

The Critical Role of Core Strength and Balance in Preventing Spinal Injuries

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ABSTRACT

The stability of the body's core is essential for track and field athletes, both to maximise performance and reduce the incidence of injuries. Recent studies of elite athletes show that approximately one quarter of their injuries involve the trunk or thigh, indicating problems with the core stabilisers, both the general stabilisers (like the external obliques, rectus abdominis and the erector spinae) and local stabilisers (like the transverses abdominus, the internal obliques, the multifidi, the pelvic floor muscles, and the diaphragm). Therefore work on balance and core stability should be elements of any training or rehabilitation programme. With the aim of providing background information and general advice for coaches and medical practitioners who work with elite athletes, this article discusses the importance of balance and core stability then outlines the causes, evaluation and treatment of spinal injuries. It concludes by stating that managing and preventing recurrences of back injuries in athletes begins with an understanding of what they do, how they do it, and the cause of injury. The basic principles of prevention are avoidance of extreme positions or stress for long periods, and preventative/maintenance exercises for range of motion, muscle flexibility, strength and power.

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Introduction

Until recently, only a few studies on injuries in elite athletics could be found in the literature. Those that did deal with athletics related injuries tended to be limited by focusing on non-elite athletes, small

populations and specific events. ALONSO et al. (2009) changed this when they began analysing all sports injuries incurred in competition and/or training during the 2007 IAAF World Championships in Athletics in Osaka. The authors found that at least 10% of the participating athletes incurred injuries during the nine days of the championships. More than half of the injuries (56%) were expected to prevent the athlete from training or competing. Eighty percent affected the lower extremity. The thigh accounted for 21.9%, the trunk 4.7% and the hip 1.6%. The most common diagnosis was thigh strain (16%).

JUNGE et al. (2009) analysed the frequency, characteristics, and causes of injuries during the Olympic Games in Beijing in 2008. They reported an incidence of 96.1 injuries per 1000 entered participants. Half of the injuries (49.6%) were expected to prevent the individual from training or competing. The injury rate in athletics was slightly higher (11.3%) than overall. In this case, the trunk represented 13.4% of the total and the thigh accounted for 13.3%, again illustrating the high incidence of injury to the primary core stabilizers.

To obtain maximum performance and to reduce the incidence of injuries, athletes must initiate rapid and forceful activities in an efficient manner. This calls for dynamic stabilisation while energy is generated from ground forces and transmitted up the lower extremities through the trunk and into the upper extremities. The stability of the body's core – defined as the trunk as a whole: the lumbar spine, pelvis, and scapulothoracic region – is essential. Therefore work on balance and core stability should be elements of any training or rehabilitation programme.

In this article our emphasis will be on the spine. After discussing the roles of balance and core stability in enhancing performance and decreasing the chance of injuries – both acute and chronic – we outline the causes, evaluation and treatment of spinal injuries. Our aim is to provide background information and general advice for coaches and medical practitioners who work with elite athletes.

Balance

We tend to think of balance as a static position due to the traditional definition as a set position maintained for a period of time. But in a sports context, balance is more about control of one's centre of mass and body angles to ensure equilibrium. It has been suggested that balance is the single most important component of athletic ability as it underpins all movements whether they are dominated by strength, speed or endurance. Additionally, balance is closely related to neural coordination and agility. Maintaining a state of dynamic equilibrium involves the ocular, vestibular, kinesthetic and auditory systems. Poor balance may lead to poor technical or skill development, which in turn often results in injury.

A relatively simple activity, such as sprinting, when seen from a balance perspective is actually highly complex. At speeds in excess of 11 m/sec the sprinter must alternate balancing on one leg and then the other within periods of less than one tenth of a second. Try losing and regaining your balance in such a timeframe and you will see the difficulty of the required skill. Therefore, balance must be constantly trained as a fundamental component of all movement skills.

Core Stability

The core of the body is the trunk complex, which can be depicted as a cylinder bounded by the abdominals anteriorly, back extensors posteriorly, the quadratus lumborum laterally, the pelvic floor muscle inferiorly and the diaphragm superiorly. However, a critical detail is the concept of general and local muscular stabilisers, the muscle groups requiring a coordinated activation to achieve spinal stabilisation during trunk movement.

The general stabilisers are the larger, more superficial muscles that control movement: the external obliques, rectus abdominis and the erector spinae. The control of movement by the general stabilisers is substantially less

effective without the coordinated activation of the local spinal stabilisers. In general, the local stabilisers are considered to be the transverses abdominus, the internal obliques, the multifidi, the pelvic floor muscles, and the diaphragm. Activation of the general and local stabilisers that is out of sequence will not provide the necessary functional stability.

It should be noted that the biomechanical body posture also has an important influencing role on core stability. Posture and gait must be evaluated both statically and dynamically to identify any deviation or substantial muscle imbalances. As the body is a kinetic chain system, any muscle imbalances will influence both the posture and dynamic movement.

Causes of Spinal Injuries

Athletics training and competition create many chances for significant acute and over-use spinal injuries. Postural stress can cause general and specific aches and pains and, through stress of joint and soft tissue structures, result in dysfunction. Lifting in strength training, throwing weighted implements as well as the spinal torsion and compression caused by pole vaulting, jumping, hurdling, and running can all cause acute or chronic back syndromes. Precipitating factors include:

1) *Sitting Posture*

A good sitting posture maintains the spinal curves normally present in erect standing posture. Poor sitting posture reduces or accentuates the normal curves enough to stress the ligamentous structures and induce pain. A poor sitting posture can produce pain to the back itself without any additional stress or injury. An athlete suffering from low back pain can experience increased pain from sitting or rising from sitting. When an individual sits in a chair for a few minutes, the lumbar spine assumes the fully flexed position, in which the muscles are relaxed and the weight bearing stress is absorbed by the ligamentous structures. An increase in intradiscal pressure occurs as the spine moves toward the flexed position in sitting, and decreases as the spine moves into

extension. Athletes are frequently required to sit for long periods at work or school and often on flights to competition sites (domestic or overseas). One should take frequent breaks from sitting, perform active stretches, and ensure adequate hydration.

