Canadian Open Orthopaedics and Traumatology Journal
Vol. 4, No. 3, December 2017, pp. 1-11
Available online at http://crpub.com/Journals.php

Open Access

Review article

CAUSES OF LOW-BACK PAIN IN SPORT. LITERATURE REVIEW.

Giuseppe Rinonapoli(1), Paola Comminiello(2), Marta Graziani(2), Flavia Marrani(2), Michele Bisaccia(1), , Francesco Manfreda(2), Giuseppe Rollo(3), Luigi Meccariello(3)

1) Orthopaedics and Traumatology Unit, Department of Surgical and Biomedical Science, S.M. Misericordia Hospital, University of Perugia, Sant'Andrea delle Fratte, Perugia, Italy.

2) School of Physical Medicine and Rehabilitation, University of Sapienza, St Andrea Hospital, Rome, Italy.

3) Department of Orthopedics and Traumatology, Vito Fazzi Hospital, Lecce, Italy.

Corresponding author:

Luigi Meccariello, MD.

Department of Orthopedics and Traumatology, Vito Fazzi Hospital, Via Ada Cudazzo, Block: A- Floor:V, Lecce, Italy.

Phone: +393299419574. Fax:+390823713864.

E-mail: drlordmec@gmail.com

ORCID ID: 0000-0002-3669-189X.

ABSTRACT

The lumbar spine, or low back, is a remarkably well-engineered structure of interconnecting bones, joints, nerves, ligaments, and muscles all working together to provide support, strength, and flexibility. However, this complex structure also leaves the low back susceptible to injury and pain.

To help understand this complicated topic, this article presents a model for understanding symptoms, physical findings, imaging studies and injection techniques to come to a precise diagnosis. The review provide to evidence that intensive multidisciplinary biopsychosocial rehabilitation with functional restoration reduces pain and improves function in patients with chronic low back pain. Less intensive interventions did not show improvements in clinically relevant outcomes.

Key Words: Low Back; Pain; Athletes; Review; Outcomes; Weight.

THE LOW BACK PAIN

Low back pain is one of the most common diseases in those who practice sports, either professionals or amateurs. Several studies have shown that a poor sport activity, as well as excess, can be harmful to the lumbar spine health(Fett et al. 2017).In professional athletes, the main purpose of training is to realize "performance", often by means of extreme activity sessions without sufficient recovery pauses, subjecting the lumbar spine to high pressures and wear of its components. This explains why a high percentage of athletes, even the younger, can suffer from backpain. Low back pain of amateur athletes depends, in most cases, on poor or incorrect athletic and /or technical preparation.

Athletes have a different risk of lumbar injuries on the basis of the type of activity they do. There is no big difference between the sexes and the most affected age is between 30 and 40 years (Trainor et al. 2017).

The present study aims to examine low back pain caused by or favoured by sports activities.

There are some sports that, because of their high lumbar overload, are at greater risk. We are speaking of weightlifting, boating, boxing, fighting, martial arts, but almost all the sports are at risk of back pain. Excessive workload can lead to degenerative changes in the spine; the compressive forces exerted at the lumbar level increase in activities involving repetitive flexion of the back. Repetitive load can therefore lead to a microscopic damage that, over time, can cause anatomical and functional damage of greater severity. (Rozan et al. 2015)

Except for particular cases of pre-existing osteoarticular diseases, the main causes of pain due to physical activity are represented by:

- **insufficient general and specific heating.** A good heating increase the muscle temperature and improve the blood flow, metabolism and elasticity at the same time. There is also an increase of the trophism of avascular tissues (articular cartilage and intervertebral disks) with an excellentpropagations of nutrients. It also reduces the viscosity of the synovial fluid and, consequently, improves the functionality and sliding of the articularsurfaces;

-**residual toxins and muscle congestion** resulting from inadequate performance of "muscle relaxation" exercises or poor recovery between exercise. At the end of each workout, the exercises that imitate the technical gesture that caused overload on the spine must be limited because, although they are useful for the

musculoskeletal and cardiovascular system, prolonge the compression on the lumbar disks (e.g.:muscular relaxation after boating training, light running after long distance run, etc.);

- **imbalance of strength and elasticity of the musculature,** that are responsible for the physiological alignment of the spine, pelvis and femur. These muscles must be strengthened and, at the same time, maintained elastic with appropriate stretching exercises;

