ORTHOPAEDICS

FOR PRIMARY HEALTH CARE

Volume 2

Non-Emergency and Non-Trauma Pathology

Edited by Michael Held

ORTHOPAEDIC DEPARTMENT

UNIVERSITY OF CAPE TOWN

Neurological symptoms

By Ishta Ramguthy, Frances Verfuss, Anria Horn, Yammesh Ramguthy & Benjamin Blankson

Learning objectives

- Understand the common neurological conditions in orthopaedic practice.
- Recognise the importance of comprehensive patient history and examination in diagnosing and managing neurological symptoms in orthopaedic patients.
- Describe the role of special investigations in diagnosing and understanding neurological conditions in orthopaedics.
- Explain non-surgical management options.
- Identify the key surgical interventions and the collaborative approach between orthopaedic surgeons and neurosurgeons in addressing severe or refractory neurological conditions in orthopaedics.

Introduction

There is an intricate interplay between the musculoskeletal system and the nervous system. In this chapter, we focus on the manifestations and management of neurological conditions that present in orthopaedic practice. Neurological symptoms encompass a wide array of signs and symptoms related to nerve compression, injury or dysfunction, which can significantly impact an individual's mobility, sensation and motor function. Carpal tunnel syndrome, lumbar radiculopathy (sciatica), cervical radiculopathy, spinal stenosis and other peripheral nerve entrapments frequently present in orthopaedic practice.

Applied anatomy

Understanding the nerve roots and their corresponding myotomes and dermatomes plays a pivotal role in localising neurological problems in orthopaedics. Knowledge of which spinal nerve roots supply myotomes and dermatomes enables clinicians to pinpoint the exact region affected by nerve compression or injury. Moreover, understanding the anatomical relationships between nerves and adjacent bones provides valuable insights into the potential sources of nerve impingement or irritation.

Clinical findings

History

In assessing neurological symptoms in orthopaedic patients, a comprehensive history is essential for accurate diagnosis and management. Age of onset and the progression of symptoms can provide crucial insights into potential underlying conditions. Additionally, inquiring about past medical history (including traumatic events, repetitive movements and occupational history) helps to identify factors that may contribute to nerve compression or injury.

Patients' complaints of numbness and paraesthesia serve as important indicators of nerve involvement. Pain in a specific dermatomal or peripheral

nerve sensory distribution may indicate an underlying neurological cause; and being aware of common neurological conditions is crucial to ensure early and accurate diagnosis.

Examination

During the examination of orthopaedic patients with neurological symptoms, a full neurological examination should be performed. Observing the patient's appearance and deformities can provide valuable diagnostic information; for example, a claw hand may indicate an ulnar nerve lesion. Assessing motor and sensory function helps localise nerve damage.

***Figure 1**: Claw hand with an ulnar nerve lesion (Source: Mcstrother, CC BY)*

Evaluating muscle tone, power and tendon reflexes aids in identifying abnormalities associated with neurological conditions, distinguishing between upper motor neuron (UMN) and lower motor neuron (LMN) damage, and pinpointing the affected nerve or nerve root. Additionally, evaluating cerebellar and cortical function can reveal neurological abnormalities beyond the peripheral nervous system.

Additional injuries and conditions to note

Carpal tunnel syndrome: This is a common condition characterised by compression of the median nerve as it passes through the carpal tunnel in the wrist. Patients may experience symptoms like pain, numbness or paraesthesia in the thumb/fingers, weakness and reduced wrist mobility.

Lumbar radiculopathy (sciatica): This occurs when a nerve root in the lower back is compressed or irritated, leading to symptoms such as pain, tingling and numbness that radiate down the leg. It often results from a herniated disc, spinal stenosis or degenerative changes in the lumbar spine.

Cervical radiculopathy: Involves compression or irritation of a nerve root in the neck region. Patients may experience pain, tingling and weakness that radiate into the arm and hand following a specific dermatomal pattern. Conditions like cervical disc herniation or foraminal stenosis can lead to cervical radiculopathy.

