Dynamic Chiropractic

BACK PAIN

Demystifying the Treatment of Strain/Sprain Injuries of the Lower Back, Part I

Abstract: A majority of the American population has suffered from low-back pain at some point in their adult lives. Prolonged rest used to be the mode of treatment for lumbar strain/sprain injuries, but this form of treatment leads to atrophy of the lumbopelvic musculature and ongoing low back dysfunction. This author's goals of treatment for a low back strain/sprain injury are to control pain, restore soft tissue and joint function, and prescribe a good strength training and flexibility program for the lumbopelvic region.

The focus of this paper will be to describe the perception of low back pain; explain the postural and phasic muscles of the low back; detail the biomechanics of the lumbar spine and pelvis when bending forward and returning to the neutral standing position; depict four distinct situations which can predispose an individual to low back pain; and then explain this author's examination protocol and treatment plan for low back strain/sprain injuries.

Key words: low back pain, rehabilitation, Flex Band R, chiropractic, lumbar, A.R.T.

Introduction

Low back pain is common in the general population, affecting more than 60 percent of people at some time in their lives and often causing appreciable disability.[1] According to an article in a 1992 issue of Business and Health, the average per employee nonspecific back pain disability costs among 12 diverse businesses were $1,000 in direct costs, $800 in hidden costs (lost productivity, temporary replacement hiring, bookkeeping, etc.), and $400 in disability costs for a total of $2,200 per employee.[2]

This paper will discuss four distinct situations which predispose one to low back pain; normal stress on an unprepared normal low back; normal stress on a deconditioned normal low back; sudden excessive stress on a normal low back; and normal stress on an abnormal low back. A rational strategy for the prevention and treatment of low back pain will be presented.[3]

Perception of Pain

Nociceptors are receptors located near the skeletal muscles, ligaments, tendons, joints, and fascia of the low back region. An anatomic structure must be supplied by nociceptive nerve endings to be a cause of low back pain. There are four main sources of neural innervation to spinal structures: the ventral rami; the dorsal rami; the recurrent meningeal nerve; and the gray rami communicants of the sympathetic trunk. All of these nerves innervate structures which can be possible low back pain generators (see Table I).

Tissue damage causes a release of prostoglandins, histamine, bradykinin, potassium and serotonin, which stimulate and activate nociceptor nerve endings. Activated free nerve endings release substance P into the surrounding area, leading to the release of histamine from adjacent tissue cells. Group IV afferent fibers relay nociception through the dorsal root ganglion and transport

neurotransmitters, substance P and calcitonin, to the dorsal horn of the spinal cord, where they synapse and release these excitatory neurotransmitters. Nociceptive information then travels from the dorsal horn of the spinal cord via the neospinothalamic or paleospinalthalamic ascending tracts to the thalamus. From the thalamus this information then travels to the cerebral cortex where pain is perceived.[4] Ongoing pain will lead to faulty motion patterns which will result in cumulative trauma injuries to adjacent muscle structures.

Table 1: Possible Pain Generators in the Low Back

Ventral Ramis
Psoas musculature
Quadratus lumborum musculature
Intertransverse musculature
Dorsal Ramis
Multifidus, rotators, semispinalis
Zygapophyseal joints
Periosteum of posterior vertebral arch
Interspinous, supraspinous and intertransverse ligaments, ligamentum flavum
Erector spinae muscles
Recurrent Meningeal Nerve
Periosteum of posterior aspect vertebral body
Posterior aspect of disc
Posterior longitudinal ligament
Anterior aspect spinal dura mater
Gray Ramis Communicants Associated with the Sympathetic Trunk
Periosteum of anterior and lateral aspect vertebral body
Lateral aspect disc
Anterior aspect disc
Anterior longitudinal ligament

Phasic and Postural Muscles of the Lower Back

To effectively treat and understand the cause of low back pain, it is necessary to be familiar with the phasic and postural muscles surrounding the spine and adjacent structures. The phasic and postural muscles in the lumbopelvic region are listed in Table II.

Slow-twitch muscle uses oxidative metabolism and has a high capillary density, giving it its characteristic red color. The twitch speed is slow, and the function of these muscles is that described as being tonic or postural. Muscles that have high density slow-twitch fibers react to functional disturbance by shortening and tightening. Fast-twitch fibers use a glycolytic metabolic pathway, fatigue rapidly and have low capillary density that results in a white color. Muscles of this type are described as phasic in function and react to disturbance by weakening.[5]

Table II: Phasic & Postural Muscles in the Lumbopelvic Region

Phasic
1. Abdominal oblique, transverse abdominal & rectus abdominal musculature
2. Gluteus maximus & medius musculature
3. Quadricep musculature
Postural
1. Iliopsoas musculature
2. Erector spinae musculature
3. Rectus femoral musculature
4. Quadratus lumborum musculature
5. Multifidus, rotators, semispinalis musculature
6. Hamstrings
7. Piriformis musculature
8. Iliotibial band & tensafascialata musculature

