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The Interplay of Disc Desiccation and Radiculopathy: A Case Study Emphasizing Their Combined Impact on Symptomatology, Diagnostic Challenges, and Therapeutic Outcomes

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ABSTRACT

Disc desiccation and radiculopathy are prevalent spinal disorders that can lead to significant musculoskeletal and neurological complications. Disc desiccation is characterized by the gradual loss of hydration in intervertebral discs, diminishing their elasticity and shock-absorbing ability, which may eventually result in conditions such as disc herniation or spinal stenosis. Radiculopathy arises from compression or irritation of the spinal nerve roots, often due to degenerative changes like herniated discs, leading to pain, numbness, and weakness along the affected nerve pathway. Furthermore, Vitamin D deficiency, a common condition, can amplify chronic pain and neuromuscular symptoms, revealing the interrelated nature of these conditions.

This study examines the case of a 21-year-old female who presented with progressively worsening radiating pain in her left leg, stemming from a five-year history of misdiagnosed ligament and tendon injuries. The study highlights the interconnected roles of disc desiccation, radiculopathy, and Vitamin D deficiency, emphasizing their combined effect on symptom presentation, diagnostic complexity, and treatment outcomes. It advocates for a multidisciplinary approach that integrates structural, neurological, and nutritional evaluations to optimize patient care. The study also suggests that further research is needed to investigate the potential benefits of Vitamin D supplementation and strength training in alleviating chronic pain and supporting recovery in similar cases.

Keywords: disc desiccation, radiculopathy, vitamin D, strength training.

INTRODUCTION

Disc desiccation and radiculopathy are commonly observed conditions in the spine and its surrounding structures, both of which contribute to back pain and significant neurological symptoms. These issues are often linked to degenerative changes in the intervertebral discs and spinal nerves, respectively.[1]

Disc desiccation refers to the gradual loss of water content in the intervertebral discs, which serve as gel-like cushions between the vertebrae. As these discs dehydrate due to aging or repeated stress, they lose elasticity and become less effective at absorbing shock. This degeneration can lead to structural changes in the spine, such as disc herniation or spinal stenosis (narrowing of the spinal canal).[2] Radiculopathy is a

condition that arises when a nerve root in the spine becomes compressed or irritated, often due to a herniated disc, bone spur, or other degenerative changes.[3] This compression can cause symptoms such as pain, numbness, tingling, or weakness along the affected nerve. Radiculopathy is typically classified based on the region of the spine involved, including cervical, thoracic, or lumbar radiculopathy.[4]

Both disc desiccation and radiculopathy often occur together, with one condition contributing to the development or worsening of the other. Understanding their causes and effects is crucial for the accurate diagnosis and treatment of spinal disorders. Timely management can help alleviate symptoms, prevent their progression, and address any associated complications effectively.

CASE PRESENTATION

A 21-year-old female, afebrile with stable vitals (BP: 110/77 mmHg), presented to the outpatient clinic with progressively worsening radiating pain in her left leg. The patient has a significant history of being misdiagnosed with a ligament tear and tendonitis following a dance-related injury five years ago, during which she experienced chronic, intermittent pain. However, her current symptoms, characterized by sharp, radiating discomfort, have escalated in intensity, prompting further evaluation. On clinical examination, findings were consistent with lumbar radiculopathy, including suspected weakness in muscle groups corresponding to a compressed nerve root, and a positive straight leg raise test, indicative of nerve root irritation. Given these findings, an MRI of the lumbar spine was ordered to investigate potential causes, such as a herniated intervertebral disc, foraminal stenosis, or structural abnormalities like spondylolisthesis. Additionally, a complete Vitamin D investigation was prescribed.

The MRI findings revealed early stages of disc desiccation and a central bulge at the L5-S1 level, causing thecal sac indentation (Fig. 1). The patient's Vitamin D levels were significantly low, measured at 12.6 ng/mL. The immediate management plan includes NSAIDs for pain relief and activity modification to minimize further nerve irritation. A referral to a neurologist or orthopedic spine specialist is planned to ensure a comprehensive treatment approach based on the MRI results and Vitamin D deficiency.

