CASE REPORT

Rehabilitation management for a dysfunctional/non-painful (DN) joint causing low back disorder in an elite athlete : A case report

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Abstract : Low back pain in athletes can arise from asymptomatic dysfunctional/non-painful (DN) joints, which cause compensatory stress on adjacent regions. This report highlights the clinical importance of identifying and correcting these underlying 'DN joints,' integrating concepts from the Selective Functional Movement Assessment and the joint-by-joint approach to prevent recurrence. A 25-year-old female professional volleyball player underwent surgery for L5 radiculopathy due to disc herniation. Postoperatively, a functional assessment revealed DN joints : restricted mobility in her right glenohumeral joint and thoracic spine. This dysfunction led to compensatory lumbar lateral flexion during spiking motions and unilateral landing on the left foot after spiking, increasing mechanical stress on her lower back. A rehabilitation program successfully corrected these DN joints. Consequently, the compensatory movement pattern resolved. The patient returned to competition six months post-surgery and remained pain-free at a two-year follow-up, competing at her pre-injury level. This case demonstrates that addressing asymptomatic DN joints as the root cause of symptomatic lumbar disorders is crucial for athletes. This comprehensive approach, which looks beyond the site of pain, is essential for a durable recovery and the prevention of injury recurrence. J. Med. Invest. 73 : 274-280, February, 2026

Keywords **:** *Rehabilitation, lumbar disorders, dysfunctional/non-painful joint, athlete, Pilates*

INTRODUCTION

Low back pain is a common complaint among athletes, with reported prevalence rates ranging from 45% to 85% (1-3). Previous studies have shown that its causes can generally be grouped into three main categories : (i) traumatic or degenerative conditions such as lumbar spondylolysis, disc herniation, and disc degeneration ; (ii) poor function of the lumbopelvic core muscles ; and (iii) psychosocial factors (4-8). These factors have been well studied and are often the focus of clinical treatment.

In recent years, as a cause of low back pain, increasing attention has been given to asymptomatic joint dysfunction. A systematic framework for evaluating this is the Selective Functional Movement Assessment (SFMA), which classifies movement patterns into four categories. One of these, Dysfunctional/Non-painful (DN), identifies movement that is performed incorrectly but without the presence of pain (9-11). Concurrently, the joint-by-joint approach (JBJA) theorizes that the joints alternate between primarily requiring mobility and stability throughout the kinetic chain (12). In this report, we integrate these two concepts. We will use the term 'DN joint' to refer to a joint that is (1) classified as exhibiting DN movement according to the SFMA, and (2) failing to provide its primary function (e.g., mobility or stability) as designated by the JBJA. The presence of a DN joint may cause compensatory mechanical stress to be redistributed to adjacent regions, potentially resulting in secondary disorders such as lumbar dysfunction. When a DN joint coexists with this secondary dysfunction, treating only the symptomatic area may lead to frequent recurrence. Therefore, the identification and correction of a DN joint are considered essential, especially for athletes, although its asymptomatic nature makes it difficult to detect.

In this report, we present a case of an athlete who developed lumbar spine disorder secondary to DN joint, and highlight the importance of identifying and correcting DN joint as a contributing factor to lumbar spine dysfunction.

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CASE PRESENTATION

We obtained oral consent from the participant regarding the use of her personal information and images. Information regarding the study was publicly disclosed, providing the patient with the opportunity to refuse participation, which she did not.

The patient was a 25-year-old female professional volleyball player who presented to our hospital with a four-month history of low back pain and left leg pain. Neurological examination revealed a positive straight leg raising test (SLRT) on the left side at 80 degrees, while the femoral nerve stretching test was negative bilaterally. She reported radicular pain and paresthesia in the L5 dermatome. No objective muscle weakness was observed. Deep tendon reflexes, including the patellar tendon reflex and Achilles tendon reflex, were within normal limits. Local tenderness was noted over the spinous processes of L4 and L5. Lumbar flexion provoked significant low back pain, and the floor finger distance was +30 cm.

