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SPINAL INJURIES

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ABSTRACT

Artificial intelligence (AI) is increasingly positioned as a technology capable of relieving the structural pressures facing agricultural extension systems, including shortages of trained advisors, rising agronomic complexity, and climate variability (Aker, 2011; Neeraja *et al*., 2026). Organic farming, which depends on ecological knowledge, site-specific soil and pest management, and certification integrity rather than synthetic inputs, presents both distinct opportunities and distinct constraints for AI-enabled extension (Brumă *et al*., 2023). This review synthesises peer-reviewed literature published between 2011 and 2026 on AI applications for agricultural and organic-farming extension, organising the evidence around three themes: opportunities, challenges, and ethical concerns. The review finds that machine learning and deep learning models support soil health monitoring, pest and disease diagnostics, and predictive decision support relevant to organic systems (Morellos *et al*., 2016; Upadhyay *et al*., 2025), while conversational and multilingual advisory platforms are extending reach to smallholder and low-literacy populations (Li *et al*., 2022; Javaid *et al*., 2023). At the same time, the literature consistently documents a digital divide, weak data governance, high technology costs, and limited farmer trust as persistent barriers to equitable adoption (Gardezi *et al*., 2023; Klerkx *et al*., 2019). Ethical concerns center on data privacy and ownership, algorithmic bias, accountability, and the risk that AI-driven extension could deepen inequities between large agribusinesses and smallholder or organic producers (Dara *et al*., 2022; Saha *et al*., 2026). The review concludes that realising the benefits of AI for organic farming extension requires farmer-centred design, transparent governance, and hybrid human–AI advisory models.

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INTRODUCTION

Spinal injuries are a significant cause of morbidity and disability worldwide. They result from trauma or non-traumatic conditions affecting the spinal cord and vertebral column, leading to varying degrees of motor, sensory, and autonomic dysfunction. Prompt diagnosis and appropriate management are essential to improve outcomes and minimize complications.

DEFINITIONS

1. Paraplegia

1. Loss of motor and/or sensory function in the lower extremities due to damage to the thoracic, lumbar, or sacral regions of the spinal cord.

2. Hemiplegia

1. Paralysis of one side of the body, often caused by lesions in the brain rather than direct spinal cord injury.

3. Quadriplegia (Tetraplegia)

1. Loss of motor and/or sensory function in all four limbs due to injury to the cervical spinal cord.

ETIOLOGICAL FACTORS

1. Traumatic Causes

1. Road traffic accidents
2. Falls
3. Sports injuries
4. Gunshot wounds or stabbings

2. Non-Traumatic Causes:

1. Spinal tumors
2. Infections (e.g., tuberculosis, abscesses)
3. Congenital disorders (e.g., spina bifida)
4. Degenerative diseases (e.g., spondylosis)

TYPES OF SPINAL INJURIES

1. Complete Injury

1. Total loss of motor and sensory function below the level of injury.

2. Incomplete Injury

1. Partial preservation of motor and/or sensory function below the injury level.

3. Central Cord Syndrome

1. Greater impairment in upper limbs compared to lower limbs.

4. Anterior Cord Syndrome

1. Loss of motor function and pain/temperature sensation, with preserved proprioception.

5. Brown-Séquard Syndrome

1. Ipsilateral motor and proprioception loss with contralateral pain and temperature sensation loss.

PATHOPHYSIOLOGY (FLOW CHART)

1. Initial Injury

1. Trauma or insult to the spinal cord ↓

2. Primary Damage

1. Mechanical disruption, compression, or transection of neural tissue ↓

3. Secondary Damage

1. Inflammatory response
2. Ischemia and hypoxia
3. Release of excitotoxic neurotransmitters ↓

4. Cellular Damage

1. Neuronal death and axonal degeneration ↓

5. Neurological Dysfunction

1. Loss of motor, sensory, and autonomic functions below the level of injury

DIAGNOSTIC EVALUATION

1. Clinical Assessment:

1. Detailed history and neurological examination (e.g., ASIA scale).
2.

2. Imaging Studies

1. X-rays: To assess fractures or dislocations.
2. MRI: To evaluate soft tissue, spinal cord, and nerve roots.
3. CT Scan: Provides detailed visualization of bony structures.