Peripheral nerve compression: Peripheral nerve compressions, such as cubital tunnel syndrome (compression of the ulnar nerve at the elbow), can cause symptoms like tingling, numbness and weakness in specific areas supplied by the affected nerve.

Spinal stenosis: Narrowing of the spinal canal can lead to compression of the spinal cord or nerve roots. Patients may experience neurological symptoms like limb weakness, paraesthesia, bowel and bladder dysfunction, neurogenic claudication, and difficulty mobilising. Lumbar and cervical spinal stenosis are the most common types in orthopaedics, with lumbar stenosis presenting with a LMN picture and cervical stenosis with myelopathy or UMN disorders. Treatment involves bony decompression of nerve structures.

***Figure 2**: Anterolisthesis of L4 on L5 with flattened and hypointense L4/5 disc showing herniation posteriorly and severe spinal stenosis with cauda equina compression*

Fractures: Fractures can directly or indirectly affect the nerves or spinal cord through nerve and spinal cord compression, bone displacement and fragments (which can cause nerve stretching and damage), blood supply interruption (which reduces blood flow to nerve tissue), and traumatic brain injury from skull fractures. For example, vertebral compression fractures cause compression of the spinal cord or nerve roots, leading to neurological deficits such as pain, weakness or sensory disturbances. All these lead to various neurological symptoms depending on the location and severity of the injury.

Spinal injuries: These can cause a wide range of neurological symptoms. The physical trauma can vary from ligamentous strains to vertebral fractures and fracture-dislocations, potentially affecting the spinal cord and nerve roots through compression, energy transfer or blood supply disruption. Subsequent biochemical changes can exacerbate the initial neurological damage.

Moreover, indirect injuries resulting from falls or violent movements pose a significant risk, subjecting the spine to various forces such as axial compression, flexion, lateral compression, flexion-rotation, shear, flexion-distraction and extension.

During the examination, one should assess for shock. Neurogenic shock, which is characterised by the loss of sympathetic pathways in the spinal cord, can lead to peripheral vessel dilation, hypotension and bradycardia. Spinal shock, which is a temporary physiological dysfunction, manifests as flaccid muscles, absent reflexes (particularly, absent bulbocavernosus reflex, anal tone and perianal pin-prick sensation), and lost sensation below the injury level.

Myelopathy: A complex neurological condition characterised by dysfunction or damage to the spinal cord. It manifests because of various orthopaedic factors, including cervical spondylosis, herniated discs, spinal fractures and degenerative disc disease, creating a cascade of symptoms that can profoundly impact patients. These conditions pose a risk of compressing the spinal cord, leading to a range of neurological deficits, such as muscle weakness, sensory abnormalities, difficulty with walking and fine motor skills, loss of balance and coordination, and abnormal reflexes.

During the examination, meticulous assessment for signs of myelopathy, including gait disturbances, upper motor neuron signs and specific sensory deficits, is essential. Tailored interventions, including conservative measures like physiotherapy and spinal bracing, as well as surgical options for decompression and stabilisation, aim to restore spinal stability, alleviate compression and enhance patient outcomes.

Special investigations

In orthopaedics, thorough investigations are vital for diagnosing neurological symptoms and understanding the intricate musculoskeletal-nervous system interplay.

Plain x-rays in initial assessments show bone pathology, fractures and dislocations which may impact the central and peripheral nervous system.

Magnetic resonance imaging (MRI) reveals cord anatomy and pinpoints compression sites, assists in determining the extent and location of lesions and aids in brain imaging. It is the investigation of choice for radiculopathy and myelopathy and is essential in preoperative planning.