Magnetic resonance imaging (MRI) revealed a left-sided disc herniation at the L4/5 level (Figure 1). Plain radiographs and computed tomography (CT) showed a chronic apophyseal ring fracture of the L4 vertebral body, classified as Type-Ⅱ according

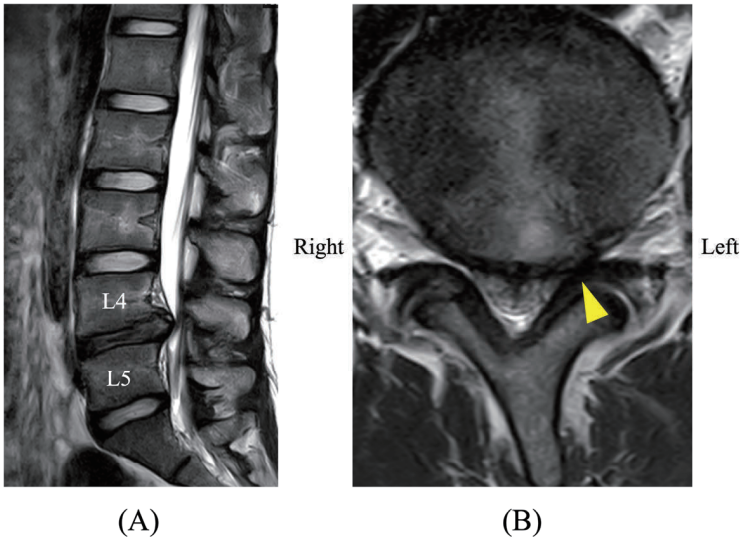

Figure 1. MRI images obtained at our hospital.
(A) T2-weighted sagittal image showing posterior disc herniation at the L4/5 level.
(B) T2-weighted axial image at the L4/5 level demonstrating left-predominant disc herniation compressing the L5 nerve root (yellow arrowhead).

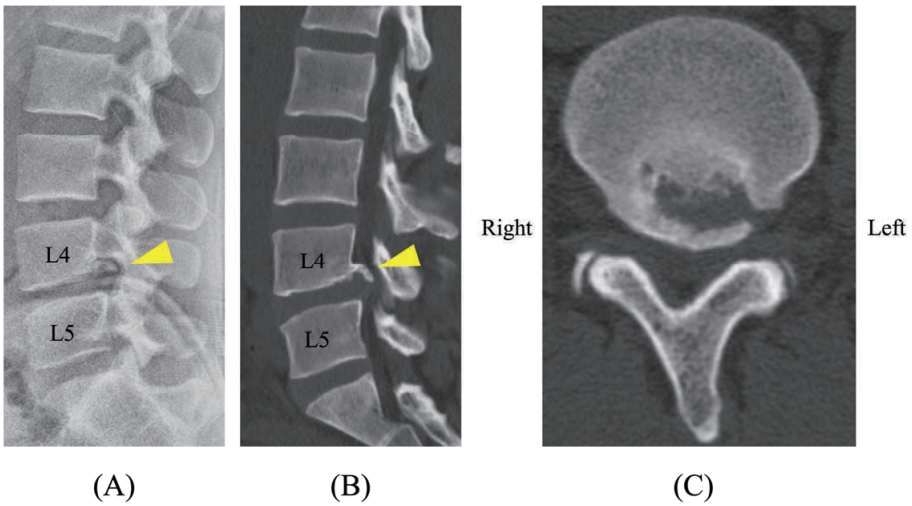

Figure 2. (A) Lateral plain radiograph and (B, C) sagittal and axial views from a non-contrast CT scan performed at our hospital.
A ring apophysis fracture extending posteriorly from the L4 vertebral body is visible (yellow arrowhead).

to the Tanaka classification (Figure 2). A selective left L5 nerve root block was performed, resulting in temporary relief. Based on the clinical findings and imaging results, the patient was diagnosed with left L5 radiculopathy caused by the disc herniation at L4/5 and a limbus fracture of L4.

Removal of the disc herniation at L4/5 from the left side was performed via microscopic laminectomy. The posteriorly extruded apophyseal ring fragment was impacted anteriorly using a bone impactor. Adequate decompression of the left L5 nerve root was confirmed, and the procedure was completed. Postoperatively, the patient's left leg pain and numbness improved, and the SLRT became negative at 90 degrees. Follow-up MRI at 10 months postoperatively confirmed adequate decompression of the left lateral recess at the L4/5 level (Figure 3).

