muscles, the interspinalis and intertransversarii, connect the intervertebral segments together with their primary function to providing proprioceptive input to the central nervous system. The quadratus lumborum works with the opposite gluteus medius and femoral adductor muscles to maintain frontal plane stability of the pelvis and lumbopelvic joints and also to control torsion of the lumbar spine. The quadratus also works in concert with the erector spinae to prepare the lumbar spine for transference of forces in the horizontal plane.[7,12,16,17]

The iliopsoas muscle is composed of the iliacus and psoas major. Due to their attachments to the lumbar vertebrae and iliac crest, the action of this muscle depends upon whether the position of the femur is in an open or closed kinetic chain.[7,16] When the foot is fixed on the ground and the iliacus contracts, the resultant force to the ilium produces an anterior torsion and extension force on the lumbosacral facets joints. Anterior torsion of the ilium equates to a forward and downward movement of the anterior superior iliac spines. This movement combined with decreased length due to adaptive shortening or increased efferent neural input, may result in a downward tilt or anteriorly rotated pelvis. This ultimately increases the compressive load on the lumbar facet joints.[7] The psoas major due to its vertebral attachments (when contracted) may also add a compressive effect on the lumbar body-intervertebral disk interface. The psoas major's role as a stabilizer of the lumbar spine works in combination with the deep erector spinae, multifidus and quadratus lumborum. The iliopsoas contracts to counterbalance the forces of the posterior lumbar muscles to create equilibrium and avoid destructive forces on the lumbar vertebral tissues.[7,16,17]

The abdominal musculature are often seen as flexors and rotators of the trunk, but their function may best be described as antirotators and antilateral flexors.[7] The obliques muscles stabilize the trunk in the horizontal plane by controlling rotary forces reaching the lumbopelvic tissues and decreasing the chance of torsional injuries.[7,16,17] The transversus abdominis and internal oblique attach to the middle layer of the thoracolumbar fascia in a direct line to the transverse process.[7] They subsequently provide stability to the spine by a laterally directed pull on the vertebrae. With a controlled abdominal contraction, lumbar movement in the horizontal and frontal planes is minimized. The external oblique also offers resistance to axial rotation and lateral motions due to its attachment to the ribs and iliac crests providing the necessary leverage relative to the lumbopelvic joints.[7,16,17] During functional activities the abdominal wall musculature works synergistically with other muscles to assist with movement but more importantly stabilizes the lower trunk region.[7,16,17]

The muscles of the anterior and posterior thigh affect sagittal plane mechanics, exerting posterior or anterior rotary movements on the pelvis.[7] These forces are transmitted to the pelvis when the femur or foot are fixed and a closed kinetic chain is established. Anterior movement due to adaptive shortening, tightness or increased efferent motor response can increase the extension forces to the tissues of the lumbar spine.[7,16,17] The powerful posterior muscles composed of the gluteals and hamstrings act to guide the lumbopelvic region by counterbalancing forward bending of the trunk. The lateral and medial thigh musculature work in a synergistic manner to provide frontal plane stability of the pelvic motion.[7] Without a balance of these two muscle groups, inappropriate weight bearing positions and faulty gait patterns lead to excessive compressive forces to the lumbar spine resulting in a variety of musculoskeletal problems.[16,17]

Developing muscular control of lumbopelvic movement prevents excessive disk loading, repetitive microtrauma and soft tissue injury. This muscular control is the goal of the physicians, therapists and numerous back programs. While the disks are often thought of as spinal shock absorbers, the musculature is actually the shock absorbers of the spine. Without an understanding of the lumbopelvic musculature and its function, successful intervention and management of low back dysfunction is difficult if not impossible.

CHAPTER III

DYNAMIC MUSCULAR LUMBAR STABILIZATION

Dynamic muscular lumbar stabilization (DMLS) is an exercise-based treatment approach to low back pain that is currently receiving much attention due to recent success. Although the term DMLS may be new to some clinicians, the program itself is based upon a number of well known theories and established principles of exercise physiology, orthopedic sports medicine, proprioceptive neuromuscular facilitation (PNF) and spinal biomechanics.[15,16,17,18,19] The concept or term "stabilization" was first mentioned in 1968 in an article by Kendall and Jenkins comparing Williams' flexion and McKenzie's extension exercises.[16] The article pointed out that to improve function and limit disability with low back patients a successful program must avoid strain to damaged structures by incorporating postural positions of minimal stress and maximal stability while exercising. Since that time DMLS has become the focus of numerous treatment protocols, training programs and back schools. The program has developed into a multifaceted treatment plan that incorporates patient education, strength, flexibility, coordination and endurance training.[15,16,17,18,19,20,21,22] As health care services continue to evolve from previous passive treatment measures to those of a more proactive stance, programs focusing on individualized self treatment such as DMLS are experiencing dramatic success.