-**inadequate muscular stretching exercises and joint mobility after each workout.** Stretching stretches and decontractsmuscles maintaining them extensible, while mobility exercises lead the joint to an optimal state of efficiency;

-**continuous compression of the spine during and after training.** Intense physical activity and fixed postures (studying, watching television, driving, etc.) continuously overload the intervertebral disks, thereby compromising the nutritional replacement and dehydration thinning (Trainor et al. 2004). The nutrition of disks does not occur through the blood capillaries but through a "pump" (perfusion) action that allows fluid to inlet and outlet. Thanks to the unloading exercises performed at the end of the training session, a rapid rehydration of the disks and an inflow of nutrients is achieved.

The main etiologic cause of sports injuries is the functional overload of the anatomical structures. Currently, “functional overload” is meant for repetitionof sport gestures or specific movements for too long or high intensity time such as to cause mechano-traumatic action on the affected structures. This mechanism can be facilitated by axial defects or traumas(Trompeter et al.2017).The elastic responses provided by the plastic materials of the athletics tracks and sports fields (tennis, basketball, volleyball, etc.) can favour several types of injuries.

The cumulative traumatic action of external and internal forces causes an alteration of the cellular component on tissues, resulting in a defensive local repair process called inflammation. There is no doubt that in functional overload injuries, the mechanical factor plays a fundamental role, but individual anatomy, neuro-humoral and metabolic component play a crucial role on their onset and evolution.

Another cause of lumbar pain in the athlete may be spondylolysis. If the lysis is bilateral, the vertebra is free to slip past the underlying one, causing a spondylolisthesis, that can cause a sciatalgia, through a traction on the nerve root(Cassidi et al.2005).Most authors agree that lysis mainly occurs in children who practice sports because, in a bone not completely formed and more fragile than in adults, a stress fracture of the isthmus can cause the lysis (Warner et al. 2017). In athletes, spondylosis is more frequent in those who practice activities in which the lumbar segment is frequently submitted tohyperextension, such as gymnastics, volley-ball, polo and soccer. Pain is the most common symptom: it can be of a mechanical (structural) or compressive nature (nervous pressure). Many sports result in increased lumbar pressure; over time these repeated stresses may affect the intervertebral disc. The disk herniationoccurs when the pressure on the outer fibers is high and tears them, with the disc coming out. If the tear occurs near the spinal canal, the disk may crawl and leak into the canal by exerting improper pressure on the spinal cord and nerve roots. Nerve-compression caused by an

herniation can lead to a rigidity, localized or irradiated pain that involves the back of the leg from the gluteus to the knee (lumbar sciatalgia), alteration of the reflexes and tingles. Initial non-surgical treatment aims to reduce inflammation and strengthen damaged tissues. Surgical treatment is required in patients with persistent or progressive neurological symptoms. However, in most cases, the return to sports activity comes after non-surgical treatment (Massel et al. 2017).

In some studies carried out on track and field athletes, mechanical low back pain had a high incidence rate of 47% compared to other etiologies, with a probability of 48%of recurrence due to other causes and a incidence of injury of 25% (Malliaropouloset al. 2017).

In younger athletes, low back pain can be caused by growth problems such as scoliosis or Scheuermann's disease: these problems can have a high impact on the athlete's performance

Although the impact, due to the contact of the foot with the ground, is an event that is continually produced in everyday life, it is not yet sufficiently studied and understood, especially in its implications for possible changes in the properties of joint tissues that are dynamically involved in it and the repercussions on the spine. The fundamental mechanisms that control the generation and attenuation of the impulse impact in the foot-to-head transmission phase have been studied for athletes but are of utility to all.

Many of the dynamical phenomena of an impulsive nature, which manifest in everyday life, are, in fact, self-produced by motor activities associated with various forms of walking, work sports and recreational activities. These particular pulses are generated by sudden contact with a rigid surface (soil) of a moving body part (generally the foot).The mechanism of self-generating impact, the repetition of impulses and the consequences of the phenomenon on the quality of life of the people, stimulated the researchers to deepen the study of this fundamental dynamic situation associated with individual bodily activity. Frequent and repeated impulsive loads, though not very intense, are considered among the causes responsible for stiffening of the trabecular bone, cartilage damage, and in general alterations in the biomechanical properties of the joints .