During postoperative rehabilitation, a functional assessment guided by the principles of SFMA was performed to identify underlying DN joint (9-12). Right shoulder flexion range of motion (ROM) was limited to 150 degrees (Figure 4A), and thoracic extension and rotation were also restricted. It was further observed that during the spiking motion, the patient exhibited a kinematic adaptation in response to these mobility restrictions, characterized by left lateral flexion of the lumbar spine (Figure 5A) and unilateral landing on the left foot (Figure 5B). This kinematic adaptation was considered to increase mechanical stress on the lumbar region.

Pilates-based rehabilitation was initiated, resulting in an improvement in right shoulder flexion ROM to 200 degrees (Figure 4B), along with increased thoracic extension and rotation. As shoulder and thoracic mobility improved, the compensatory left lateral flexion of the lumbar spine observed during the spiking

motion resolved, and the patient was able to land on both feet (Figure 6). She was discharged home after three weeks rehabilitation and returned to official competition six months after surgery. At a two-year follow-up, the patient has had no recurrence of low back pain and continues to compete at her previous level.

DISCUSSION

In this report, we present a case of chronic apophyseal ring fracture with disc herniation in an athlete. A notable aspect of this case is that the lumbar disorders appeared to be secondary to DN joint involving the shoulder and thoracic spine stiffness. Recurrence was successfully prevented by correcting the underlying DN joint.

Importance of identifying DN joint

Cook *et al*. developed the Selective Functional Movement Assessment (SFMA) as a systematic approach to evaluating dysfunctional movement patterns in patients with pain or functional limitations, to identify their underlying causes. Stanek *et al*. applied the SFMA to 25 healthy individuals and found it to be a highly reproducible method for assessing physical function (13). The SFMA is a movement assessment system consisting of segmented sections that focus on individual joints (12). It evaluates both pain and functional impairment in each section, classifying findings into four categories : functional / non-painful (FN), functional / painful (FP), dysfunctional / non-painful (DN), and dysfunctional / painful (DP). FN indicates normal joint function and typically requires no correction, whereas FP and DP involve pain and are more likely to be recognized by the patient, often

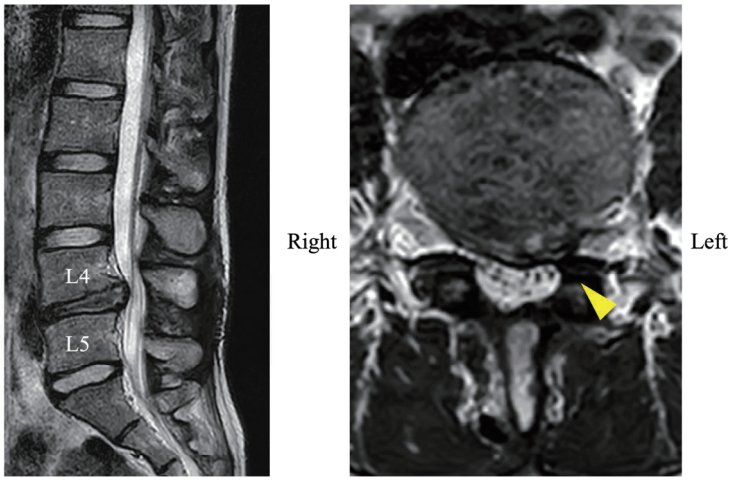

Figure 3. Postoperative MRI showing the site of decompression indicated by the yellow arrowhead.

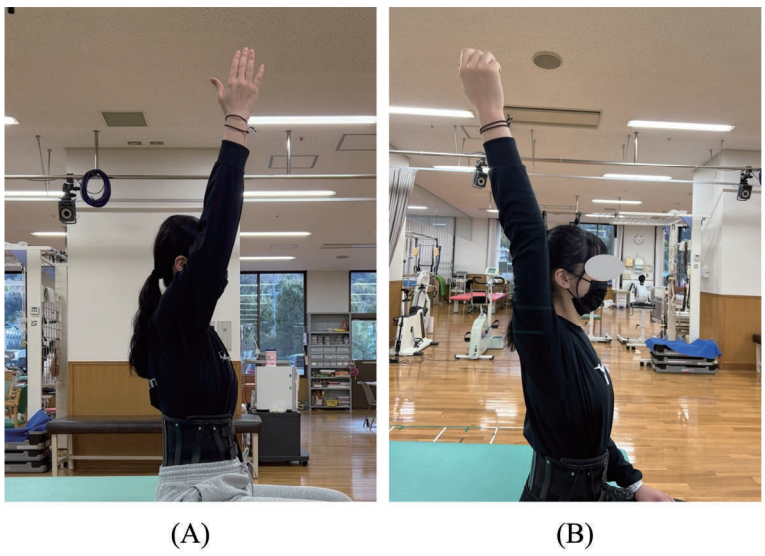

Figure 4. Shoulder flexion before (A) and after (B) the rehabilitation intervention. An increased range of motion is evident after the intervention.