MRI LUMBOSACRAL SPINE WITH WHOLE SPINE SCREENING (NON CONTRAST)

Sequences: Sagittal T1,T2, 3D T2, Coronal STIR, Axial T2

Vertebral Bodies: Normal morphology and alignment of vertebral bodies, pedicles, laminae and spinous processes.
No spondylolysis/spondylolisthesis noted. CVJ appears normal.
No spinal canal stenosis noted. Flaval ligament and bilateral facet joints appear normal.

Intervertebral Discs:

Disc level	Spinal Canal	Neural Foramen		Nerve root impingement
		Right	Left	
L1/L2	19.0mm	14.8mm	14.7mm	Normal appearing disc. No traversing or exiting nerve root impingement seen at this level.
L2/L3	18.5mm	15.2mm	15.1mm	Normal appearing disc. No traversing or exiting nerve root impingement seen at this level.
L3/L4	17.8mm	14.7mm	14.5mm	Normal appearing disc. No traversing or exiting nerve root impingement seen at this level.
L4/L5	16.0mm	13.7mm	13.9mm	Normal appearing disc. No traversing or exiting nerve root impingement seen at this level.
L5 /S1	10.7mm	11.3.mm	11.2mm	**Minimal disc desiccation and central bulge seen causing thecal sac indentation.** No traversing or exiting nerve root impingement seen at this level.

Spinal Cord: Normal signals seen. Conus medullaris, cauda equina and CSF sub arachnoid spaces are normal.
Bilateral sacroiliac joints normal. No sacroilitis.

(Fig.1)

PATIENT HISTORY

A 21-year-old female presented to the outpatient department with progressively worsening radiating pain in her left leg. The pain began five years ago following a dance-related injury and was initially misdiagnosed as a ligament tear and tendonitis. An earlier MRI of the leg suggested tendonitis and

ligament damage (fig.2), for which she underwent conservative treatment, including rest and physical therapy. She had also been taking collagen supplements, but her symptoms persisted. Over the years, the pain remained intermittent and mild but recently intensified, becoming sharp and radiating from the lower back to the left leg, often accompanied by tingling sensations. The pain was aggravated by prolonged sitting and certain movements, with minimal relief from rest. She denied recent trauma, fever, or bowel and bladder dysfunction. There was no history of prior surgeries, chronic illnesses, or a significant family history of musculoskeletal or neurological conditions. The patient is a student and was an active dancer until her initial injury, with no history of smoking, alcohol, or substance use.

The patient also noted a recent significant weight gain, which she suspected had worsened her condition. A management plan was established, emphasizing active physiotherapy, including strength training, and a structured weight-loss regimen. She was prescribed Vitamin D supplementation (60,000 IU weekly for 2 months, followed by 60,000 IU monthly for 12 months) and calcium citrate malate tablets to address deficiencies. For neuropathic pain, gabapentin and methylcobalamin tablets (1 tablet nightly for 10 days) were initiated alongside Hifenac for pain relief.

At her six-month follow-up, the patient reported substantial improvement, with reduced pain and discomfort, enabling her to resume all daily activities with ease.

(Fig.2)

DISCUSSION

Disc Desiccation

Disc desiccation refers to the dehydration or drying out of the intervertebral discs in the spine. These discs, which act as gel-like cushions between the vertebrae, consist of a tough outer layer (the annulus fibrosus) and a softer, gel-like inner core (the nucleus pulposus). Over time, these discs can lose their water content, leading to structural and functional changes.[1]

The primary causes of disc desiccation include aging, repetitive stress or trauma, genetic factors, and degenerative disc disease (DDD). As people age, the intervertebral discs naturally lose water, reducing their flexibility and shock-absorbing capacity. Activities involving repetitive bending, lifting, or poor posture can accelerate this dehydration. Additionally, genetic factors can predispose individuals to early disc degeneration, and disc desiccation is commonly seen in cases of DDD, where the discs lose height, flexibility, and shock-absorbing abilities.[2]