Goals and Philosophy

The term spinal stabilization has often been used in orthopedics to represent the process of limiting motion to spinal segments with rods, plates or screws following spinal surgery. In back education and training programs the word stabilization is used in a different context. The stabilized spine is dynamic and responsive to a variety of musculature and movement patterns.[15] Thus the name dynamic muscular lumbar stabilization. The primary goal of (DMLS) should be to optimize function and improve quality of life rather than simply treat pain.[16,17,18] Teaching the patient to assume control of their lumbar dysfunction rather than allowing their pain and condition to dictate their lives is vital to the success of the stabilization program.[16,17,18] The underlying philosophy of (DMLS) is that the patient is an active participant in the rehabilitation process and is empowered with the responsibility to manage their low back problem and prevent further injury.[15,16,17,18] The emphasis of stabilization training is that exercise will improve function without increasing pain. Because (DMLS) is an aggressive active program, whose focus is both education and exercise, patient independence is a realistic goal. It is important to note that the general principles of treatment for one disorder, such as disk herniation for example, remain consistent with others such as spondylisthesis or pain of mechanical origin with exception to positional or postural biases.

Diagnosis and Evaluation

Stabilization training begins with a thorough patient evaluation that requires accurate diagnosis and early intervention.[16] A detailed history and functional assessment should be performed regardless of physician diagnosis to determine the status of the patient's low back biomechanics and movement patterns. It is essential to know the mechanism of injury and possible risk factors in order to avoid further injury throughout the treatment process.[16,17,18] Subjective and objective information is gathered in the initial interview to determine limitations in strength, flexibility, coordination, range of motion, symptom behavior and functional limitations.[16] Knowledge of the patient's occupation, recreational habits and functional level assist in the development of a treatment plan with appropriate patient goals. The patient is continually reassessed to determine their current functional level and advancement into more challenging stages of the program. A clear understanding of the anatomy and physiology of the spine, its movement patterns and function are necessary for accurate assessment and treatment.

The Functional Position & Neutral Spine

The concepts of neutral spine and stabilization training are introduced initially during the acute or pain control phase of the low back rehabilitation program.[15,16] Educating the patient to the nature and dynamics of low back dysfunction are paramount to the success of the stabilization program. After gaining an understanding of the underlying pathology, the goals and philosophy of the stabilization program, the patient is taught to recognize the functional limits of their low back pain and manage the spine within those limits. The position or range of movement defined by the patient's symptoms, pathology, and musculoskeletal restrictions is called the "neutral spine".[15,16,17,18,19,20,21,22] This is a position where vertical forces to the spine are transferred equally to the weight-bearing surfaces via the feet when standing or ischeal tuberosities when sitting. The functional position or range is defined as "the most stable and asymptomatic position for each individual task, and is usually the mid range of the available degrees of pain-free motion".[15,16,17,18] This position is achieved by moving the pelvis back and forth into an anterior and posterior pelvic tilt. The functional range will also depend upon the patient's flexibility, strength, endurance, weight-bearing tolerance and coordination.[16,17] The patient learns to operate within the limits of the pain free range by increasing coordination and control of the lumbopelvic musculature and by eliminating end-range use. To control, prevent or eliminate low back symptoms the patient must be able to maintain the functional range and facilitate proper movement patterns throughout the exercise regiment. Quality of movement and kinesthetic awareness are stressed and achieved only through endless repetition. The patient works to develop an unconscious awareness of the functional position so that proper movement patterns become automatic.[15,16,17,18]