Figure 5. Images captured during a spike motion before the injury.
(A) The red dashed line illustrates the compensatory left lateral flexion of the trunk in response to restricted right shoulder and thoracic mobility.
(B) The yellow dashed circle highlights the consequential unilateral landing on the left foot.

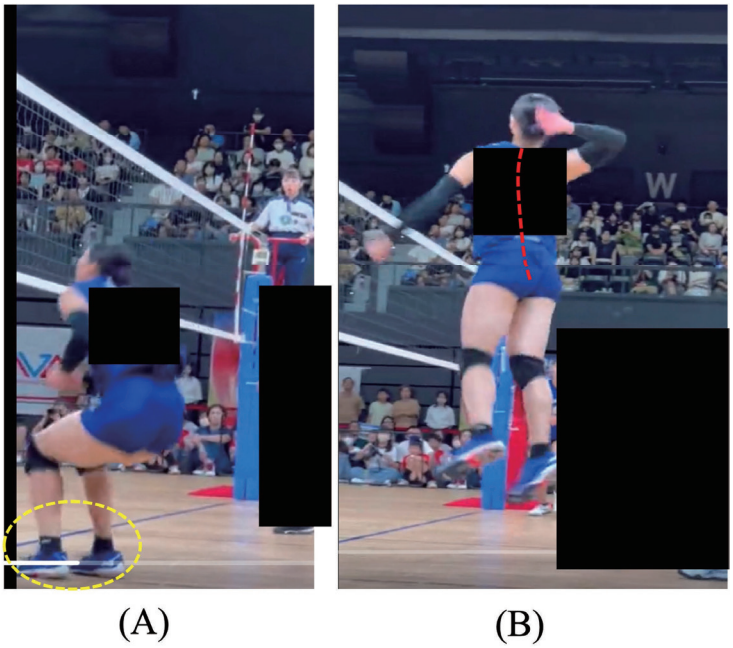

Figure 6. Images captured during a spike motion after the rehabilitation intervention.
(A) The yellow dashed circle shows that the athlete is now able to land on both feet.
(B) The red dashed line indicates the improved, neutral trunk alignment during the spiking motion.

making them the primary targets for intervention.

On the other hand, a DN classification is typically asymptomatic due to the absence of pain and is therefore often unrecognized by patients, making it less likely to be addressed in treatment. To further conceptualize this issue, we incorporated the joint-by-joint approach (JBJA) proposed by Cook *et al*. (12). This model categorizes the joints into two types : those that require stability and those that require mobility, arranged in an alternating pattern throughout the kinetic chain (Table 1). According to the JBJA, the lumbar spine is classified as a stability-focused region, while the glenohumeral joint and thoracic spine are considered mobility-focused regions.

Table 1. Functional status of the joints based on the joint-by-joint approach, where mobility and stability alternate from the ankle upward

Joint	Function
Ankle joint	Mobility (sagittal)
Knee joint	Stability
Hip joint	Mobility
Lumbar spine	Stability
Thoracic spine	Mobility
Scapulothoracic joint	Stability
Glenohumeral joint	Mobility

By integrating the SFMA's DN classification with the JBJA, we defined the concept of the 'DN joint' for this report. Unlike joints classified as FP or DP, a DN joint is asymptomatic and therefore easily overlooked by both patients and clinicians. However, this underlying dysfunction can increase the mechanical load on adjacent regions, leading to secondary pathology. If treatment targets only the symptomatic area while the primary DN joint remains unaddressed, recurrence is likely. Therefore, the identification and correction of the DN joint becomes a critical component of a comprehensive and effective management strategy.

