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Review Article

Low Back Pain in Athletes with Non-pharmacologic Care and Management

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Abstract: Low back pain affects a large proportion of athletes. The purpose of this study was to perform a comprehensive review of literature regarding prevalence of low back pain, treatment, and rehabilitation with a specific exercise programme. With the information gathered a rehabilitation programme will be proposed with emphasis on specific exercises and progressions that can be used to help guide rehabilitative clinicians in their treatment and rehabilitation of the athlete with low back pain. A search of electronic databases was performed including; Pub Med, Medline, and Google Scholar. Key Words used: Spondylolysis, Lumbar stabilization, core stabilization, low back pain, athletes, exercise, and any combination of these words. Based on the search of electronic databases their does appear to be some efficacy of exercise programme established in the athletes with low back pain. However, at this time does not appear to be superior to other exercise interventions. The most effective prevention strategy seems to be exercise, specifically trunk stretching and strengthening exercises. It is not the intent of this study to create an all-encompassing approach to treating every athlete, but to give some insight into the best strategies and progressions to receive the best outcomes possible. However, further high quality studies, isolating specific primary interventions need to be completed in an attempt to reduce the burden of low back pain in athletes.

Keywords: Low back pain, Spondylolysis, Spondylolisthesis, Exercise.

INTRODUCTION

Low back pain (LBP) is defined as pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without leg pain. Non-specific (common) low back pain is defined as low back pain not attributed to recognizable, known specific pathology (e.g. infection, tumour, osteoporosis, ankylosing spondylitis, fracture, inflammatory process, radicular syndrome or cauda equina syndrome). Low back pain is estimated to occur in 10% to 15% of young athletes [10], but the prevalence may be higher in certain sports. Studies show that low back pain occurs frequently in college football players (27%), artistic gymnasts (50%), and rhythmic gymnasts (86%) [15, 18, 28]. An interesting review found that 80% of low back injuries in athletes occurred during practice, 6% during competition, and 14% during preseason conditioning. [17]

The lumbar spine is a highly vulnerable area for injury in a number of different sports which leads to low back pain in athletes. But an organized diagnostic and therapeutic plan can prevent permanent injury and allow full function and maximum performance.

Epidemiology:

It is important to remember that low back pain is a symptom, not a diagnosis. Most often, it is not associated with an underlying structural abnormality. With conflicting reports, it is not clear whether athletes are at higher risk for low-back pain. Injuries to the low back occur from either an acute traumatic event or from repetitive micro trauma (overuse injury), with overuse injuries being more common. Contact sports such as football or rugby tend to produce acute injuries from high- energy impacts, whereas sports involving repetitive flexion, extension, and torsion, such as gymnastics, figure skating, and dance, result in overuse injuries. According to Granhed H and Morelli B, the lifetime prevalence of low-back pain in wrestlers (59%, nineteen of thirty-two) was significantly higher than that of age-matched controls (31%, 223 of 716)[7]. Sward et al. [29] found a significantly higher rate of low-back symptoms in elite gymnasts (79%, nineteen of twenty-four) than in a control group (38%, six of sixteen).

In comparison with other athletes, gymnasts appear to be among the most likely to report severe low back pain [30]. Hutchinson [14] found that six of seven elite rhythmic gymnasts reported low back pain over a seven-week period. Literature reveals that gymnastics is probably the most commonly mentioned sport. The motions and activities of gymnastics produce tremendous strains on the lumbar spine. Female gymnasts have an incidence of spondylolisis of 11%

[16]. Spondylolisis is a fatigue fracture of the neural arch, and it is felt that the vigorous lumbar motion in hyperextension in gymnastics produces the fatigue fracture. It is known that there is a hereditary predisposition to the stress fracture of the spondylolisis. But the nature of the sports itself plays a tremendous role in a much higher incidence of spondylolisis and a much higher incidence of low back pain in general. Garrick and Requa[6] noted a high incidence of low back pain in female gymnasts and recommended the vigorous trunk strengthening exercises that are used today to prepare gymnasts properly for their sport.

Predisposing Factors for LBP:

It is necessary to understand some factors that are important in pre-disposing the athlete to LBP as well as training and therapeutic techniques to prevent lumbar spine problems in athletes. The poorly conditioned athlete places himself at great risk for low back injury. This situation is often encountered at the beginning of a season when athletes return from periods of inactivity.