Once the patient develops an understanding of the functional position, an exercise program is designed to fit the individual needs of the patient. If the patient is unable to maintain the functional position due to lack of kinesthetic sense or inadequate strength, they are placed in an over-corrected position to avoid movement out of the range. This is the concept of prepositioning.[15] Passive prepositioning involves placing the body and extremities in a specific posture that demands little muscular effort to prevent movement out of the functional range. The amount of passive assistance is gradually decreased as the patient's ability to stabilize the spine improves. Active prepositioning incorporates muscular control to maintain the over-corrected spinal position. This is where the patient uses their own muscular control to position the pelvis. Upon improvement, the patient will progress from the over-corrected spinal position to one of a neutral or midrange position.[15,16,17,18] This requires a higher level of skill due to a co-contraction of the muscles needed to maintain the neutral position. Associated movement of the arms and legs provide a diversity of stresses and loads to the lumbopelvic region forcing the patient to adjust the muscle tension to maintain the neutral spine.[15,16,17,18] At this point the patient is instructed on how to maintain lumbar control while incorporating more functional activities. The patient is then progressed from basic to more advanced transitional movements required for activities of daily living (ADLS).

Stabilization Concepts

During functional activities the abdominal musculature works synergistically with other muscles to assist with movement but more importantly stabilize the lower trunk region. In DMLS this is referred to as muscle fusion.[17] The concept of muscle fusion involves using the lumbopelvic musculature to brace the spine and eliminate repetitive microtrauma to the lumbar motion segments and the intervertebral disk. This is first accomplished by reducing the lumbar lordosis which helps to eliminate shear forces on the intervertebral segments through the use of the abdominal musculature, the dorsolumbar fascia and midline lumbar ligament.[17,18] This becomes important due to the changes in axial rotation that occur as a result of increasing degrees of lordosis. The abdominal muscles function to corset the lumbar spine due to their attachments to the dorsolumbar fascia and the latissimus dorsi muscle. The abdominal musculature with their influence on the superficial portion of the fascia flex the lumbar spine while deep portions of the fascia combine to form the alar interspinal ligaments and extend the lumbar spine.[17,18] Through tension created by the thoracolumbar fascia and simultaneous tightening of the posterior ligamentous system, a corset to stabilize the spine against torque and shear forces is established. Forces directed to the fascia by various muscles are similar to those encountered when erecting a tent.[7,17] The direction and forces exerted by the guy wires directly affect the stability of the tent. The extensor muscles also contribute to this process by reducing anterior shear of the lumbar vertebrae and managing the lumbar lordosis, assuring proper weight-bearing.[17] The Deep erector spinae muscles function to anchor the spine to the ilia. Contraction of this muscle stabilizes rather than moves the spine. The multifidus muscle is the most prominent extensor muscle and contributes to spinal stability by counteracting flexion and shear during forward bending and locks the vertebral assembly by squeezing the vertebrae together.[7,12,17,18]

Strengthening of the abdominal musculature is the cornerstone of the stabilization program. Teaching patients the concept of abdominal bracing through muscle fusion and emphasizing recruitment of the oblique muscles to manage the lumbodorsal fascia rather than simply the rectus abdominis is vital to the stabilization process. The oblique muscles stabilize the trunk in the horizontal plane.[16,17,18] The internal oblique provides spinal stability due to a laterally directed pull on the vertebrae. The external oblique offers resistance to axial rotation and lateral motions to the lumbopelvic joints. Use of the oblique muscles to increase tension through their attachment to the lumbodorsal fascia helps provide the corset affect and fortify the spinal elements against torque and shear forces.[7,12,16,17,18]

While correct abdominal strengthening is considered the cornerstone of stabilization training, flexibility and spinal range of motion are key to the overall success of the program.[20] Muscles that attach to the pelvis or vertebrae directly impact pelvic and spinal stability. These muscles are often thought of as guy wires whose influence results in changes to the position of the spine or symmetry of the pelvis.[7,16,17,18] Flexibility of the hamstrings, iliac, psoas, quadriceps, quadratus lumborum, hip rotators, gluteals, hip abductors and adductors and iliotibial band eliminate possible repetitive fatigue stress due to shortened structures. The muscles of the upper trunk and extremities should also remain flexible to avoid faulty movement patterns created by overcompensation of the lumbopelvic muscles.[15,16,20]

CHAPTER IV

THE MCKENZIE METHOD

The McKenzie method for evaluation and treatment of low back pain is the treatment of choice for many clinicians. This treatment regimen has experienced success in both chronic and acute low back patients.[2,3,23,24,25,26,27] Although there are those who associate this treatment regimen with simple extension exercises, most who employ this protocol insist that while extension is a key factor, it is but one facet of a total approach to low back pain management. In 1956, while working with a patient experiencing a three-week history of low back and leg pain, McKenzie observed that peripheral pain was eliminated after lying in the prone position of lumbar hyperextension for approximately 10 minutes. The patient recovered quickly following this event, leading McKenzie to monitor patients' pain response during various positions and movements.[23] Prior to this discovery, spinal pain and its response to mechanical stresses was not considered to be an effective diagnostic tool.