Precipitants of Low Back Pain

The first situation which can lead to low back pain is normal stress on an unprepared normal low back. This individual attempts to lift an object and underestimates or is unaware of the actual weight of the object. As a result, the lower back muscles are not prepared to protect the functional unit. A functional unit consists of two lumbar vertebrae, an adjoining disc, facet articulations, surrounding ligaments, muscles, fascia, and the nerve roots exiting at that level. Initially, the surrounding musculature contracts to protect the functional unit; however, when the applied force exceeds the maximum strength of the musculoligamentous unit, one gets a strain/sprain injury to the lower back.

The second situation which can lead to low back pain is normal stress on a deconditioned normal low back. A low back can be structurally normal, but not necessarily conditioned. Conditioned, or functionally normal, means the surrounding low back tissues have appropriate flexibility and strength to accomplish a particular movement without injury. A conditioned normal low back will be able to bend forward and return to the standing position with ease. However, a deconditioned low back is susceptible to a strain/sprain injury when put under ordinary stress. These two coupled motions of bending forward and returning to the standing position are dependent on the strength and flexibility of various muscle groups and will be discussed as movement 1 and movement 2 respectively.

Movement 1: Anterior Flexion of the Lower Back

The low back consists of five functional units. There is approximately 9 degrees of flexion allowed at each functional unit, allowing up to 45 degrees forward flexion. At 45 degrees the fascia, muscles and ligaments of the low back are taut and no more flexion is allowed without forward rotation of the pelvis. An endpoint of motion in forward flexion of the low back is that point at which a person bends forward and can go no farther (no pain). If the ligaments, fascia and muscles of the low back are not flexible, this endpoint of motion will be decreased and will result in a strain/sprain injury of the low back when attempting to bend forward to 45 degrees. In order to bend forward past 45 degrees, the pelvis has to rotate anteriorly. The anterior motion of the pelvis is dependent on the flexibility of the hamstrings and gluteus maximus musculature. If the hamstrings and gluteus maximus musculature are not flexible, the pelvis will be limited in anterior flexion. When this limited endpoint of forward flexion is exceeded, one will usually complain/suffer from an acute onset of low back pain.

Movement 2: Extension of Lower Back from Full Anterior Flexion toNormal Posture

When individuals are bent over in forward flexion, they should initially flex their knees to return to

the neutral standing position. Flexing the knees will tense the quadricep musculature, which tenses the iliotibial band, which tenses the tensor fascial atae musculature and pretenses the gluteus maximus musculature. The gluteus maximus contracts and the pelvis derotates from its anteriorly rotated position. At the same time, the abdominal oblique and transverse abdominal musculature contract. This action tightens the fascia surrounding the erector spinae musculature and takes pressure off of the low back when returning to the upright position. The kinetic motion chain of movement 1 and movement 2 clearly indicate that weak abdominal musculature (abdominal obliques & transverse abdominals), weak gluteus musculature, weak quadricep musculature, tight erector spinae musculature and tight hamstrings are precursors to lower back injury.[6]

Having flexibility of the iliopsoas muscle (hip flexor) is also crucial in the prevention of low back pain. Contracture of the psoas muscle will inhibit the gluteus maximus musculature, thereby limiting derotation of the pelvis when returning to the neutral standing position, which will predispose the low back to injury. The psoas musculature originates from the lumbar transverse processes and inserts onto the lesser trochanter of the femur making this muscle a powerful hip flexor. However, if the psoas musculature is not conditioned properly and shortens from its its normal length, it will cause an individual to have a lordotic posture. A lordotic posture in a standing neutral position consists of an anteriorly rotated pelvis with an increased anterior curve of the lumbar spine. Usually an individual with a lordotic posture will have a protruding abdomen, especially if the abdominal musculature is weak. This lordotic posture will put undue stress on the erector spinae musculature and will lead to a repetitive motion injury to the lower back. An individual with a lordotic posture will complain of a gradual onset of low back pain which will increase with time if not treated appropriately.