3. Electrophysiological Studies

1. Somatosensory evoked potentials (SSEPs) to assess functional integrity.

MANAGEMENT

1. Emergency Management

2. Stabilization:

1. Immobilize the spine using cervical collars or spinal boards.
2. Maintain airway, breathing, and circulation (ABC).

3. Pharmacological Interventions:

1. Administer high-dose corticosteroids (controversial, case-specific).

4. Transport:

1. Rapid transfer to a specialized spinal injury center.

2. Medical Management

1. Medications:

1. Pain management: NSAIDs or opioids.
2. Muscle relaxants for spasticity.
3. Anticoagulants to prevent thrombosis.

2. Rehabilitation:

1. Physical and occupational therapy to maximize functional recovery.
2. Psychological support for coping.

3. Surgical Management

1. Indications:

1. Decompression of the spinal cord.
2. Stabilization of fractures using rods, plates, or screws.

2. Procedures:

1. Laminectomy or spinal fusion.

4. Nursing Management

1. Assessment:

1. Monitor neurological status and vital signs.
2. Observe for signs of complications (e.g., pressure ulcers, infections).

2. Intervention:

1. Ensure proper positioning and skin care to prevent pressure sores.
2. Educate on bowel and bladder management.
3. Provide emotional support and encourage patient involvement in care.

3. Education:

1. Teach family members about patient care techniques.
2. Reinforce adherence to rehabilitation programs

Prevention

1. Primary Prevention:

1. Promote road safety measures (e.g., seatbelts, helmets).
2. Implement workplace safety regulations.
3. Raise awareness about risk factors and preventive strategies.

2. Secondary Prevention:

1. Early diagnosis and intervention to minimize complications.
2. Public education on the importance of prompt medical attention.

3. Tertiary Prevention:

1. Rehabilitation to restore function and improve quality of life.
2. Support groups for long-term coping and adaptation.

SPINAL CORD COMPRESSION: HERNIATION OF INVERTEBRAL DISC

Introduction

Spinal cord compression due to herniation of an intervertebral disc is a common condition that arises when the nucleus pulposus of the disc protrudes through a tear in the annulus fibrosus, leading to pressure on the spinal cord or nerve roots. This condition can cause significant neurological deficits and requires timely management.

Definition

Herniation of Intervertebral Disc: A condition where the intervertebral disc's nucleus pulposus protrudes through its annulus fibrosus, causing compression of adjacent neural structures.

Etiological Factors

1. **Degenerative Changes:**

1. Age-related disc degeneration.
2. Osteoarthritis of the spine.

2. **Trauma:**

1. Lifting heavy objects incorrectly.
2. Sudden falls or accidents.
3.

3. **Genetic Predisposition:**

1. Family history of disc herniation.

4. **Lifestyle Factors:**

1. Sedentary habits and obesity.
2. Poor posture.

TYPES

1. **Cervical Disc Herniation:**

1. Affects the neck region, potentially causing pain, numbness, and weakness in the arms.

2. **Thoracic Disc Herniation**

1. Rare, but can cause mid-back pain and neurological symptoms.

3. **Lumbar Disc Herniation**

1. Most common; affects the lower back and legs (sciatica).

Pathophysiology (Flow Chart)

1. **Disc Degeneration or Injury**

1. Weakening of the annulus fibrosus ↓

2. **Protrusion of Nucleus Pulposus**

1. Herniation through the annulus fibrosus ↓

3. **Compression of Neural Structures**

1. Spinal cord or nerve root impingement ↓

4. **Inflammatory Response**

1. Release of cytokines and inflammatory mediators ↓

5. **Neurological Symptoms**

1. Pain, weakness, numbness, or paresthesia

DIAGNOSTIC EVALUATION

1. **Clinical Assessment:**

1. History of back pain, radiculopathy, or neurological deficits.
2. Physical examination, including straight-leg raise test.

2. **Imaging Studies**

1. MRI: Gold standard for evaluating soft tissue and neural compression.
2. CT Scan: Useful for bony abnormalities.
3. X-rays: To assess spinal alignment.

3. **Electromyography (EMG)**
4.

1. Evaluates nerve root function.

MANAGEMENT

1. Emergency Management

2. **Immobilization:**

1. Prevent further spinal cord damage by using braces or collars.

3. **Pain Management:**

1. Administer analgesics and anti-inflammatory medications.

4. **Neurological Monitoring:**

1. Regular assessment of motor, sensory, and autonomic functions.

2. Medical Management

1. **Medications**

1. NSAIDs for pain relief.
2. Muscle relaxants for spasms.
3. Corticosteroids to reduce inflammation.

2. **Physical Therapy:**

1. Strengthening exercises and posture correction.

3. Surgical Management

1. **Indications:**

1. Severe neurological deficits or failure of conservative treatment.

2. **Procedures:**

1. **Discectomy:** Removal of the herniated portion of the disc.
2. **Laminectomy:** Decompression of the spinal cord or nerves.
3. **Spinal Fusion:** Stabilization of the spine.