Goals and Philosophy

McKenzie advocates a system of assessment and treatment based upon pain responses and patterns frequently observed in low back pain patients.[23,24,25] The patient plays an active role in both assessment and the treatment process by indicating which positions and movements relieve mechanical stresses and or peripheral symptoms. The prevention of recurrence of low back pain through mechanical analysis of pain patterns and patient self-treatment is the foundation of the McKenzie program.[23,24,25] This ultimately leads to a series of individualized, progressive exercises to correct posture, localize and eliminate pain.

McKenzie proposes that there are three predisposing factors in the etiology of low back pain. Poor sitting posture, loss of extension range and frequency of flexion.[23] A poor sitting posture can often lead to an accentuation of reduction of normal spinal curves. Placing these ligamentous structures on stretch will eventually produce pain. Wyke[23] also confers, that after a few minutes in the sitting position, the lumbar spine assumes a fully flexed posture. While in this posture the musculature are completely relaxed and the ligamentous structures are left to absorb the full weight bearing strain. In general, McKenzie contends that relaxed sitting, often becomes poor sitting posture, necessitating corrections to reduce stress on the ligaments.[23,25]

Loss of extension range is often the result of poor postural habits and adaptive shortening following low back trauma. A reduction of extension leads to a decrease in lordosis in sitting, and a slightly stooped posture when standing erect or walking. This causes a flattened lumbar spine, resulting in an increase in intradiskal pressure and subsequent pain due to stress on the nucleus and posterior annular wall.[23]

Frequency of flexion is another predisposing factor according to McKenzie.[23] Flexion demands of the spine are high throughout today's modern lifestyle. The constant flexion of the spine during activities of daily living, leads to a loss of ability to easily extend the spine. Other precipitating factors for low back pain include sudden unexpected body movements on the job, around the house or during sports or recreational activities. Incorrect lifting techniques, trauma due to falls, and motor vehicle accidents may also lead to low back pain.[23]

Diagnosis and Evaluation

The McKenzie approach to examination of low back pain attempts to minimize variability and maximize consistency by using a systematic method. The examination consists primarily of a patient history, a postural assessment and the use of passive and active range of motion tests.[2,3,23,24,25,26] McKenzie contends that a concise thorough history is the most effective tool to combat low back pain. A specific list of questions are used consistently in the initial interview to aid in this process. The history includes: patient occupation, location of pain, length of present episode, initial onset, previous episodes, constant or intermittent pain and positions making pain better or worse.

According to McKenzie, the patient's occupation helps to reveal information regarding everyday activities predisposing them to injury.[23,24,25] The location and associated symptoms of pain help to determine the level and extent of the lesion. To identify if the condition is acute, sub-acute or chronic the clinician must know the duration of the pain and/or symptoms. Initial onset of pain is important in determining causative factors and treatment strategy. Even though previous episodes of back pain play an important role in classifying the patient into one of the three syndromes. McKenzie believes that the most important conclusion gained from the interview is weather pain is constant or intermittent.[23,24,25]

Constant pain can be of mechanical or chemical origin.[23] If it is mechanical it can be due to constant soft tissue deformation. It can also be caused by chemical irritation due to inflammatory and infective disorders. Intermittent pain is always produced by mechanical deformation. McKenzie's approach to treatment relies heavily on knowing which positions relieve or exacerbate the condition. Other pertinent questions include: Pain on cough/sneeze, sleeping patterns, previous x-rays, medications, general health, major surgery, prior accidents, and bladder control. McKenzie emphasizes that proper diagnosis and treatment depend upon accurate information gathered in the initial history.[23,24,25]

The assessment actually begins during the history taking portion of the initial visit. McKenzie suggests assessing sitting posture throughout the history taking process.[23] When the patient rises from sitting, observation of standing posture, gait and movement patterns are all noted. McKenzie emphasizes quality of movement and determines if there is movement loss or deviation of normal movement pathways in the lumbar spine. End range testing and various movements in flexion, extension and side-gliding are assessed first in standing, then in the prone position. It is McKenzie's contention that in order to relate pain to movements, the testing procedures must produce a change in the patient's symptoms. "Any attempt to force normal movement (application or abnormal stress) in a joint with visibly impaired function (abnormal tissue) must result in the production or enhancement or pain".[23] If this process does not produce pain it is possible that the symptoms may not be of a mechanical origin.