Although disc desiccation itself may not always cause pain, the degenerative changes it triggers in surrounding structures can lead to symptoms such as lower back or neck pain, stiffness, reduced range of motion, and

numbness or tingling if nerve roots are compressed. Diagnosis typically involves imaging techniques such as magnetic resonance imaging (MRI) to assess dehydration, disc height loss, or bulging, and computed tomography (CT) scans, which help detect structural damage.[1]

Treatment generally focuses on managing symptoms, as disc desiccation is often part of the natural aging process. Common interventions include physical therapy to strengthen the muscles supporting the spine and improve posture, medications like nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, or analgesics, and lifestyle modifications such as weight management, ergonomic adjustments, and reducing repetitive stress. Surgery is rarely needed, except in severe cases involving nerve compression.[2]

Radiculopathy

Radiculopathy refers to the compression, irritation, or inflammation of a nerve root as it exits the spinal column. Nerve roots are the initial segments of nerves branching off from the spinal cord and passing through openings between the vertebrae. Compression or irritation of these nerve roots can result in a variety of symptoms depending on the affected region of the spine—cervical, thoracic, or lumbar.[3]

Common causes of radiculopathy include herniated discs, degenerative disc disease, spinal stenosis, spondylolisthesis, and trauma. A herniated disc occurs when the nucleus pulposus, the inner gel-like core, bulges out through a tear in the annulus fibrosus, pressing on nearby nerve roots. In degenerative disc disease, bulging discs or the formation of osteophytes (bone spurs) can impinge on nerve roots. Spinal stenosis, a narrowing of the spinal canal, can also compress the spinal cord or nerve roots. Spondylolisthesis, where one vertebra slips over another, can lead to nerve root compression, and trauma can directly damage nerve roots.[4]

Symptoms of radiculopathy include sharp, shooting, or burning pain radiating along the path of the affected nerve. For instance, cervical radiculopathy may cause pain radiating down the arm, while lumbar radiculopathy often leads to sciatica, with pain radiating down the leg. Other symptoms include numbness, tingling (pins and needles), muscle weakness affecting movement or grip, and loss of reflexes in severe cases.[4]

Diagnosis typically involves MRI to identify herniated discs, spinal canal narrowing, or other abnormalities. CT scans offer detailed images of bone structures, while electromyography (EMG) can detect nerve damage or dysfunction. X-rays may also reveal degenerative changes such as bone spurs or narrowed disc spaces.[3]

Treatment depends on the severity of symptoms and the underlying cause. Conservative approaches, which are effective in most cases, include physical therapy to strengthen muscles and improve posture, anti-inflammatory medications such as NSAIDs or corticosteroids, and heat/cold therapy for pain relief. If conservative treatments are unsuccessful or nerve compression is severe, surgical options like discectomy, laminectomy, or spinal fusion may be considered.[4]

Vitamin D Deficiency

Vitamin D deficiency occurs when the body does not have enough of this crucial nutrient, which is vital for bone health, muscle function, and overall well-being. Primarily obtained through sunlight exposure and, to a lesser extent, from foods like fatty fish, fortified dairy products, and supplements, Vitamin D aids in calcium absorption, which is necessary for strong bones. When Vitamin D levels are insufficient, calcium absorption decreases, leading to weakened bones, an increased risk of fractures, and conditions such as osteomalacia (bone pain and tenderness).[5]

Muscle weakness and pain are common symptoms of Vitamin D deficiency, as the nutrient plays an essential role in muscle function and repair. Additionally, this deficiency can heighten pain sensitivity and

contribute to chronic conditions like fibromyalgia and lower back pain. It may also affect nerve health, leading to sensations like tingling or discomfort. Correcting Vitamin D deficiency through increased sunlight exposure, dietary changes, or supplements can alleviate pain and improve musculoskeletal health. Early detection and treatment are essential for preventing long-term complications and managing pain effectively. If pain persists, a medical evaluation is necessary to rule out or address other underlying causes.[6]

MANAGEMENT

A comprehensive approach to managing spine-related pain involves several key factors, including effective weight management, strength training, and addressing underlying health conditions like disc desiccation, radiculopathy, and Vitamin D deficiency. These components work synergistically to provide long-term relief and prevent further complications.

