APPROACH TO LOWER BACK PAIN IN THE ELITE ATHLETE

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Lower back pain (LBP) is a common medical condition affecting at least once in the life of sedentary population (85-90%)[1] and elite athletes (46-65%)[2], of all ages and genders. It affects physical performance and the overall well-being. It is recognized that sports participation influences health in a positive way but there is no optimal dose-effect relationship. The correlation between activity level and LBP follows a U-shaped curve: too little or too much activity is potentially harmful to the spinal health[3,4,5]. It is possible that elite athletes are exposed to a higher risk of LBP3[3,5]. They spend a great amount of time training and competing, both of which expose to a great deal of mechanical strain and a high level of stress on the musculoskeletal (MSK) system. Everyone responds differently to the load depending on various intrinsic factors like previous injuries, age, fitness level, psychological condition, etc[3,6]. The amount of strain on the back depends on the duration, intensity and frequency of training, the sports discipline, the level of competition and the training periods during the year[3]. The youth athletes are at higher risk of developing LBP due to the skeletal immaturity and growth spur periods, which are natural processes within human life. LBP in elite athletes can stem from a variety of factors, ranging from biomechanical abnormalities and overuse injuries to muscular imbalances and structural pathologies.

The demanding nature of their sport discipline and the extensive physical stress make it crucial for the sport physician to develop a comprehensive approach to managing and preventing LBP in athletes. It is essential to conduct a thorough assessment to identify the specific etiology and contributing factors unique to each athlete when dealing with LBP.

ANATOMY

The spinal structure can be seen as a triple joint system, comprising two facet joints at the posterior aspect and an intervertebral disc at the anterior aspect. This intricate arrangement allows for a broad range of motion and facilitates the transmission of forces from the lower extremities to the upper extremities. When the spine is flexed forward, it exerts greater stress on the intervertebral disc, whereas extension places more stress on the facet joints. Additionally, the combination of extension and rotation intensifies this stress, potentially leading to stress fractures (Figure 1). To further stabilize the spine, multiple ligaments are present (Figure 2). These include the anterior and posterior longitudinal ligaments, which run along the front and back of the vertebral body, attaching to the ligamentous annulus of the intervertebral disc[7,8,9].

At the posterior aspect, stability is maintained by the interspinous and supraspinatus ligament, flavum ligaments, anterior and posterior longitudinal ligaments, which prevent one vertebra from slipping forward on the caudal vertebrae, along with the bony protrusions of the facet joints. The facet joints play a pivotal role in maintaining stability, with the inferior facet of one vertebra engaging the superior articular process of the caudal facet. In cases of spondylolysis overuse fractures, bony stability may be compromised, but intact ligaments often compensate effectively. The bony arch anterior to the pars is known as the pedicle, connecting to the adjacent vertebrae. Posteriorly, the pars expand into the