Repeated motions are also used as a diagnostic tool to determine which of McKenzie's three syndromes are evident.[2,3,23,24,25,26,27] Patients with postural syndrome experience no pain with repetition of test movements. Pain is reproduced only upon placement into certain positions. With dysfunction, repeated movements will stretch adaptively shortened structures and produce pain at end range, but repetition does not make the pain more intense. The derangement patient will experience an increase in derangement or peripheralizing pain when repeated movements occur in the direction which increases movement of nuclear disk material. Repeated movements in the opposite direction result in reduction or centralization of pain and symptoms. McKenzie contends that a decrease or centralization of pain is extremely reliable in determining which treatment approach will reduce mechanical deformation.[2,3,23,24,25,26,27] Repeated movements are also used to determine weather stretching is appropriate following derangement or trauma. If application of repeated movements to painful structures reduces pain with each repetition these exercises are indicated for treatment. If the patient experiences more pain upon repetition these movements should be stopped to allow healing to occur.[23,24,25,26,27]

The McKenzie method of evaluation follows an algorithm classifying relevant information from the subjective and objective portions of assessment.[23,26,28] "An algorithm is any method or procedure of computation, usually involving a series of steps as in long division (Hanks and McLeod, 1987) and is a useful way to simplify often seemingly complicated problems".[28] The McKenzie algorithm allows for a systematic model of symptom assessment minimizing examiner error. The correlation of information from the history, examination and test movements determine whether the patient is suffering from the postural, dysfunctional or derangement syndrome.

McKenzie's Syndromes of Pathology

Postural syndrome is usually seen in patients under the age of thirty, with sedentary occupations, who rarely exercise. This syndrome is a result of soft tissue deformation due to postural stresses maintained over prolonged periods of time.[23,24] Pain is produced following sustained postures or positions with prolonged static loading at the end ranges of movement. This pain is without underlying pathology and is similar to the pain response when a normal finger is bent backward and held with the metacarpophalangeal joint in hyperextension. A change of position or postural correction is required to decrease static loading in the flexed lumbar spine.[23,24]

Patients classified in the dysfunction syndrome are characterized by poor postural habits, lack of regular exercise and are typically over the age of thirty.[23,24] Intermittent pain results before full normal end range is reached and partial loss of movement develops from mechanical deformation of soft tissue due to adaptive shortening. Prolonged immobilization, repair from previous injury and surgery can often lead to scarring or inelastic shortened tissues. The pain does not increase or shift with end range stretching of the shortened structures but is often painful. The pain is usually centralized, however, referred pain may occur if shortened, scarred structures adhere to a nerve root.[23] Rapid changes of symptoms do not occur in dysfunction. These painful inelastic structures must be stretched into the painful end-range to restore normal ROM.[23,24]

The derangement syndrome consists of a disruption and alteration of fluid material within the intervertebral disk.[2,3,23,24,25,26,27] Patients typically report a sudden onset of pain with dramatic changes in functional abilities. Those affected range from 12 to 55 years of age. Pain is generally constant but may alter its presentation due to lesion size and location. The patient may experience local or radicular pain, paraesthesia or numbness distally. McKenzie states that the derangement patient experiences pain upon midrange movement that may centralize or peripheralize depending upon the direction of the movement. Centralization occurs only in the derangement syndrome. Seven different types of derangement are identified by various signs and symptoms.[23,24,25]

McKenzie's Principles of Treatment

After proper assessment and classification into one of the three McKenzie syndromes the treatment phase begins. Treatment techniques are specific for each syndrome and predicated on McKenzie's principles of spinal flexion and extension.[2,3,23,24,25,26,27] McKenzie advocates a self treatment approach to the management of pain. He states, "If it is possible for patients to stop their pain, it is also possible for them to prevent the onset of future pain."[23] Thus, the goal of the clinician is to foster an attitude of self-reliance toward pain management.