Correction of DN and DN-related lumbar dysfunction

From JBJA perspective, core stabilization plays a critical role in improving lumbar spine function, as supported by previous reports (14), and is also relevant to lumbar dysfunction secondary to DN (13). Therefore, enhancing core stabilization is the first priority. Once adequate stabilization has been achieved, corrective exercises targeting DN joint are introduced. These exercises are guided by the "6 Ps" : pain, purpose, posture, position, pattern, and plan (15).

Exercises that induce pain should be avoided, as the potential risks may outweigh the benefits. The purpose of corrective exercise is to address dysfunction, and setting appropriate priorities is essential. Posture is a critical component of corrective exercise, as the demands on motor control and balance vary depending on the posture. It is recommended to begin with postures that can be performed comfortably and gradually increase the level of challenge. During this process, attention should be paid to whether the patient can maintain natural breathing. Similarly, the initial position of the DN joint is important, as it influences movement difficulty in the same way as posture. After performing a series of corrective exercises, the movement pattern should be reassessed, and an appropriate plan should be developed for subsequent exercises.

Case outcome

In this case, surgery was first performed to treat lumbar disc herniation and chronic apophyseal ring fracture. Postoperatively, physical therapy incorporating Pilates was implemented to achieve core stabilization of the lumbar spine. Concurrently, a full-body assessment revealed DN joints as ROM restrictions in the glenohumeral joint, lack of stabilization in the scapulothoracic joint and thoracic spine ROM restriction, which were subsequently corrected.

Specifically, shoulder joint ROM was addressed through physical therapy, and glenohumeral joint ROM was targeted using the trapeze table (Figure 7). The Chair machine was also used to address scapulothoracic joint stabilization (Figure 8). Figure 8A demonstrates starting position and both bar of the chair is pushed down by the scapular motion with serratus muscle contraction (Figure 8A). The chair machine is also used for thoracic spine extension (Figures 9) and rotation ROM (Figures10). This correction improved the problematic movement pattern observed during spiking motion, in which the patient leaned the trunk

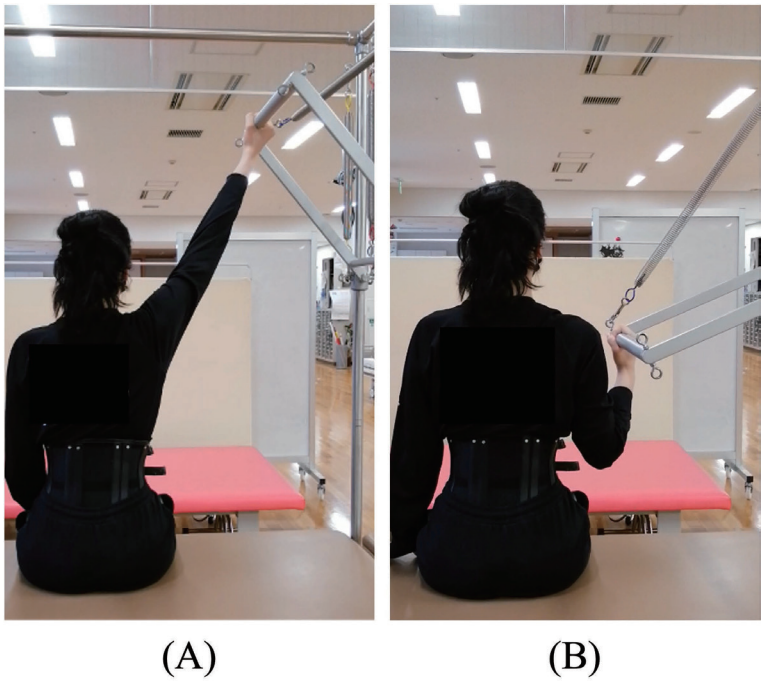

Figure 7. Scapular rotation exercises using the trapeze table : (A) upward rotation and (B) downward rotation. This exercise aimed to improve glenohumeral joint ROM.