Inrunning, the foot impact is effectively attenuated by the ankle joint system. Energy is transmitted to the bones of the lower limb that behave like a "rigid" system. The latter creates a type of impulse that activates compensating defense mechanisms that reduce the aggressiveness of the phenomenon but, if constantly activated, cause tissue degeneration, resulting in severe mechanical damage to the cartilage. In addition, a portion of the energy transmitted at higher frequencies, will reach the spine. The short shots made during training produce dynamic load conditions which, at the lumbar spine level, are configured as compressive stresses, flexo-extensible moments and antero-posterior (sliding) actions.

Even shots, jumps, flexions and hyperextensions produce the same categories of stresses. The spine is the preferred path of force pulse transmission that can reduce the highest frequencies. However, disks have a very limited absorption-dissipation capacity due to their modest mass: in fact, excessive energy transfer at high frequencies (hard impact) will cause overload at lumbar disk levels.

The rigidity of the sole and soil complex increases the acceleration transmitted to the lower limbs: running with shoes with heels on cement surfaces rather than with soft soles on the lawn, creates the presuppositions for the development of overloading diseases of the lower limb. Repeat shocks on stiff surfaces have traumatic consequences on the spine, as they accelerate the expulsion of liquids from the vertebral disks and reduce the elasticity of all the spine.

People who practice aerobic exercise perform typical movements (jumping, moving, stepping, etc.) that can, over time, promote the onset of back pain (neck pain and dorsal and neck pain, dorsal pain, low back pain and lombosciatalgia). Painful symptomatology can represent both the effect of an overload on undamaged anatomical structures and the exacerbation of pre-existing symptoms in a people already suffering from vertebral (scoliosis, lordosis, kyfosis discopathy, osteoarthritis) or muscle-tendon disorders. The most commoninjuries in aerobic non-agonistic gymnastics are therefore those of the spine, especially of the cervical and lumbar spine; they are determined by the pressure to which intervertebral discs are subjected during physical activity. To achieve high levels of performance, training programs are becoming more and more intense, both in the amount and intensity of workloads. It is above all the repeated administration of the loads during training, rather than the stimulus induced by the competition, which favors the onset of overloading chronic diseases.

Some authors reported a high correlation between lumbar hyperflexion movements and low back pain incidence in a group of young boating athletes: this suggests that mechanical stress on non-contractile tissues is sufficient to stimulate muscle-skeletal system pain receptors at the lumbar level. (Trompeter et al. 2017)

In the cyclist, the forced flexion position of the spine, the constant activation of the core muscle resulting in extension deficiency, characteristic of bicycle posture, often accompanied by inappropriate ratios, leads to stress intensities of duration greater than normal. This is associated with all the traumas caused by continuous vibrations andkickbacks on the saddle. The handlebar height plays a crucial role because, if excessively low, results in a greater lumbar-sacral flexion angle during sporting activity (Streisfeld et al. 2016).If all these strains exceed the resistance of the defense mechanisms, chronic (caused by repeated microtraums, with cumulative adverse effects) or acute (due to violent stresses) lesions may occur. (Martinelli, 2000)

In tennis, the spin rotation work is mostly done. "Extension and rotation" movements during the serve and "flexion and rotation" in the reverse submit intervertebral discs to high and asymmetric pressures, causing early degeneration. This is accompanied by rapid movements, abrupt stoppages and continuous trunkrotations. Serve and smash gestures cause an increase of the lumbar lordosis, especially in individuals with rigid shoulders.

Among other sports, weightlifting may result in a traumatic (even if of a modest entity) action that, if repeated over time, can lead to serious degenerative pathology and may lead to serious form of low back pain.(Mansoorehossadat et al. 2016)

In the inclination of the trunk, the load is transmitted axially; when a force "P" is applied through the vertebral endplate, it crushes and expands, the nucleus pulposus flattens, its internal pressure undergoes a considerable

increase which is transmitted laterally towards the outer ring fibers,inducing the increase of its tension; in this way, the vertical load is transformed into lateral compression thanks to the core acting as a pressure distributor. During the flexion of the trunk, however, the upper vertebra slides forward, tilting towards the more loaded side, inducing the decrease of the anterior intervertebral space. During static stresses on a slightly oblique vertebrae, the force "P" breaksdowninto a "N" force, that firmly presses the upper vertebra to the lower one and an "E" force that tends to push the nucleus pulposus back against the anulus fibrosus, causing an increase of the tension in its back, creating a tractionon the posterior fibers of the intervertebral disk (fig.1).