Treatment for the postural syndrome starts with patient education.[23,24] McKenzie believes this to be the most important tool for treatment of low back pain of a postural origin. The patient must have an understanding of the mechanism causing pain. Postural correction exercises and techniques for postural modification in sitting, standing and lying are taught to the patient. Proper maintenance of normal spinal curves and the use of lumbar supports are also emphasized.[23,24]

Treatment of dysfunction begins with education, including an explanation of what its causes are and the McKenzie treatment approach. Postural correction and instructions for proper spinal maintenance are given to control pain caused by bad posture. Due to adaptive shortening or scarring of soft tissues, normal movement is brought to a halt prematurely. Further movement into this range will result in overstretching of the shortened tissues and cause pain.[23,24] Stretching of ligamentous structures and scar tissue must be performed without causing micro-tearing.[23] McKenzie states that in order to restore movement and function, exercises must be performed about ten times per day with a minimum of ten stretches each time.[23,24] The patient will experience minor pain when stretched into the shortened range but the pain should subside within twenty minutes after completion of the exercises. If pain is present the next day, overstretching has taken place and frequency of exercises or stretching intensity must be reduced.[23,24]

McKenzie states that those suffering from the derangement syndrome represent the largest group of spinal pain patients.[23] While these patients often experience the most rapid and dramatic recoveries, derangements can also be the most disabling of all mechanical low back problems. McKenzie identifies four stages of treatment for derangement: Reduction of derangement, maintenance of reduction, recovery of full function and prevention of recurrence.[23] McKenzie advocates reducing the derangement based upon the principles of spinal flexion and extension.[2,3,23,24,25,26,27] The extension principle is used for reduction of a posterior derangement by stretching the anterior passive visco-elastic structures and forcing the nucleus pulposus in an anterior direction. The flexion principle works to stretch the posterior structures forcing the nucleus material in a posterior direction thus reducing the anterior derangement.[23] To maintain the reduction, once again emphasis is placed upon posture correction, normal lordosis, exercises and patient education.[23,24,25,26,27] An understanding of the disk properties, pain presentations, and reduction techniques are required for future patient self treatment. Recovery of function occurs only after the patient has complete reduction of the derangement and is painfree. Movements that were once contraindicated to reduce and maintain the derangement are now used to recover normal range of motion and function in the opposite directions. Following full recovery of function the patient must have full knowledge and understanding of the prophylaxis and self treatment techniques to prevent recurrence.[23,24,25,26,27]

CHAPTER V

WILLIAMS EXERCISES

The treatment approach for low back pain employed by many clinicians prior to McKenzie's contentions and the recent evolution of dynamic muscular lumbar stabilization was often referred to as Williams flexion exercises. While the current literature abounds with articles discussing the two previously mentioned treatment philosophies, little is mentioned regarding Paul C. Williams and his contribution to the effective treatment of low back pain. In 1937 Williams published "Lesions of the Lumbosacral Spine".[29] The articles were based on a study of 1,000 chronic low back pain cases. While the articles offered no statistical evidence or support for their observations at that time, their significance and profound influence on future research and the care of low back patients was immeasurable.[2] No discussion of self-directed exercise regimens would be complete without a brief explanation of this philosophy.

Philosophy and Treatment Principles

In contrast to McKenzie's theory that stresses the importance of maintaining lumbar lordosis and the extension principle throughout the lumbar spine and low back, Paul Williams proposed a treatment approach that implied the complete opposite. The foundation for Williams exercises was based on the flexion principle.[29,30,31] Although Williams conservative treatment approach involved casting, bed rest and bracing for extended periods of time, his exercise regimen reinforcing maintenance of a flattened lumbar spine became known as Williams' flexion exercises.[29,30,31] Williams contended that man's vertebral column was severely deformed due to the repetitive stress required to maintain an erect posture. Williams viewed the lumbar lordosis "as a pathological deformity" and stated that "the contour of the lower spine should resemble as nearly as possible that of the quadruped animal."[31] In standing erect, Williams believed man transferred body weight to the posterior aspect of the intervertebral disks in the lumbar spine, specifically at the fourth and fifth lumbar levels. Williams felt that the fifth lumbar disk was most often involved and subsequently ruptured allowing nuclear material from the disk to escape into the spinal canal, placing pressure on the spinal nerves. Nerve irritation at the intervertebral foramen could also occur where the nerve exited from the spinal canal.[29] He stated that this took place infrequently at the other levels of the lumbar spine and that the probability of nerve impingement was further increased with extension of the lumbar spine. According to Williams " the fifth lumbar disk has ruptured in the majority of all persons by the age of twenty".[29] Williams argued that while most people at this age don't experience severe low back pain, problems encountered in the future were the result of the ruptured disk.[29]