2) *Lack of Postural Extension*

Another predisposing factor to low back pain is the loss of lumbar extension. A loss of spinal extension influences the athlete's posture in sitting, standing, walking and running. From faulty postural loading, the spine undergoes adaptive changes.

3) *Frequency of Flexed Position*

The majority of activities that an individual performs occur in the flexed position. Theoretically, this produces stress on the annular wall and causes the fluid nucleus to move posteriorly.

4) *Unexpected and Unguarded Movements*

In athletics unexpected and unguarded movements may cause an acute episode of low back pain. Throwers and jumpers often experience muscular strains or ligamentous sprains due to the explosive nature of their events. In attempts to reduce low back pain episodes, it is necessary to examine and advise each athlete regarding the precipitating factors involved.

5) *Lifting*

Correct lifting and throwing techniques are vital in preventing back injuries. Lumbar intradiscal pressure has been shown to increase with lifting movements from a forward bent position. Maintaining a functional neutral position (an individual's functional range between flexion and extension) and lifting with bent knees aids in symptom-free lifting.

Evaluating Spinal Injuries

Assessment of back pain should begin with a thorough history and examination. Medical practitioners should listen and communicate with the athletes to understand their subjective complaints and comments, and to determine

the area, nature and severity of their symptoms. They should also determine whether the symptoms are constant or intermittent and what positions or movements provoke the pain. Objective evaluation of movement testing to reproduce the symptoms should be performed. A neurological examination should be performed as indicated. The medical practitioner should identify asymmetries and deficits. Communication with the coach will certainly be useful. A comprehensive treatment plan should include exercise prescription to enhance strength deficiencies and inflexibility.

Back pain of mechanical origin can be classified as one of three syndromes:

1) Postural Syndrome

Pain of postural origin is intermittent and appears when soft tissues surrounding the lumbar joints are placed under prolonged stress. Upon evaluation, inspection and lumbar range of motion is normal. Postural assessment generally indicates poor sitting and standing posture. Treatment should correct posture, strengthen muscles if any weakness is found, and increase the flexibility of tight structures.

2) Dysfunction Syndrome

Dysfunction syndrome occurs when adaptive shortening and resultant loss of mobility causes pain before gaining a full range of motion. Adaptive shortening and loss of mobility can result from poor postural mechanics, spondylosis, acute trauma, or disc derangement. Treatment should emphasise lengthening of the shortened tissue and improving range of motion.

3) Derangement

Disturbance of the intervertebral disc mechanism is responsible for the most disabling cause of mechanical low back pain. The actions of the disc have been described and documented by various authorities to explain the relationship of the disc and increased pain upon movements. Minor disc bulging may cause spinal deformity and limitation of certain movements of the spinal column increasing the bulge while others may reduce it. Shifting

the fluid nucleus of the disc may also disturb annular material. A herniated nucleus pulposus may cause nerve root compression, radicular symptoms, and altered neurological findings.

Treatment and Rehabilitation

After the potential stresses and the structures are identified, a plan of treatment may include back education, including a review of proper back mechanics and assessment of any faulty mechanics present while executing the athlete's specific skill; modality intervention; and mobilisation and exercises to achieve pain relief and regain function. A treatment plan should include an individualised self-, coach- or medical practitioner-monitored home programme.

The primary treatment aim is restoration of normal painless joint range by:

- relief of pain and reduction of muscle spasm;
- restoration of normal tissue-fluid exchange, soft tissue extensibility and normal joint relationship and mobility;
- correction of muscle weakness or imbalance;
- restoration of adequate control of movement and stabilisation;
- relief from chronic postural stress;
- functional return for the athlete;
- prevention principles to avoid recurrence;
- restoration of the athlete's confidence.

The priority of goals may differ with each individual. The philosophy of treatment and rehabilitation of specific back injuries may differ depending on the medical practitioner's educational and clinical background and experience, as well as the treatment and rehabilitation techniques that have proven successful for the individual patient.

Self-treatment should emphasise the principles of postural correction, repeated extension or flexion movements, use of lumbar aids and supports, and use of various local treatment modalities such as cryotherapy or heat treatment. Other treatments may include:

- electrical stimulation,
- traction,

- acupressure/acupuncture,
- local injections or oral analgesic/or anti-inflammatory medications,
- joint mobilisation and osteopathic manipulation,
- muscle energy techniques for regaining muscle balance,
- proprioceptive neuromuscular facilitation (PNF) or soft tissue and nerve mobilisation,
- core stabilisation.

Conclusions and Outlook

The lumbar spine has optimal positions in which it functions most efficiently and these positions vary depending on the stresses it must withstand. There is no one best position for all functional tasks and activities, and it will vary from athlete to athlete. A good functional position is generally near the mid-range of all available movement of the lumbar spine and the athlete must learn how to obtain and maintain core stability.

For the athlete to learn to maintain the low back within a functional range, he or she must develop a kinesthetic sense in order to feel and control back movements and positions so that it becomes a habit during all activities. The athlete must also maintain the necessary coordination, strength, flexibility, and endurance to perform well.

Managing and preventing recurrences of back injuries in track and field athletes begins with an understanding of what they do, how they do it, and the cause of injury. The basic principles of prevention are avoidance of extreme positions or stress for long periods, and preventative/maintenance exercises for the range of motion, muscle flexibility, strength and power.

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