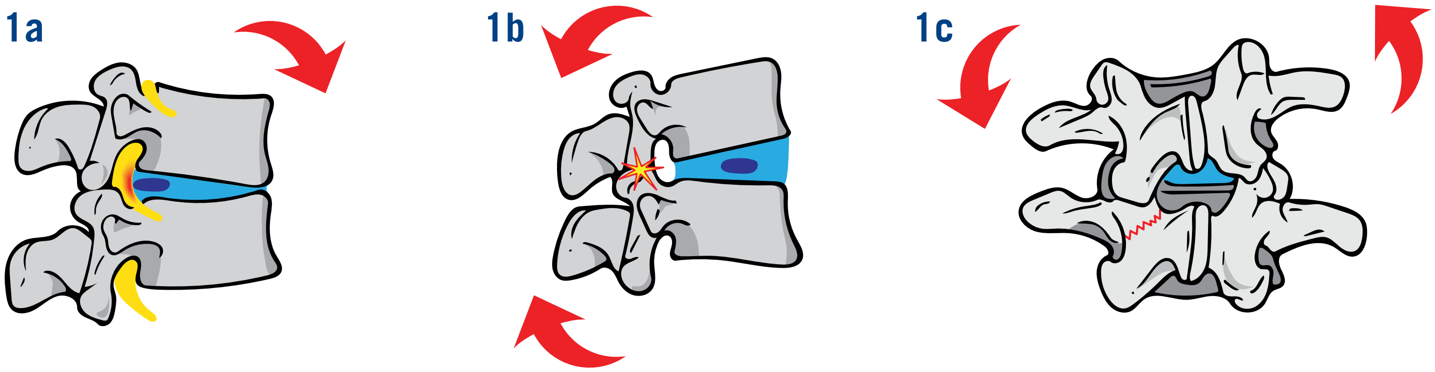

Figure 1: (a) Forward flexion; (b) extension; (c) extension-rotation.

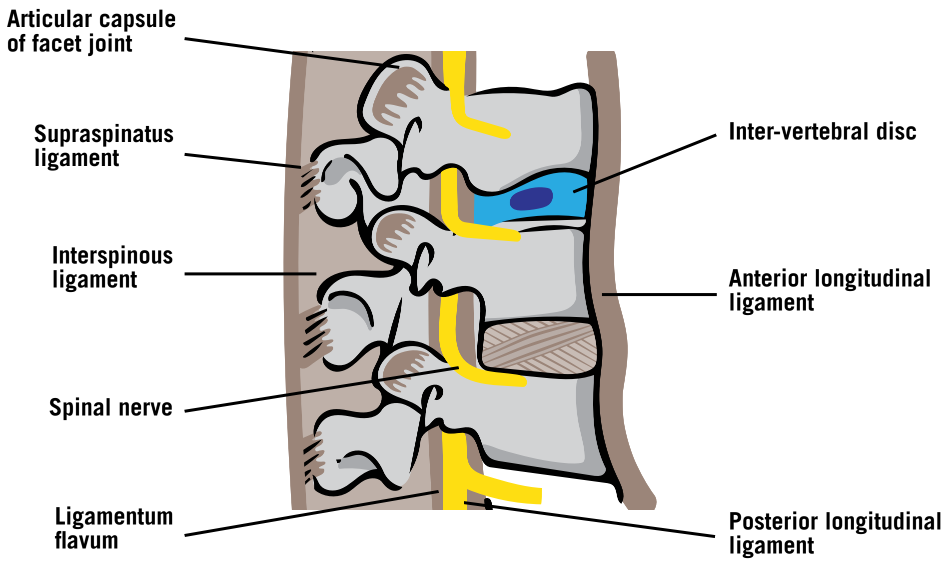

Figure 2: Visualization of vertebral ligaments.

lamina, and in some instances, fractures may extend into the pedicle or lamina[10].

The pars also form the posterior roof of the neural foramina, through which exiting nerve roots pass. While uncommon, spondylolysis can occasionally manifest clinical signs of irritation of the exiting nerve root[11].

EPIDEMIOLOGY

Athletics "track & field" encompasses diverse disciplines with specific physical, technical and psychological demands that differ according to the nature of discipline and define the profile of injuries[12].

The LBP is not the most common injury in track and field comparing with other lesions but when is present the impact could be important. Fedderman- Demont et al, described a 5.9% of time loss injuries located on trunk during international competitions. The group with highest prevalence were described for youth athletes 13.8%, jumps 13.5%, race walks 14,3% and throwers 13,6% and long distance with 4.2%[12]. However, during a season 96% of injuries are overuse or non-traumatic and 73% is produced during training[13].

The frequency of LBP was described by Jacobson et al[13] for 11% for adults and 10% for youth athletes with mild variation comparing by discipline. Rebella described a frequency of 16,7% of LBP in pole vault, where one third of the cases were spondylolysis (representing 5,6% of all injuries.) and the lumbar strains represent 9% of cases[14]. The sacral stress fracture even rare was described in long distance runner and the suspicious should be considered[15].

The prevalence of symptomatic disc degeneration in elite athletes is higher than in nonathletes (75% vs 31%)[16]. For the adult, discogenic followed by muscle-ligament etiology is a frequent medical complaint[17].

For youth athlete, the bone is a common structure affected and Spondylolysis the most frequent diagnosis, with worse burden[18]. For that, the age and level of competition must be considered when dealing with athletes complaining of LBP.