The erector spinae and the abdominal muscles stabilize the back during athletic activities. The normal extensor to flexor strength ratio is 1.3 to 1. Foster and Fulton reported this ratio to be substantially reduced in athletes with LBP[5].

Etiology of LBP:

One of the most common etiologies relates to changes in normal training regimens. Sudden increases in the intensity or duration of workouts can prompt the start of LBP in the athletes. Improper techniques while performing athletic activities can lead to injury. Many athletes incorporate weight lifting in their strength training programme. Lifting weight while hyper extending the low back places immense strain on the spine and results in injury. Poor equipment also predisposes the athletes to injury. Athletic footwear can also contribute to low back pain and must not be overlooked.

Other causes of low back pain:

Inflammation, infection, tumours and visceral pathology can present as back pain. 'Red flag' symptoms such as fever, night pain, neurological abnormalities, weight loss etc.

Diagnosis:

A good history and physical examination by a physician will provide the most information leading to an accurate diagnosis of low back pain. Several different diagnostic tests are also helpful to aid in this assessment. X-rays reveal any abnormalities of the vertebral bodies, such as arthritis, fractures and slippage. MRIs best identify degeneration, bulging and herniation of the discs. A stress fracture is best seen with a bone scan.

In diagnosing the exact etiology of the LBP in athletes, age is an important factor. Younger athletes are certainly more likely to have stress fractures and to have congenital predisposition to stress fractures. Diseases that affect growing cartilage (e.g. Scheuermann's disease) are more common in young athletes. In the mature athletes, often the radiological assessment involves distinguishing between age-related, asymptomatic changes and symptomatic recent trauma.

One of the most important diagnoses to make in the athlete with LBP is that of peripheral nerve injury and peripheral nerve entrapment. There is a great variety of peripheral nerve problems including generalized peripheral neuropathy, carpal tunnel syndrome, peroneal nerve injury, femoral neuropathy, and interdigital neuroma. The chief reason for getting an electrmyogram (EMG) and nerve conduction (NC) study of the lower back is to diagnose a peripheral nerve problem.

Fig.1 shows MRI image of lumbar spine which reveals herniation and stenosis. MRI Shows tumors and soft tissues (e.g., herniated discs) much better than CT scan. MRI can demonstrate the extent of herniation, including nerve root impingement, but is reserved for progressive or refractory symptoms. Because MRI can be overly sensitive for disc herniation, clinical correlation is important.

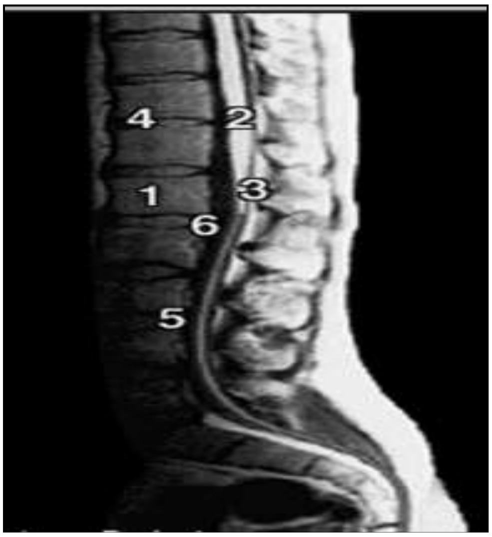


Fig. 1. MRI imaging of 1. Vertebral body 2. Spinal cord 3. Conus medullaris 4. Intervertebral disc 5. Filum terminale (internum) 6. Subarachnoid space (Adopted from Laura Purcell et al. 2009)

Spondylolysis and Spondylolisthesis:

Age is important in the natural history of spondylolysis and spondylolisthesis. Most symptoms of spondylolysis appear in adolescence, but fortunately, the risk of progression after adolescence is low. Isthmic spondylolisthesis develops as a stress fracture. It is believed that there is a hereditary predisposition to developing such a stress fracture, and there is certainly a genetic predisposition for conditions on which the bone of the pars inarticularis is not sufficient to withstand normal stresses.

Imaging:

Imaging of an athlete with low-back pain and suspected spondylolysis begins with a series of plain antero-posterior, lateral, and oblique lumbar radiographs. A coned-down lateral radiograph of the lumbo-sacral junction produces a clearer image of the posterior bone structures than does a standard lateral radiograph.