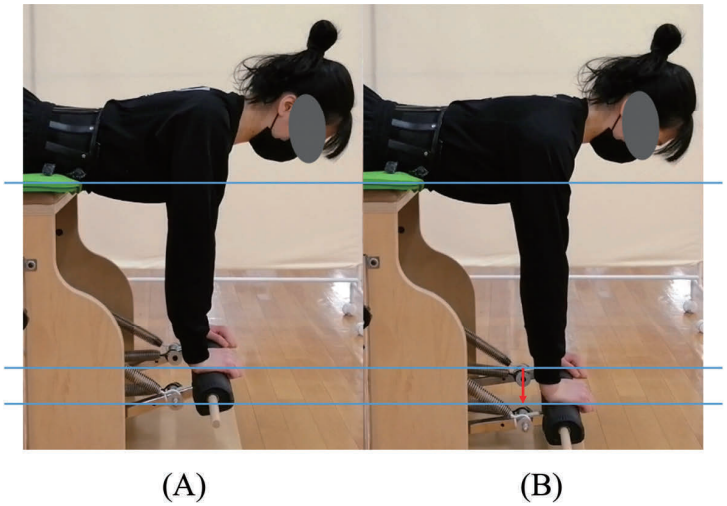

Figure 8. Scapular retraction (A) and protraction (B) exercises performed using the chair. This exercise aimed to achieve scapulothoracic joint stabilization.

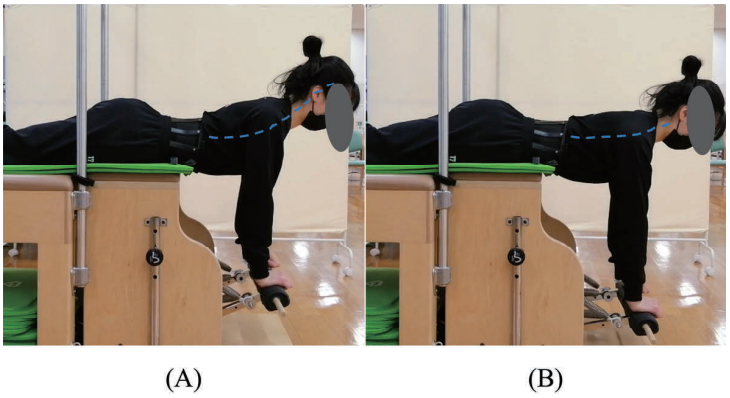

Figure 9. Thoracic extension exercise using the Pilates chair. The blue dashed lines highlight the curvature of the thoracic spine.
(A) Thoracic extension exercise using the chair.
(B) Neutral thoracic spine position before the extension movement.

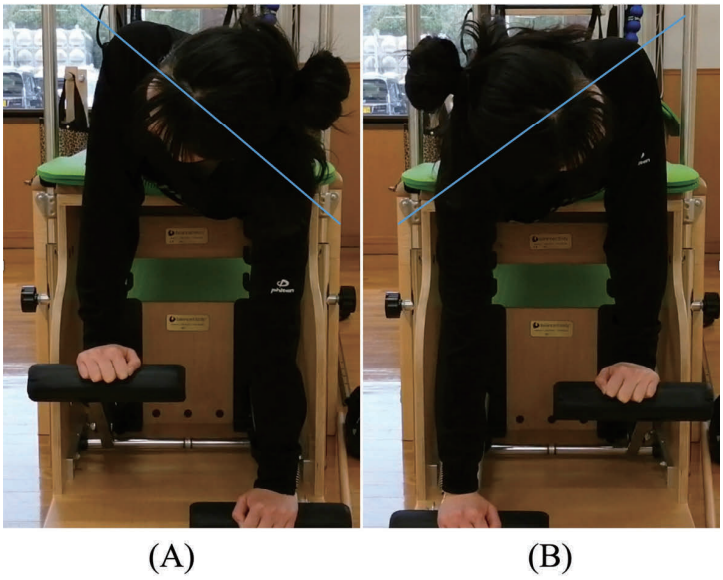

Figure 10. Thoracic rotation exercises using the chair : The blue lines indicate the angle of thoracic rotation during (A) right rotation and (B) left rotation.

and landed solely on the left leg. After intervention, trunk alignment normalized, and landing on both feet was achieved. Since returning to sport, the patient has experienced no recurrence of low back or lower limb pain at 2 years follow up and continues to compete at her previous level. While several previous reports have described the use of the SFMA in athlete rehabilitation, their follow-up periods have been limited to several months and are thus shorter than our two-year follow-up (16, 17). Furthermore, these reports did not specifically focus on adjacent joint disorders secondary to a DN joint. Therefore, to our knowledge, this is the first report to propose the importance of identifying and correcting the DN joint as a strategy for achieving successful long-term outcomes and preventing recurrence.