An individual without a lordotic posture can also suffer from a repetitive strain to the lower back. Prolonged standing or sitting in a forward flexed position causes a repetitive strain to the erector spinae musculature, posterior longitudinal ligament, supraspinous ligaments, and fascia of the low back. This forward flexed posture also causes the nucleus pulposus to migrate posteriorly which may cause failure of the outer annular fibers of the disc. Mackenzie techniques are based on doing extension exercises to strengthen the erector spinae musculature of the lower back and preventing injury due to a repetitive or constant anterior flexion posture.[3] It is important to strengthen the erector spinae musculature to a certain extent; however, it depends on the individual's low back condition on whether this form of treatment is warranted. Florence Kendall states that:

People who have a lordosis often complain of having a "weak back." The term is used because of the feeling of aching and fatigue in the low back, and because of the inability to lift heavy objects without pain. This type of back is mechanically weak and inefficient because of the faulty alignment, but low back muscles are not weak. The connotation of the word "weak" is that the back muscles are weak and in need of strengthening exercises. On the contrary: the muscles are strong, overdeveloped and short, and back extension exercises are contraindicated.[7]

In this author's opinion, a good strengthening and flexibility program for all of the muscles surrounding the lumbopelvic region with more emphasis on flexibility training for postural muscles and strengthening exercises for phasic muscles should be implemented in a treatment plan for all low back pain patients. One must also be aware of the interrelationship of antagonistic muscles in the lumbopelvic region. A tight postural muscle will make it difficult to strengthen an antagonistic phasic muscle as indicated by Table III.[6]Electromyographic (EMG) data show that a tight erector spinae muscle will be active during its reverse action, trunk flexion, and thus inhibits the action of the agonist and the abdominals. After the erector spinae muscle has been stretched, not only does it relax during trunk flexion, but also a significant, spontaneous facilitation effect is seen in the

abdominal muscles.[8] An individual with weak abdominal musculature and tight erector spinae musculature would want to begin a daily erector spinae stretching routine, not only to stretch the low back musculature, but also to allow for proper strengthening of the abdominal musculature.

Table III: Antagonistic Postural and Phasic Musculature in theLumbopelvic Region

Postural Musculature		Phasic Musculature
Tight psoas	>	Weak gluteus maximus
Tight erector spinae musculature	>	Weak abdominal musculature
Tight tensafascialata/quadratus lumborum	>	Weak gluteus medius musculature

The third condition which can lead to low back pain is a sudden excessive stress on a normal low back, such as a severe blow to the low back while playing a contact sport; auto accident; traumatic fall; or other acute traumas. Trauma-related injuries can cause a severe strain of the musculature surrounding the low back and can also extensively involve the ligaments, fascia, disc and nerve roots in this region. As a result, these injuries will take longer to heal than low back strain/sprain injuries not related to trauma.

The fourth condition which can lead to low back pain is a normal stress on an abnormal low back. An abnormal low back does not have integrity of the functional units and is, therefore, susceptible to low back pain under normal stress. Table IV lists several tumor and tumor-like processes, joint diseases and muscular disorders which decrease the strength of the functional unit and predispose these individuals to low back pain under normal conditions.[9]

Table IV: Abnormal Low Back Conditions

Tumor & Tumor-like Processes	Muscular Disorders	Joint Diseases
Metastatic carcinoma	Muscular dystrophy	Ankylosing spondylitis
Multiple myeloma	(limb-girdle)	Reiter's syndrome
Osteosarcoma	Myasthenia gravis	Tuberculosis arthritis
Ewing's sarcoma		Suppurative arthritis
Hodgkins lymphoma		Osteoarthritis
Osteoid osteoma		Osteoporosis

Editor's note: Part II of "Demistifying the Treatment of Strain/Sprain Injuries of the Lower Back" will appear in the February 22nd issue of *Dynamic Chiropractic.*

References

1. *British Medical Journal* April 26, 1997;314:7089, p. 1225.
2. Fordyce W. *Nursing Homes.* International Publishing Group, 1996, p. 32.
3. Cailliet R. *Low Back Pain Syndrome,* 4th edition. Philadelphia: Davis Company, 1988, p. 22-24, 76-103.
4. Cramer G, Darby S. *Basic and Clinical Anatomy of the Spine, Spinal Cord, and ANS.* Mosby-Year Book Inc., 1995, p. 205-217, 251-271, 355-370.
5. Greenman P. *Principles of Manual Medicine,* 2nd edition. Baltimore: Williams & Wilkins, 1996, p. 146-147, 449-456.
6. Lewit K. Manipulate Therapy in Rehabilitation of the Locomotor System, 2nd edition. Butterworth-Heinemann Ltd., 1991, p. 14-32, 126.
7. Kendall F, McCreary E, Provance P. *Muscle Testing and Function.* Baltimore: Williams & Wilkins, 1993, p. 133-176, 350-354.
8. Janda V. Muscle strength in relation to muscle length, pain and muscle imbalance. In:

Harms-Rindahl K (ed.) *Muscle Strength.* New York: Churchill Livingstone, 1993.
9. Robbins. *Robbins' Pathologic Basis of Disease,* 4th edition. Philadelphia: W.B. Saunders Company, 1989.

JANUARY 1999