Fig. 2. X-ray images showing Spondylolisthesis of lumbar spine. (Adopted from Johnson Olubusola Esther (2012)

The most common site for spondylolysis and spondylolisthesis is L5-S1. The slippage of disk in spondylolisthesis results from the lack of support of the posterior elements produced by the stress fracture of the pars.

The diagnosis and therapeutic plan for spondylolisthesis begins with a high degree of diagnostic suspicion in the athlete with low back pain. A combination of an MRI, bone scan, and CT scan can be used to diagnose most significant pathologies in the lumbar spine.

Biomechanics of low back pain:

Because of its lordotic shape, the spine experiences a vectoral force as a vertical axial loading compressive force horizontal to the disc. The centre of gravity of body weight is anterior to the spine. This weight times the distance back to the spine produces a lever-arm effect of the weight of the body. This is resisted by the erector spinae muscles and the lumbodorsal fascia.

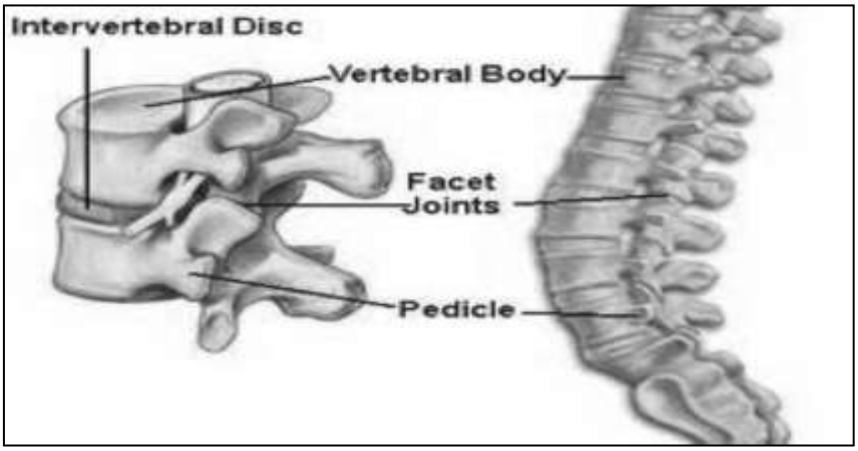


Fig. 3. Lumbar vertebrae with the inter-vertebral disc.(Adopted from Eric M. Kephart, 2012)

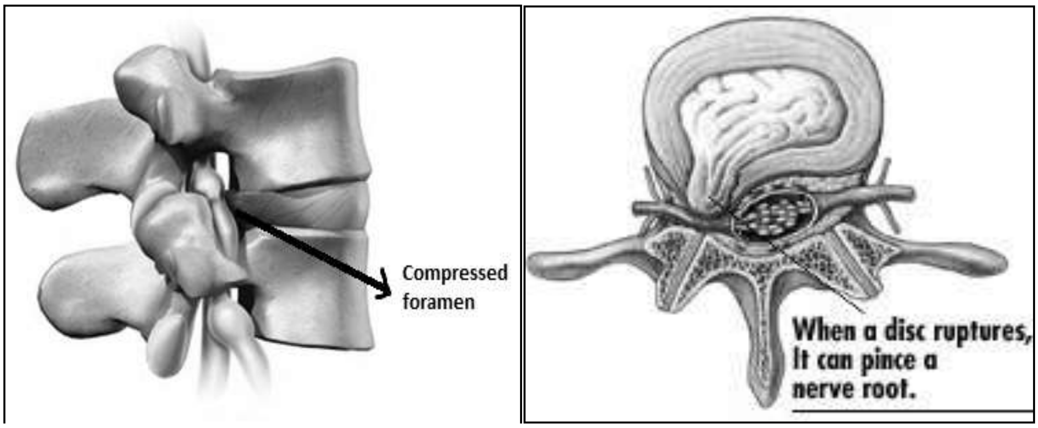
The three basic mechanisms of injury to consider are the following:

1. Compression or weight loading to the spine.
2. Torque or rotation, which may result in various shear forces in a more horizontal plane.
3. Tensile stress produced through excessive motion on the spine.