CONCLUSION

This case report highlights the clinical importance of identifying and addressing asymptomatic 'DN joints' as the underlying cause of symptomatic lumbar disorders in elite athletes. The successful, long-term outcome of this case, with a two-year pain-free follow-up, suggests that a comprehensive management strategy should extend beyond the site of pain to correct remote dysfunctional joints. This approach may be crucial for resolving compensatory movement patterns, ensuring a durable return to sport, and preventing injury recurrence.

CONFLICTS OF INTERESTS

The authors declare no conflict of interest.

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REFERENCES

1. Sward L, Hellstorm M, Jacobsson B, Peterson L : Back pain and radiologic changes in the thoracolumbar spine of athletes. Spine 15 : 124-129, 1990
2. Nadler SF, Wu KD, Galski T, Feinberg JH : Low back pain in college athletes : a prospective study correlating lower extremity overuse or acquired ligamentous laxity with low back pain. Spine 23 : 828-833, 1998
3. Kujala UM, Taimela S, Erkintalo M, Salminen JJ, Kaprio J : Low back pain in adolescent athletes. Med Sci Sports Exerc 28 : 165-170, 1996
4. Standaert CJ, Herring SA, Pratt TW : Rehabilitation of the athlete with low back pain. Curr Sports Med Rep 3 : 35-40, 2004
5. Soler T, Calderon C : The prevalence of spondylolysis in the Spanish elite athlete. Am J Sports Med 28 : 57-62, 2000
6. Goldstein JD, Berger PE, Windler GE, Jackson DW : Spine injuries in gymnasts and swimmers : an epidemiological investigation. Am J Sports Med 19 : 463-468, 1991
7. Standaert CJ, Herring SA : Physiological and functional implications of injury. In : Malden FW, ed. Rehabilitation of Sports Injuries : Scientific Basis. The Encyclopedia of Sports Medicine, vol 10. International Olympic Committee, Lausanne, Switzerland, 2003, pp.144-159
8. Linton SJ : A review of psychosocial risk factors in back and neck pain. Spine 25 : 1148-1156, 2000
9. Aghi A, Salvagini D, Berton G, Cecconi M, Valle ED, Spera R, Mambeli M, Palermi S, Neunhaeuserer D, Vecchiato M : Selective functional movement assessment (SFMA) reliability and proposal of its use in sports. Int J Environ Res Public Health 20 : 2032-2041, 2023
10. Cook G, Burton L, Hoogenboom BJ, Voight M : Functional movement screening : the use of fundamental movements as an assessment of function-part 1. Int J Sports Phys Ther 9 : 396-409, 2014
11. Cook G, Burton L, Hoogenboom BJ, Voight M : Functional movement screening : the use of fundamental movements as an assessment of function-part 2. Int J Sports Phys Ther 9 : 549-563, 2014
12. Cook G : Movement : Functional movement systems screening-assessment-corrective strategies. On Target Publications, Ramsey, NJ, 2010
13. Stanek JM, Smith J, Petrie J : Intra- and Inter-rater reliability of the selective functional movement assessment (SFMA) in healthy participants. Int J Sports Phys Ther 14 : 107-116, 2019
14. Wong AYL, Parent EC, Funabashi M, Stanton TR, Kawchuk GN : Do various baseline characteristics of transversus abdominis and lumbar multifidus predict clinical outcomes in nonspecific low back pain? A systematic review. Pain 154 : 2589-2602, 2013
15. George SZ, Childs JD, Teyhen DS, Wu SS, Wright AC, Dugan JL, Robinson ME : Rationale, design, and protocol for the prevention of low back pain in the military (POLM) trial (NCT00373009). BMC Musculoskelet Disord 8 : 92, 2007
16. Huang L, Liu H, Zhao L, Peng L : The Effect of Exercise Intervention Based Upon the Selective Functional Movement Assessment in an Athlete With Non-specific Low Back Pain : A Case Report and Pilot Study. Front Psychol. 2020 ; 11 : 2010
17. Goshtigian GR, Swanson BT : USING THE SELECTIVE FUNCTIONAL MOVEMENT ASSESSMENT AND REGIONAL INTERDEPENDENCE THEORY TO GUIDE TREATMENT OF AN ATHLETE WITH BACK PAIN : A CASE REPORT. Int J Sports Phys Ther 11(4) : 575-595, 2016