CLINICAL APPROACH

Accurate diagnosis is the cornerstone of effective management. The diagnosis process for LBP in elite track and field athletes involves a combination of clinical evaluation, imaging techniques and specialized tests. The clinical evaluation includes a detailed medical history, physical examination, and assessment of movement patterns and muscle imbalances. Imaging techniques such as X-rays, magnetic resonance imaging (MRI), and computed tomography (CT) scans can provide valuable insights into the structural integrity of the spine and surrounding tissues. Specialized tests, such as functional movement assessments, help identify any limitations or dysfunctions that may contribute to LBP. The combination of contextual risk factors of the athlete will determine levels of pain experienced, disability behaviors and coping strategies as well as the probability of recurrence and chronicity[19].

History Taking is the first and most important step on clinical approach. Inquiries about any red flag symptoms, such as trauma, fever, unexplained weight loss, cancer history, incontinence, or severe neurological deficits helps identify the ones who might require urgent evaluation[20].

Not only the MSK system is the origin of LBP in athletes, other conditions such as: chronic inflammatory intestinal disease, subacute or chronic appendicitis, menstrual disorders (in female), urinary symptoms, or tumors may have LBP symptoms. For that reason, a clear evolution of symptoms, exacerbation pain or sweating overnight, associated gastrointestinal (GI) or gastro-urinary (GU) symptoms and loss of weight are red flags that needs complementary additional investigations[21].

The analysis of training and competition calendar, biomechanics characteristics for the athlete and discipline are main topic in this approach. Information about athlete's medical history, including any previous injuries, surgeries, or previous episodes of LBP, together with details about any performed radiographic investigations, received treatment and medication administration should be noted. Details about the onset, duration, and characteristics of the pain are essential to understand present episode[5]. For the youth athletes, certain questions about puberty and growth pattern must be included. Some special attention during a period of peak high velocity must be taken in consideration by health practitioners and coaches. Inquiries about the sport discipline, training loads and approaching completions are mandatory as they provide crucial information when dealing with athletes and the nature of injuries in track and field[22].

The Physical examination has not been standardized, each physician has its own approach which may include, but not limited to, following aspects: visual inspection of the patient posture in different positions; evaluation of spine movements with their limitations or compensatory strategies; palpation of different bony landmarks and muscular groups; assessment of functional movements and sport specific activities; pain provocation movements- identified by athlete; strength assessment of the lower limbs and core muscles; tests for neurologic deficits with presence of radicular pain or signs of nerve compression[21,23,24].

Following clinical routine can be used, with adaptation to individual conditions, when assessing athletes complaining about LBP[25]:

1. Observation of active movement patterns (flexion, extension, side bending, combined movements,) in sitting, lying or standing
2. Passive movements with overpressure at the end of active movements to assess muscle length of psoas, hamstrings, gluteal and hip quadrant assessment
3. Palpation (Figure 3) bony landmarks (spinous processes, facet joints, sacroiliac joints, iliac crest) and soft tissue structures (iliolumbar ligament, paraspinal muscles, quadratus lumborum, gluteal muscles).
4. Assessment of strength for lower limbs and core muscles during squats (double and single leg), lunges, Sorensen test
5. Special tests (Figure 4): Stork test a) – for SIJ disorder suspicion; One-Legged Hyperextension Test b) – for Spondylolysis suspicion
6. Neurological examination: Slump test (Figure 5a); Single leg raise test (Figure 5b).

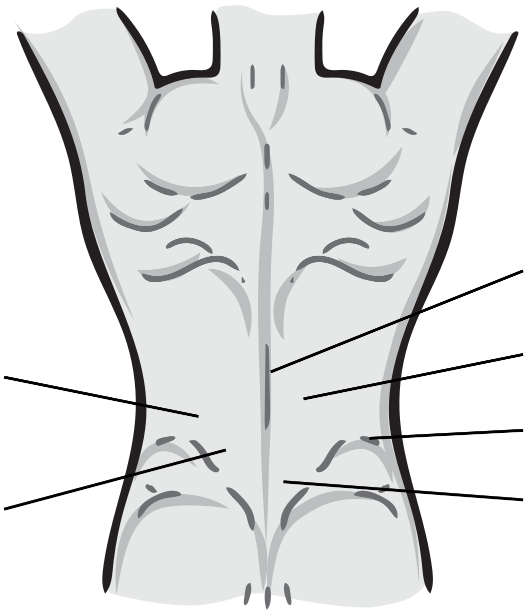

Figure 3: Palpation.