The compressive type of stress is more common in sports that require high body weight and massive strengthening such as football and weight lifting. Torsional stresses occur in sports involving throwing such as javelin, baseball and golf. Motion sports that put tremendous tensile stresses on the spine include gymnastics, ballet, other dance, pole vault, and high jump.

Biomechanical functioning of the spinal column and its relationship to the biomechanics of nerve tissue involves several basic concepts.

1. Flexion of the lumbar spine increases the size of the intervertebral canal and the intervertebral foramina.[26]
2. Extension decreases the size of the inter-vertebral canal and the inter-vertebral foramina.[27]
3. Flexion increases dural sac and nerve root tension.[27]
4. Extension decreases dural sac and nerve root tension.[27]
5. Front flexion, axial loading, flexion and upright posture increase intradiscal pressure.
6. With flexion, the annulus bulges anterioirly.[31]
7. With extension, the annulus bulges posterioirly.[31]
8. Nuclear shift in an injured disc is poorly documented, but probably corresponds with annular bulge.[26]
9. Rotation and torsion produces annular tears and disc herniation.[21]



Compression of the nerve root in the foramen leads to pain *Tears in the annulus*

Fig. 4. Physiology of Disc Herniation (Adapted from Haldeman, 1990)

Non-pharmacologic Care and Management:

Exercise techniques that promote independent contraction of the transversely oriented abdominal muscles (in co-contraction with multifidus)[25] have been demonstrated to have beneficial effects in relieving pain and disability in patients with chronic low back pain and lowering recurrence rates after an acute pain episode. [11] This study provides some evidence to explain why precise exercise techniques are effective in the relief of LBP.

The athlete should be given an exercise programme that concentrates on trunk strength and trunk mobility, balance, coordination and aerobic conditioning. The basis of the trunk stability programme is to have the athlete find a natural, pain-free position, lying supine on the ground with the knees flexed and feet on the ground.

The athlete who learns to control muscles by tight, rigid contraction and to control the spine with the lumbodorsal fascia, gluteus maximus, oblique abdominals, and latissimus dorsi can protect the lumbar spine while improving athletic performance.

The key to safe strengthening is the ability to maintain the spine in a safe, neutral position during the strengthening exercises. Dead bug exercises are done supine with the knees flexed and feet on the floor.

Specific exercises treatment for LBP

Flexion Exercises:

1. **Pelvic tilt.** Lie on the back with knees bent, feet flat on floor. Flatten the small of the back against the floor, without pushing down with the legs. Hold for 5 to 10 seconds.

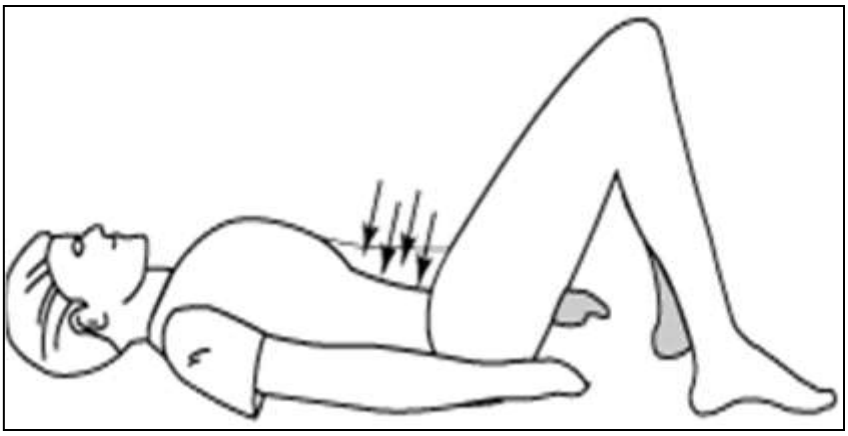


Fig. 7. Pelvic tilt: Exercise for the core spinal stabilizer transversus abdominus muscle Adopted from Johnson Olubusola Esther (2012)

2. **Single Knee to chest.**
   Lie on the back with knees bent and feet flat on the floor. Slowly pull the right knee toward your shoulder and hold 5 to 10 seconds. Lower the knee and repeat with the other knee.