Williams also felt that a sedentary lifestyle led to disuse of the spinal flexors, primarily the abdominals which become weak, while the antagonistic spinal extensors become strong.[29,30,31] Increased weight demands resulting in a protruded abdomen, displaced the center of gravity anteriorly and led to a compensatory increase in the lumbosacral lordosis, thus shifting the added weight of the thorax in a posterior direction. Williams proposed that exercises and postural principles should decrease the lumbar lordosis and spinal extension, shifting the center of gravity forward and ultimately relieving pressure on the posterior elements of the lumbar spine.[29,30,31] This was accomplished by strengthening the flexors of the lumbosacral spine and by stretching the extensors. Williams original program consisted of four flexion exercises designed to maintain the flattened lordosis and restore the proper balance between the spinal flexors and extensors. All exercises that involved extension of the lumbar spine were contraindicated for low back patients according to Williams.[29,30] While many of Williams treatment techniques are considered outdated by today's clinical standards, the concept of muscle imbalance, abdominal strengthening and flexibility were precursors for the exercise philosophies that followed. Williams flexion exercises, although not always utilized the way he envisioned, continue to play a role in the treatment of low back patients.[2]

CHAPTER VI

CONCLUSION

Patients with low back pain represent a large percentage of the population facing today's clinician. Despite the high prevalence of low back patients and the self-limiting nature of the pathology, it continues to be one of the most difficult diagnosis to treat. While the conservative approach includes a wide variety of treatment measures, the concept of self-directed exercise programs as the primary component of the treatment process, continues to gain momentum throughout the medical community. The three programs reviewed in this paper provide very different perspectives as to the clinical approach to similar problems. Dynamic muscular lumbar stabilization (DMLS) is a self-directed exercise program focusing on bracing or corseting the lumbar spine through strengthening, flexibility and positioning against torsional or end range stresses. This concept is based upon the principles of the neutral spine or functional position. The McKenzie method is a treatment approach utilizing a series of individualized, progressive exercises to identify, localize and ultimately eliminate low back symptoms. The focus of this technique is upon the maintenance of the lumbar lordosis and the extension principle. Williams exercises are based upon the flexion principle, decreasing the lumbar lordosis and maintaining a proper balance between the spinal flexors and extensors.

The question facing many of today's clinicians is which school of thought provides the most efficacious results. With current literature providing limited support for all three respective exercise programs, the question actually becomes weather today's clinician should subscribe entirely to one viewpoint or incorporate a more eclectic approach utilizing one or more of the above treatments. It is clear that all three treatment approaches have their place in the discipline of physical therapy and while substantial differences in treatment philosophy were presented in this paper, there are important similarities. The most important of which is placing the patient in a position of shared responsibility by incorporating an exercise program that relies heavily on their feedback and participation. Another factor common to all three philosophies is that each exercise regimen focuses on strengthening and stretching to establish a balance between the musculature of the lumbopelvic region and the intervertebral disk. The three programs also share the distinction of being identified or associated with a dominant theme such as the flexion principle, extension or nuetral spine. It is evident, however, after reviewing the literature, that the three respective exercise programs incorporate aspects of one another. While there is some overlap amongst philosophies, it is this author's opinion that an eclectic approach to low back problems equips the therapist with the flexibility to incorporate a diversity of treatment stratagies, otherwise limited by the confines of one author's assumptions. The importance of further research efforts to determine future prophalaxis and treatment cannot be overstated.

REFERENCES

1. Margo K. Diagnosis, treatment and prognosis in patients with low back pain. Am Fam Physician. 1994;49:171-179.

2. Ponte D, Jensen G, Kent B. A preliminary report of the use of the McKenzie protocol versus Williams protocol in the treatment of low back pain. JOSPT. 1984;6(6):130-138.

3. Elnaggar IM, Nordin MA, Sheikhzadeh A, et al. Effects of spinal flexion and extension exercises on low-back pain and spinal mobility in chronic mechanical low-back pain patients. Spine. 1992;17(10):967-972.

4. Beattie P. The use of an eclectic approach for the treatment of low back pain: a case study. Phys Ther. 1992;72:923-927.

5. Gilmer HS, Papadoppulos SM. Lumbar disk disease: pathophysiology, management and prevention. Am Fam Physician. 1993;47:1141-52.