Feretti et al (1996) demonstrated that the high compressive strength of the disk, if repeated several times, causes small cracks and cavities in the fibrous ring, through which it can filter the nuclear material (Feretti, 1996)(fig. 2 and 3)

For proper lifting, one should approach the weight as much as possible, bend his legs and, while keeping the bust extended and the more perpendicular to the ground, grasp the weight while keeping it adherent to the body, and bring it up using the force of the lower limbs that extend. During the movement, the feet must be well grounded, avoiding twisting of the trunk. (Aeberg et al. 2002)(Fig.4).

A cause of low back pain in older athletes, especially amateur or master, can be consequent to an incorrect posture because of a hip pain. The hip pain, caused by a trochanter bursitis, a pubalgia, a hip osteoarthritis or a painful hip prosthesis (Fortina et al, 2009;Ferrata et al, 2011), can cause an alteration of the gait rhythm or induce a back muscle overload.

The main goals of therapeutic treatment of the forms of back pain can be resumed in the following points:

- Attenuation of pain
- Reduction of muscle contracture
- Recovery of district movement by restoring the correct mechanics and muscular function
- Teaching the patient the rules to prevent recurrence and chronicization
- Return to normal daily and sports activities

CONCLUSIONS

In conclusion, the continuous repetition of sports gestures can cause dysfunctions that, over time, lead to low back pain. Rehabilitation should follow some precise guidelines: stretching shortened (excessively contracted)muscles, strengthening physiologically hypotonic ones, controlling body weight, mobilizing stiffed joints, paying attention to maintaining proper posture, choosing the most suitable surfaces for sports practice (avoiding, whenever possible, the hardest ones, preferring the natural ones). Once one has learned and performed the exercises he chooses, shouldregularly practice them at home and keep a constant attention to his own behavior according to the indications received.

Rehabilitation begins at the end of the behavioral education phase, which must be not only theoretical but theoretical/practical, give information about the risk of spine, teach antalgic postures and the more appropriate compensatory movement strategies: the subject re-plan his life, corrects incongruous postures, harmful movements, incorrect actions.The athlete needs to learn the correct positions to keep in sports life avoid to think only to obtain the best performance, correcting any "vices" that could increase the load on the spine. The intervention protocol is complex also in consideration of multiple factors such as age, gender, anthropometric characteristics, constitutional, metabolic, psychosocial, behavioral, motivational, emotional and specific sports factors.It is therefore appropriate, both for prevention and for the overall treatment of back pain in the athlete, adapting the program to the needs of the single subject, considered in his psychophysical globality and inserted into his social and sports context, in close collaboration with professional figures who work in the field of therapeutic, scholastic and sports. Training should be as functional as possible to improve the overall movement, not the individual muscle. The space and time to devote to rehabilitation should then be the greater the more the sport practiced is considered at risk for lumbar spine, especially if the athlete is very young.