Weight management is critical in reducing strain on the spine and its supporting structures. Excess body weight, particularly around the abdominal area, can significantly increase pressure on the lower back, leading to discomfort and contributing to conditions like degenerative disc disease and herniated discs. By maintaining a healthy weight, individuals can reduce this burden, minimize pain, and decrease the risk of developing further spinal issues. Additionally, weight loss can alleviate stress on weight-bearing joints such as the knees and hips, which is particularly beneficial for those suffering from leg pain or joint-related problems.

Strength training is another essential component of spine health. Targeted exercises designed to strengthen the muscles that support the spine can improve posture, increase stability, and reduce the risk of injury.[7] A strong core, which includes the muscles of the abdomen, back, and pelvis, is especially important for maintaining spinal alignment and minimizing stress on the intervertebral discs. By enhancing muscle strength and endurance, strength training not only helps to stabilize the spine but also supports better movement and flexibility, further reducing the risk of pain and injury.[8]

Vitamin D deficiency plays a significant role in musculoskeletal health, as this vital nutrient helps the body absorb calcium, which is necessary for strong bones and proper muscle function. Low Vitamin D levels can lead to weakened bones, increased pain sensitivity, and muscle weakness. Addressing this deficiency through increased sunlight exposure, dietary adjustments, or supplements can help alleviate musculoskeletal pain and improve overall function. Vitamin D deficiency is often associated with conditions like osteomalacia and chronic pain syndromes, including fibromyalgia and lower back pain, so addressing this issue can be an important step in managing and preventing chronic discomfort.[5]. By combining strategies to manage disc desiccation, radiculopathy, and Vitamin D deficiency with weight management and strength training, individuals can significantly improve their spine health, reduce pain, and prevent further degeneration. This holistic approach not only addresses the underlying causes of pain but also enhances mobility, flexibility, and overall well-being. In the long term, this comprehensive treatment plan can help individuals achieve better quality of life, reduce the risk of spinal complications, and maintain an active and pain-free lifestyle.

CONCLUSION

Disc desiccation, radiculopathy, and Vitamin D deficiency represent distinct but interrelated conditions that can significantly impact musculoskeletal and neurological health. Disc desiccation is a common degenerative change associated with aging, which may not directly cause pain but can contribute to conditions like radiculopathy when nerve roots are compressed. Radiculopathy itself, often stemming from structural issues such as herniated discs or spinal stenosis, manifests with sharp, radiating pain and neurological deficits,

necessitating timely diagnosis and management to prevent complications. Meanwhile, Vitamin D deficiency, though often overlooked, plays a critical role in maintaining bone and muscle health and can exacerbate chronic pain conditions and neuromuscular symptoms.

Effectively managing these conditions requires a comprehensive and individualized approach. This includes conservative treatments like physical therapy, ergonomic adjustments, and appropriate nutritional supplementation for Vitamin D deficiency. Advanced imaging techniques like MRI and CT scans are pivotal in diagnosing structural abnormalities and guiding targeted interventions. While most cases can be managed non-surgically, severe or refractory cases may require surgical solutions, particularly in the context of significant nerve compression.

By addressing contributing factors such as lifestyle habits, weight management, and nutritional deficiencies, patients can improve their overall musculoskeletal health and reduce the risk of long-term complications. Early detection, a multidisciplinary treatment approach, and patient education are key to achieving optimal outcomes and enhancing quality of life.

Declaration by Authors

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