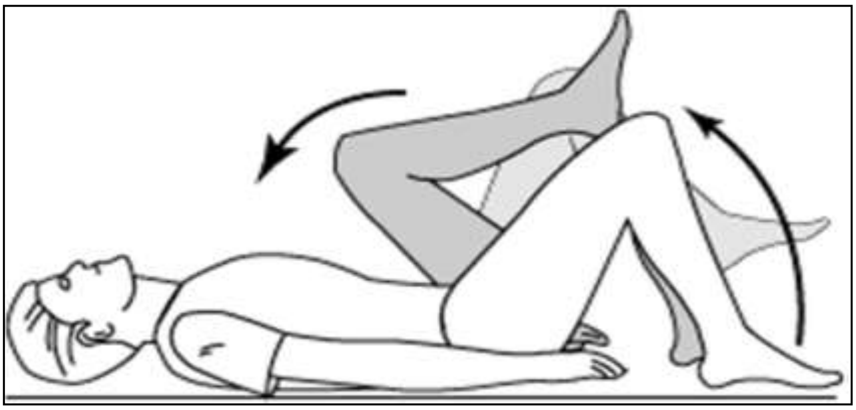


Fig. 8. Single Knee to chest Adopted from Johnson Olubusola Esther (2012)

3. **Double knee to chest:** Begin as in the previous exercise. After pulling right knee to chest, pull left knee to chest with alternate arm swing and hold both knees for 5 to 10 seconds. Slowly lower one leg at a time.

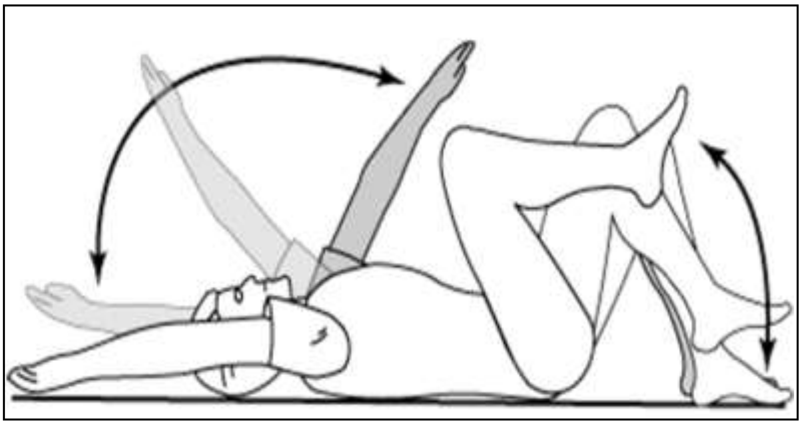


Fig. 9. Double knee to chest with arm swing. Adopted from Johnson Olubusola Esther (2012)

4. **Partial sit-up:** Do the pelvic tilt (exercise 1) and, while holding this position, slowly curl the head and shoulders off the floor. Hold briefly. Return slowly to the starting position.

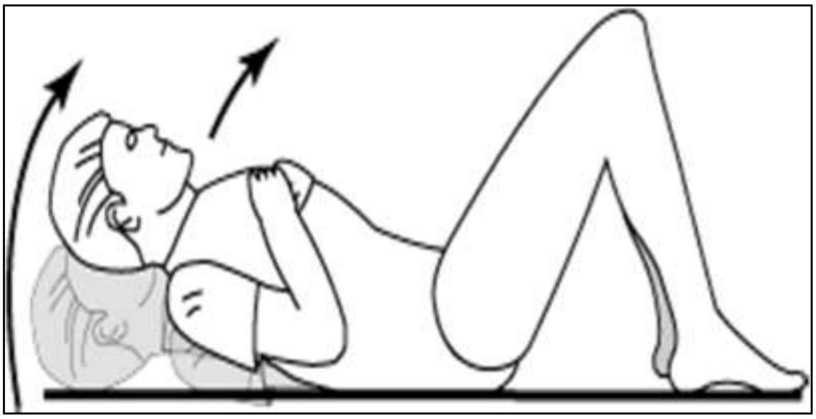


Fig. 10. Partial sit-up Adopted from Johnson Olubusola Esther (2012)

5. **Hamstring stretch:** Start in long sitting with toes directed toward the ceiling and knees fully extended. Slowly lower the trunk forward over the legs, keeping knees extended, arms outstretched over the legs, and eyes focus ahead.