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Figures

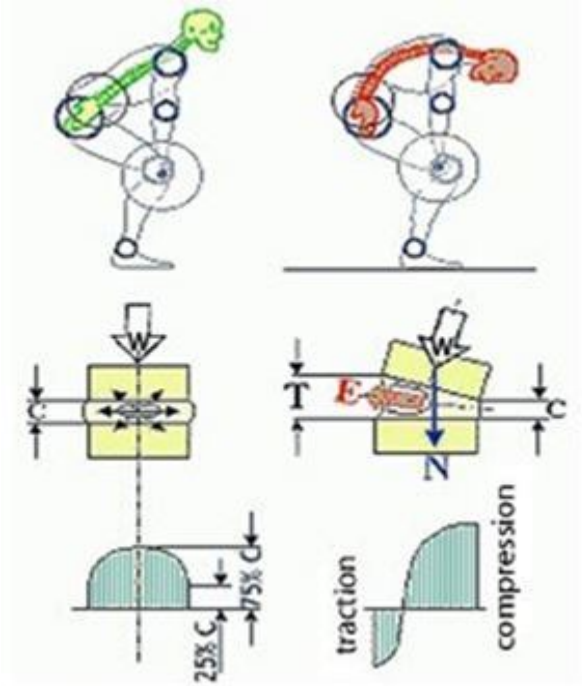

Fig .1 : Effect of inclination and flexion movements on the vertebral elements

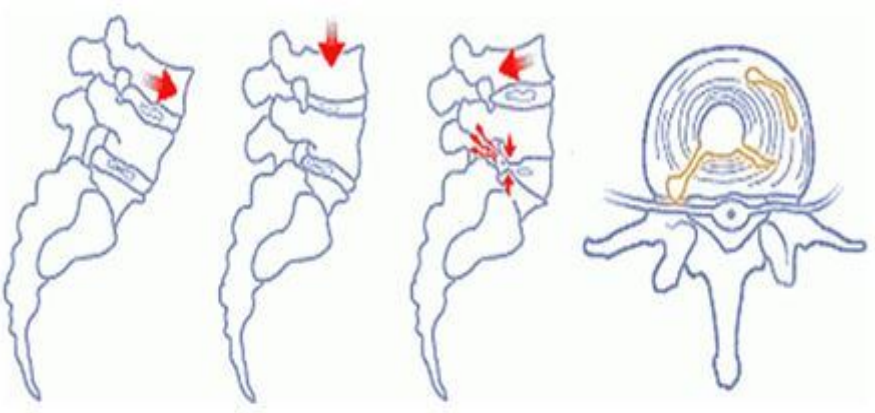

Fig.2: excessive and prolonged overload can result in micro-lacerations at the level of the intervertebral disk with the release of the nuclear substance

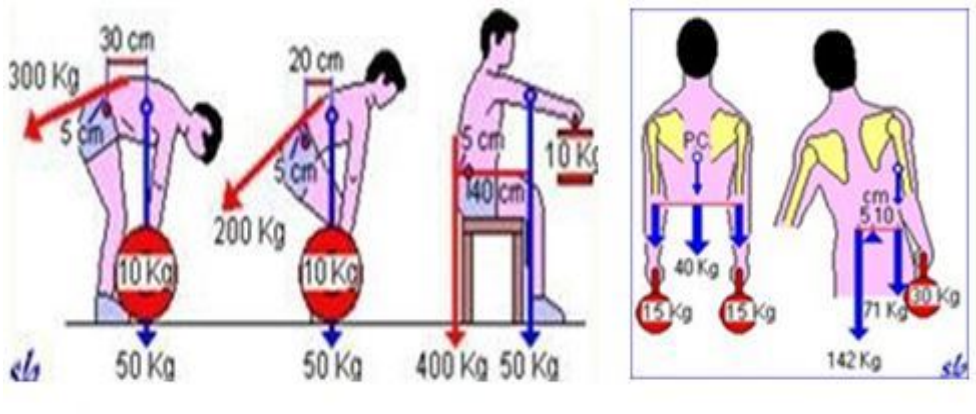

Fig.3: Pressures of the lumbar vertebrae in various positions of displacement of loads

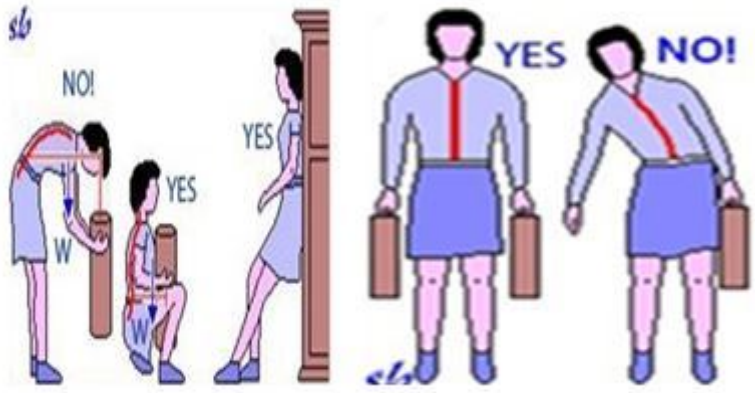

Fig .4: Correct modalities to lift or move a weight and to carry a suitcase