IMAGING INVESTIGATIONS APPROACH

The problem of imaging patients with LBP when it is not indicated is well recognized[26], but in elite athletic population additional aspects must be considered. The absence of training limits the chances to progress in performance efficiently. For that, is important to have a precise diagnosis image to limit the time out of training. Therefore, radiology investigations must be considered different than for non-athletic population in early stage.

The current recommendation is that MRI is the gold standard to assess LBP image and rule out major catastrophic medical conditions for cost-benefit. The additional advantage is to detect early stage on the continue process of bone stress injuries with presence of bone edema (without fracture) or fracture line in advance stage for spondylolysis[27]. It is known that bone edema is a precursor of fracture, so that an athlete who continues to load without a fracture is at high-risk of progression to a fracture[8]. Recent study propose that the use of imaging software has an acceptable reliability to assess and monitoring the progression of bone edema in early stage. This may be used to quantify the severity and risk for more informed clinical decision-making[28].

Once considered important for diagnosing spondylolysis, the X-ray oblique view (or "Scotty dog" view) is no longer recommended due to its limited sensitivity and greater radiation exposure[29].

There is not clear consensus when is the best moment to request a radiology image but is clear that the presence of red flag on clinical assessment is the main criteria[30]. In pediatric-adolescent population a functional approach with lack of favorable resolution of symptoms after 4 weeks of treatment is the recommendation[31]. In elite athletes the decision cannot be delayed so long due to the competition calendar, but it is acceptable to some extend to have a delay of no longer than 1-2 weeks after the initial treatment started without clinical improvement.

A SPECT (Single Photon Emission Computed Tomography) study may be recommended when there are concerns about underlying pathology, especially when the initial plain radiographs show suspicious findings. Some of the potential pathologies that may prompt a SPECT study include:

1. Osteoid Osteoma: This is a benign focal tumor that is typically observed in the posterior elements of bones. It can mimic other conditions and may require further imaging to confirm its presence and characteristics[32].
2. Transitional Vertebrae: This refers to an L5 vertebra with incomplete segmentation. This condition can be identified through imaging, and SPECT can be useful in assessing its impact on surrounding structures.
3. Spinous Process Impingement: If there are concerns about impingement of the spinous processes of vertebrae, a SPECT study can provide valuable information about the extent and nature of this issue.

Therefore, a SPECT study is a valuable imaging tool in cases where initial plain radiographs raise suspicions of underlying pathologies such as osteoid osteoma, transitional vertebrae, or spinous process impingement, helping to provide a more accurate diagnosis and guide appropriate treatment[33].

Computed tomography (CT) is highly effective in detecting osseous (bone-related) abnormalities and offers superior specificity compared to a SPECT scan for identifying spondylolysis, a condition characterized by spinal stress fractures. In a study involving 40 patients with spondylolysis not visible on plain radiographs, CT revealed fractures in 34 patients, while SPECT scans suggested fractures in all 40 cases, although six of these were false positives[34] for that is known to be a valuable diagnostic tool.

CT also plays a crucial role in distinguishing between acute and chronic spinal lesions, aiding in prognosis and treatment decisions. Studies have shown that healing occurs in different percentages of cases depending on the stage of the injury, with early fractures having the highest healing rate. A combination of CT and MRI findings can help predict healing time, guiding decisions about when athletes can safely return to sports and whether bracing is necessary[35].

However, the use of CT in children and adolescents is debated due to the high radiation exposure involved. As a result, many clinicians prefer MRI initially and only turn to CT if issues arise during management. Limited lumbar CT scans focused on specific vertebrae of interest in suspected spondylolysis cases expose patients to lower radiation levels, making them a more acceptable option when needed[34]. In summary, CT is a valuable tool for detecting spondylolysis and assessing its severity when the MRI does not complement with relevant information. Still, its use in young individuals must be carefully considered due to radiation exposure concerns[36].