4. Nursing Management

1. **Assessment:**

1. Monitor for changes in pain, mobility, and neurological status.

2. **Intervention**

- Educate on proper body mechanics and postural care.
- Encourage adherence to prescribed therapy.

3. **Postoperative Care**

- Monitor surgical site for signs of infection.
- Ensure early mobilization as advised.

Prevention

1. **Ergonomic Practices**

1. Maintain proper posture while sitting, standing, and lifting.

2. **Lifestyle Modifications**

1. Regular exercise to strengthen back muscles.
2. Maintain a healthy weight.

3. **Education**

1. Raise awareness about proper body mechanics.
2. Advocate early intervention for back pain.

NURSING ASSESSMENT

1. Subjective Data

- Patient complains of back pain, radiating to the arms or legs (depending on the affected area).
- Reports of numbness, tingling, or weakness in extremities.
- History of trauma, repetitive strain, or heavy lifting.
- Difficulty in mobility or performing activities of daily living (ADLs).
- Bowel or bladder dysfunction, if severe compression is present (e.g., cauda equina syndrome).

2. Objective Data

- Altered gait or inability to ambulate.
- Muscle weakness, especially in areas innervated by affected nerve roots.
- Reduced range of motion (ROM) in the spine.
- Tenderness, muscle spasms, or abnormal curvature on palpation of the spine.
- Positive straight-leg raise test (for lumbar disc herniation).
- Diminished or absent deep tendon reflexes

3. Diagnostics

- MRI or CT scans showing herniated disc or spinal injury.
- X-rays indicating fracture, misalignment, or degeneration.
- EMG or nerve conduction studies for nerve involvement.

NURSING CARE PLANS (NCPS)

NCP 1: Acute Pain Related to Nerve Compression or Tissue Injury

Goal: The patient will report a reduction in pain to a tolerable level within 24–48 hours.

Interventions

- Assess pain level using a standardized scale (e.g., 0–10).
- Position the patient to reduce spinal strain (e.g., semi-Fowler's with knees slightly flexed).
- Administer prescribed analgesics (e.g., NSAIDs, muscle relaxants, opioids if severe).
- Apply cold packs for inflammation or heat therapy for muscle spasms.
- Encourage relaxation techniques (e.g., deep breathing, guided imagery).

NCP 2: Impaired Physical Mobility Related to Pain and Neurological Deficits

Goal: The patient will demonstrate improved mobility with minimal assistance within 5–7 days.

Interventions

- Perform a thorough assessment of the patient's ROM, strength, and ability to ambulate.
- Collaborate with physical therapy to create a safe and progressive mobility plan.
- Encourage the use of assistive devices (e.g., walker, cane) as needed.
- Teach the patient proper body mechanics to prevent further injury.
- Promote bed exercises (e.g., ankle pumps, isometric muscle contractions) if ambulation is limited.

NCP 3: Risk for Neurovascular Dysfunction Related to Nerve Compression

Goal: The patient will maintain adequate neurovascular function as evidenced by normal sensation, strength, and pulses.

Interventions

- Monitor neurovascular status (e.g., capillary refill, sensation, and motor function) every 2–4 hours.
- Assess for signs of worsening nerve compression, such as increased numbness or weakness.
- Educate the patient to report any changes in bowel/bladder function immediately.
- Avoid prolonged sitting or standing, which may exacerbate nerve compression.
- Elevate the lower extremities and avoid restrictive clothing to maintain circulation.

NCP 4: Deficient Knowledge Related to Condition, Treatment Plan, and Prevention Strategies

Goal: The patient and family will verbalize understanding of the condition, treatment options, and preventive measures.

Interventions

- Provide education on spinal anatomy and the pathophysiology of herniated discs.
- Explain the prescribed treatment plan, including medications, therapy, or surgical interventions (if indicated).
- Teach proper posture and ergonomics during daily activities and work.
- Instruct on maintaining a healthy weight and engaging in low-impact exercises (e.g., swimming, walking).
- Discuss the importance of follow-up care and recognizing red-flag symptoms, such as severe pain, weakness, or loss of bladder/bowel control.

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