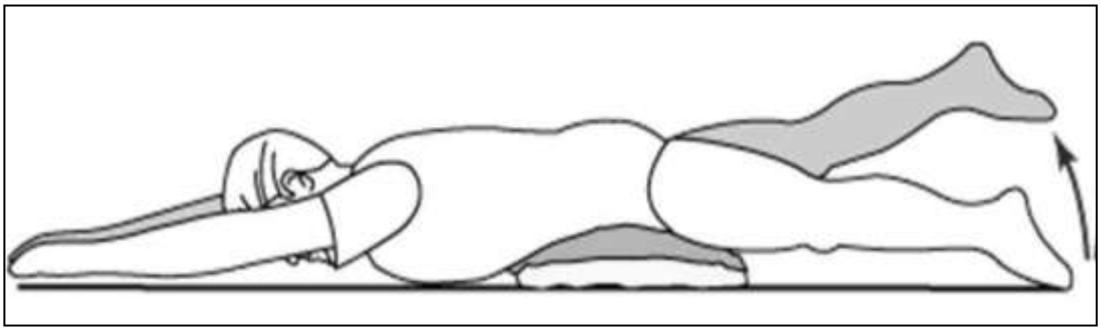


Fig. 11. Hamstring stretch Adopted from Johnson Olubusola Esther (2012)

6. **Ball hyperextension:** Lie in pronation on a Swiss ball and extend the trunk with the hands on the head. Slowly roll the trunk on the ball forward and backward.

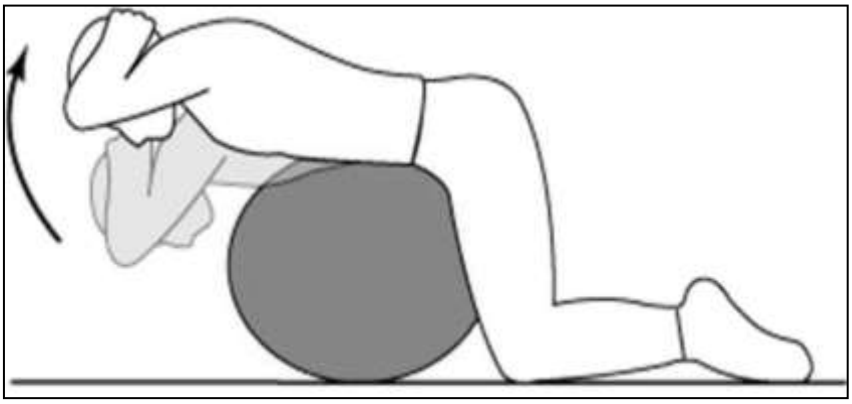


Fig. 12. Hyperextension of the trunk with Swiss ball Adopted from Johnson Olubusola Esther (2012)

Three-Cycle System for Treatment of Non-radicular Low-Back Pain in Athletes as Described by Hopkins and White [23]

Cycle IA: Immediate return to full activity; games and practices are not missed

Cycle IB: Games and body contact are prohibited, practice is reduced by 75% (duration, intensity, frequency), non-steroidal anti-inflammatory drugs, physical therapy optional, back to competition in four days.

Cycle IC: Games and body contact are prohibited; practice is reduced by 50%, non-steroidal anti-inflammatory drugs, physical therapy optional, advance to Cycle B in four days.

Cycle II: Games and practice are prohibited, non-steroidal anti-inflammatory drugs, two days of bed rest followed by physical therapy for abdominal strengthening for five days, advance to Cycle I.

Cycle III: Games and practice are prohibited, non-steroidal anti-inflammatory drugs, two days of bed rest followed by physical therapy for abdominal and Para-spinal strengthening, stationary bicycling, walking, or swimming.

Conclusions:

The nature of the sports played, and the particular forces and motions required of its participants, can enlighten about more serious injuries that may be sustained. Young athletes who present with low back pain are more likely to have structural injuries and therefore should be investigated fully. Injuries can be prevented by recognizing and addressing risk factors. The athlete should be given an exercise programme that concentrates on trunk strength and trunk mobility, balance, coordination and aerobic conditioning. Exercises for lower back pain should incorporate a precisely controlled contraction of the transverses abdominis independently of the global muscles. Back strengthening and stretching programmes are very important for the prevention, treatment and rehabilitation of low back pain. These exercises should not only be utilized following injury but must be incorporated into the athlete's normal training schedule in order to prevent low back pain.

Return to sport should be a gradual process once the pain has resolved and the athlete has regained full strength.

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Conflict of interests: None

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