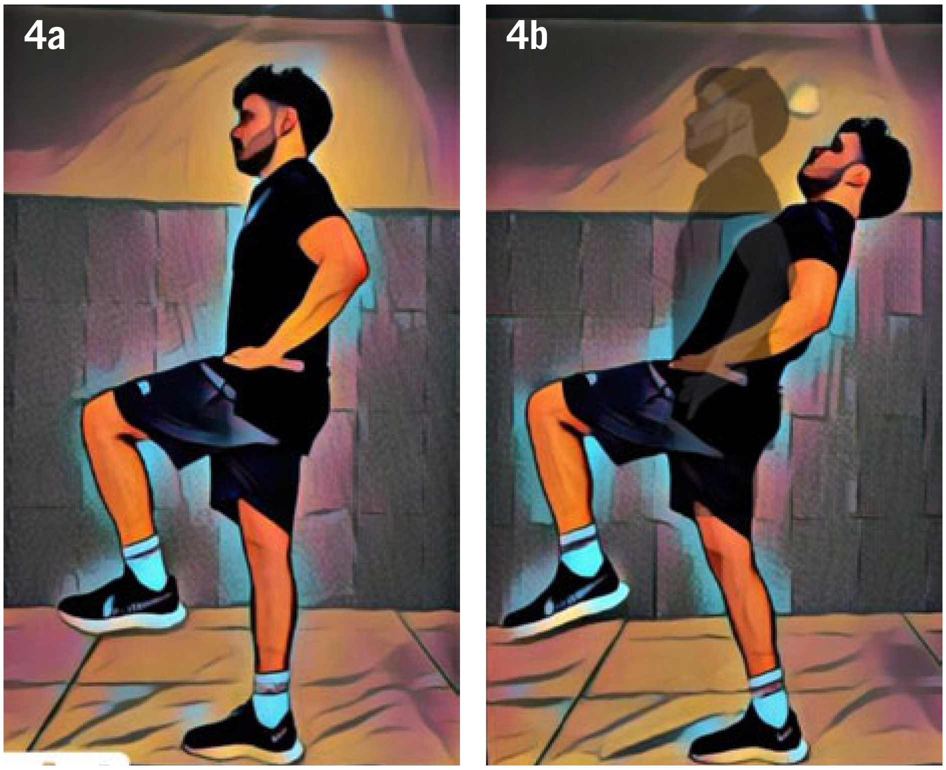

Figure 4: a) Stork test – SIJ disorder; b) One legged Hyperextension – spondylolysis.

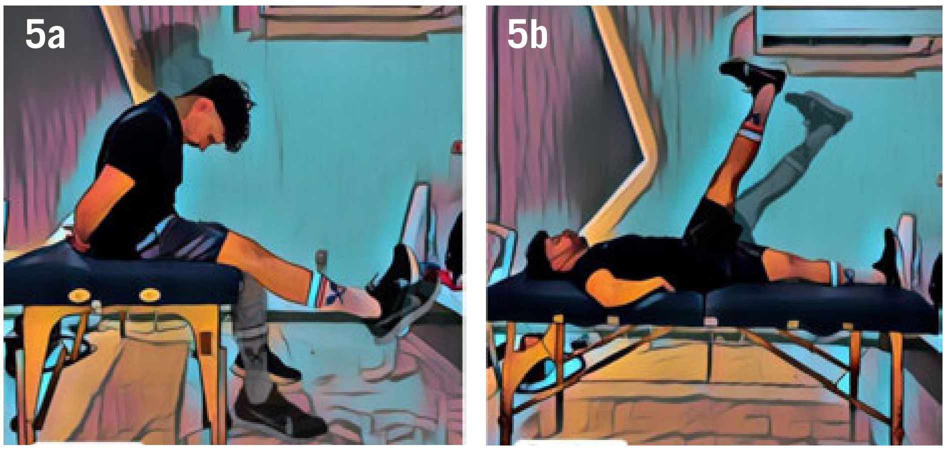

Figure 5: a) Neural tests: Slump tests; b) Single leg raise test.