6. Wood GW. Lower back pain and disorders of intervertebral disk. In Crunch AH, Daugherty K, ed. Campbell's Operative Orthopaedics. 8th ed. St. Louis, Mo: Mosby Year Book; 1992;5(37):17-75.

7. Porterfield JA, Derosa C. Mechanical Low Back Pain: Perspectives in Functional Anatomy. Philadelphia, Pa: W.B. Saunders Corp; 1991:47-104.

8. Lanier DC. The family physician and lumbar disk disease. Am Fam Physician. 1993;47:1057-58.

9. Jurgen K, Mueller KH, Stoll JE, Mueller HK. Trans. Intervertebral Disk Disease: Causes, Diagnosis, Treatment and Prophylaxis. 2nd ed. New York, NY: Thieme Medical Publishers, Inc; 1990:118-140.

10. Saunders DH. Evaluation, Treatment and Prevention of Musculoskeletal Disorders. Minneapolis, Minn: Viking Press Inc; 1985.

11. Karl RD, Folberg JA. Radiologic assessment of the musculoskeletal system. In: Boissonnault WG, ed. Examination in Physical Therapy

Practice: Screening for Medical Disease. New York, NY: Churchill Livingstone Inc; 1992:324-327.

12. Lindh M. Biomechanics of the lumbar spine. In: Nordin M, Frankes BH, eds. Basic Biomechanics of the Musculoskeletal System. 2nd ed. Philadelphia, Pa: Lea & Febiger; 1989:183-207.

13. Oegema TR. Biochemestry of the intervertebral disk. In: Stinson JT, Wiesel SW, eds. Clinics in Sports Medicine. Philadelphia, Pa: W.B. Saunders Company; 1993:419-39.

14. White AA, Panjabi MM. Clinical Biomechanics of the Spine. Philadelphia, Pa; JB Lippincott Company; 1978:1-42.

15. Morgan D. Concepts in functional training and postural stabilization for the low- back-injured. Top Acute Care Trauma Rehabil. 1988;2(4):8-17.

16. Robison R. The new back school prescription: stabilization training part 1. Occup Med. 1992;7:17-31.

17. Saal JA. The new back school prescription: stabilization training part 2. Occup Med. 1992;7:33-42.

18. Saal JA, Saal JS. Nonoperative treatment of herniated lumbar intervertebral disk with radiculopathy: an outcome study. Spine. 1989;14:431-36.

19. White L. The evolution of back school. Occup Med. 1992;7:1-7.

20. Saal JA. Flexibility training. Phys Med and Rehabil. 1987;1(4):537-559.

21. Saal JA, Saal JS. Nonoperative treatment of herniated lumbar intervertebral disk with radiculopathy: an outcome study. Spine. 1989;14:431-36.

22. Saal JA. Rehabilitation of sports-related lumbar spine injuries. Spine. 1987;1(4):613-689.

23. McKenzie R. The Lumbar Spine: Mechanical Diagnosis and Therapy. Waikanae, New Zealand: Spinal Publications (N.Z.)Ltd; 1981.

24. Oliver MJ, Lynn JW, Lynn NJM. An interpretation of the McKenzie approach to low back pain. In: Twaomey LT, Taylor JR. Physical Therapy of the Low Back. New York: Churchill Livingstone, Inc; 1987.

25. Dimaggio A, Mooney V. The McKenzie program: exercise effective against back pain. Journal of Musculoskeletal Medicine. 1987;63-72.

26. Nwuga G, Nwuga V. Relative therapeutic efficacy of the Williams and McKenzie protocols in back pain management. Physiotherapy Practice. 1985;1:99-104.

27. Donelson R, Silva G, Murphy K. Centralizing phenomenon: Its usefulness in evaluating and treating referred pain. Spine. 1990;15(3):211-213.

28. Kilby J, Stigant M, Roberts A. The reliability of back pain assessment by physiotherapists, using a McKenzie algorithm. Phys Ther. 1990;76:579-583.

29. Williams PC. The Lumbosacral Spine Emphasizing Conservative Treatment. New York, NY: McGraw-Hill; 1965.

30. Williams PC. Lesions of the lumbosacral spine, part I. J Bone Surg. 1937;19:343-363.

31. Williams PC. Lesions of the lumbosacral spine, part II. J Bone Surg. 1937;19:690-703.