Recently a new MRI sequence named MRI bone sequence, or "VIBE", "MRI bone" or "Zero TE" in the literature, describe a sequence accurate for cortical and trabecular bone assessment considered an effective alternative to CT scan for similar results and no ionizing radiation[37,38,39].

Causes and differential diagnosis of LBP

Differential diagnosis involves considering various potential causes of LBP and systematically narrowing down the possibilities. Below is a list of some common causes of LBP in track and field athletes. Table 1 summarize the common findings during the clinical assessment together with the suggested radiological investigations for the common diagnosis linked with LBP modified from MacDonald et al, 2017[40].

1. *Muscle Strain or Sprain:* is often the most common cause, characterized by localized pain and tenderness in the muscles of the lower back. It is typically due to overuse or sudden exertion.
2. *Herniated Disc:* if a disc in the spine protrudes or herniates can compress nerve roots, leading to pain that may radiate down the lower limbs to different levels. Pain increase with anterior lumbar flexion
3. *Facet Joint Dysfunction:* pain (prevalent on lumbar hyperextension) can result from irritation or inflammation of the facet joints in the spine, often exacerbated by extension and rotation movements.
4. *Stress fractures:* A stress fracture or defect in a vertebra, often appears in the athletes who hyperextend their spines or who have repetitive impact activities.
5. *Ankylosing Spondylitis:* is an inflammatory condition that primarily affects the spine, causing stiffness and pain
6. *Muscle Imbalances:* Weakness or imbalances in the core or supporting muscles can contribute to LBP unspecific, especially in athletes with poor form
7. *Infections:* are uncommon in athletes but such as spinal epidural abscesses or vertebral osteomyelitis can cause severe back pain.
8. *Inflammatory Conditions:* conditions like inflammatory bowel disease (IBD) or rheumatoid arthritis can manifest with LBP and stiffness.
9. *Visceral Causes:* occasionally, LBP may be referred from abdominal or pelvic organs, like kidney stones or ovarian issues.
10. *Psychogenic Pain:* Psychological factors, such as stress, anxiety, or depression, can exacerbate or even be the primary cause of LBP.
11. *Tumors:* although rare, tumors in the spine or nearby structures can lead to persistent, localized pain.

A thorough assessment, including history, physical examination, and appropriate imaging or laboratory tests, is crucial to differentiate between these potential causes. Working closely with an experienced multidisciplinary team in sports medicine and spine conditions can aid in accurately identifying and treating the specific source of LBP in a track and field athlete[41].

TREATMENT APPROACH

The foundation of a successful treatment is an accurate diagnosis by identifying the source of LBP. Several rehabilitation programs have been described for LBP based on specific diagnoses, but there is little evidence in the literature supporting their use in athletic population[42]. The treatment should be a multifactorial process which must be adapted to each individual and focus at the beginning on reducing the pain and discomfort, follow by restoring the loss of mobility and strength, recognition and address of any deficits in biomechanical function aiming to limit any loss of sport performance[42].

In the absence of an anatomical cause, physicians are using the terminology of "Non-specific LBP" diagnosis and focus the treatment on signs and symptoms. The initial management for mechanical or non- specific LBP should be non-pharmacological, focused on manual therapy, and heat ward plus exercises. The role of oral NAIDs must be preserved in moderate to severe pain with other origin[43]. Osteopathic Manipulative Treatment (OMT) has demonstrated effectiveness in reducing pain and enhancing functional well-being in individuals with both acute and chronic nonspecific LBP[44]. Moderate evidence suggests that heat wrap therapy provides temporary pain relief and a small reduction in disability for individuals experiencing LBP lasting longer than three months[45]. Exercise training been showed to be more effective than therapist hands-on treatment[46]. Hayden et al. (2021) showed evidence that Pilates, McKenzie therapy and functional restoration were more effective than other types of exercise treatment for reducing pain intensity and functional limitations in LBP[47].

On the other end, Spondylolysis is a well-defined diagnosis with an anatomical cause which has been well described and researched in the literature. The Management of lumbar bone stress injury is complicated as there are no clear pathways that can be directed by Level 1 evidence. The elite athlete management needs to be different for the general

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Take Home Message

- *Low Back Pain (LBP) can negatively affect elite track & field athletes with lifelong sequels, even if is not the most common injury.*
- *Examination could reveal pain origin based on symptomatic lumbar movements:*
  - *Flexion: discogenic origin*
  - *Extension: facet origin or spondylolysis*
  - *Multidirectional: mechanical LBP.*
- *Magnetic Resonance imaging (MRI) with bone sequence is now the gold standard and the recommended imaging for LBP if still symptomatic after a reasonable period of intensive pain treatment.*
- *Managing LBP in athletes should be multidimensional and must include the athlete in the plan. The content of rehabilitation should mimic training sessions content as soon as symptoms allow.*

community and the approach could be with mild a few differences in youth or adults[48,49].

While the application of a brace to limit lumbar extension and rotation logically should promote healing, there is a lack of strong evidence to support a clear advantage in all athletes. There may be benefit for specific individuals from encouraging or enforcing unloading from sport, or those that are more likely to benefit from bracing, including those with persisting pain at rest, exaggerated lumbar lordosis, clinical factors making delayed or non-union more likely, or bilateral stress fractures. In practice, we generally do not prescribe braces for full-time athletes[50].

In daily practice, conservative and functional physiotherapy is the most common approach in elite track and field athlete. The timing to return to play is conditioned by the severity (bone edema, incomplete or complete fracture line), location (uni- or bi-lateral), and time to resolve clinical signs and symptoms at early acute phase or delayed bone union. For that, the time to return to perform could be so width from 6 to 24 weeks[51].

For the symptomatic disc degeneration, a non-operative treatment typically includes education, nonsteroidal anti-inflammatory drugs, and physical therapy. The physical therapy entails functional rehabilitation, activity modification and pain management. Sedrak et al. (2021) found no effectiveness differences between operative and nonoperative care regarding return to play rate in elite athletes (83.0 % vs 81.5%)[16]. In specific instances, it is essential to evaluate the injury's severity, the effectiveness of conservative treatments, the presence of neurological deficits, the athlete's previous surgical history, and the potential risks associated with surgery alongside the obtained results to make an informed decision regarding the most suitable treatment approach.

One important point to keep in consideration is the psychosocial aspect. Pain is a negative experience in any context, but when this is present in elite athlete, especially during a specific time on sport calendar, it could become an even more stressed experience[52].

Overall when training is limited by LBP, the first approach is to inform about the diagnosis and take the time to answer all the questions that the athlete might have about his/her current medical condition. Secondly need to explain all related limitations, potential sequelae or impact in short or long term which might affect his/her career. The focus should be on all possible options that the athlete has close to resolve this problem involving him actively in developing an action plan. It is highly recommended to approach them as an athlete and not as a patient when considering the treatment options[53].

FOLLOW UP APPROACH

The clinical follow up should be until resolution of symptoms and in case of spondylolysis to conclude bone healing (if possible). The time of bone healing depends on the age, sport and size of fracture and there is not clear time frame of frequency to complete radiology image for follow up. However, a 3-4 months post injury it is a reasonable time[54].

The clinical follow up should continue in elite athlete after the medical discharge case at least monthly by medical team. A continue monitoring of symptoms, training program, execution of secondary preventive program and monitoring invisible load (sleep, healthy habits, etc.) is crucial to minimize the recurrence or at least the burden of recurrence during the sport career[55].

CONCLUSION

The clinical approach in track and field athletes with LBP requires a multidimensional perspective and holistic approach.

Always consult with a sports medicine physician or orthopedic specialist experienced in treating athletes to ensure proper diagnosis and management of lower back pain in track and field athletes. Individualized care is crucial to facilitate a safe and successful return to performance. The interdisciplinary work with coaches and strength & conditioner may prevent recurrences and minimize sequelae. We should treat the athlete as injured athlete and not as a patient, for that matter medical approach should be focused to include in rehabilitation process the sport specific essential concepts.

References
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