***Figure 3**: MRI showing bulge of the L2 vertebral body and extradural fluid components resulting in severe spinal canal stenosis with cauda equina compression and L1/2 and L2/3 neural foraminal compromise*

Computed tomography (CT) is also valuable for identifying bone fragments' relationship with nerve structures. CT or MRI are best suited for detecting narrowing of the spinal canal, commonly caused by osteophytic overgrowth due to disc degeneration and osteoarthritis of facet joints.

Positron emission tomography (PET) is a functional scan used to isolate specific brain activity regions.

Nerve conduction studies are important in assessing nerve function post-injury, localising the level of nerve involvement, and in cases with two different sites of nerve compression or involvement (e.g. neck and wrist).

Myelography, a diagnostic technique, employs a contrast material combined with real-time fluoroscopy, a specialised form of x-ray imaging. This procedure is valuable in identifying abnormalities within the spinal cord. Notably, myelography serves as an alternative for patients who cannot undergo MRI.

Complementary blood, cerebrospinal fluid investigations, muscle and nerve biopsies, and diagnostic local injections can help in a comprehensive diagnostic approach.

Management

Non-surgical

Orthotics and physiotherapy

Modern orthoses, designed with advanced materials, significantly improve the quality of life for patients with orthopaedic-related neurological symptoms. Orthotics provide external support and alignment to the musculoskeletal system to stabilise and improve functional movement.

Collaborating with physiotherapists, these customised devices optimise stability, muscle strength, flexibility and functional mobility. Regular follow-ups ensure proper fitting and address any changes for improved muscle function and natural movement.

For spinal injuries, immobilisation using orthotics like back braces or cervical collars aids healing and prevents further damage. Physiotherapy employs targeted exercises, stretches and manual techniques to minimise pain and enhance mobility, strength and flexibility.

In carpal tunnel syndrome, wrist splints and braces alleviate pressure on the median nerve, reducing tingling and numbness.

In cases of radiculopathy, physiotherapy exercises help relieve pressure on affected nerve roots and additional treatments like nonsteroidal anti-inflammatory drugs (NSAIDs) and epidural steroid injections help reduce inflammation and pain.

In spinal stenosis, a comprehensive non-surgical approach combining physiotherapy, pain medications and epidural injections, focuses on improving flexibility and spinal stability.

***Figure 4**: Lightweight orthosis (Source: Orthodontist101, CC BY-SA)*

Self-management strategies

Education on posture, exercises and lifestyle modifications empowers patients to actively participate in managing their neurological symptoms and maintaining long-term well-being.

Surgical

Surgical management of neurological symptoms in orthopaedics is a critical intervention aimed at addressing structural causes and providing relief for patients with severe or refractory conditions.

Procedures are tailored to the specific underlying neurological pathology, such as nerve compression, nerve injury or spinal cord compression. Surgical interventions may include discectomy for herniated discs causing radiculopathy, carpal tunnel release for median nerve compression, or ulnar nerve transposition for ulnar nerve entrapment.

In complex cases, nerve grafting or nerve transfers may be employed to restore function in cases of peripheral nerve injuries. Collaborative efforts between orthopaedic surgeons and plastic surgeons are often necessary in these cases. Collaboration with neurosurgeons is often required in the management of compressive pathologies affecting the central nervous system, especially when addressing conditions affecting the spinal cord.

Surgical management requires a thorough evaluation of clinical presentation, imaging studies and the overall health status of the patient. Post-operative rehabilitation and physiotherapy are crucial components of surgical management, aiding in the recovery process and optimising functional outcomes.

***Figure 5**: Posterior internal fixation of an unstable vertebral fracture*

Key takeaways

- Neurological symptoms in orthopaedics involve signs and symptoms related to nerve compression, injury or dysfunction; affecting mobility, sensation and motor function.
- Common neurological conditions encountered in orthopaedic practice include carpal tunnel syndrome, lumbar radiculopathy (sciatica), cervical radiculopathy, myelopathy, spinal stenosis and peripheral nerve entrapments.
- Special investigations, such as plain x-rays, MRI, CT, myelography, PET scans, blood tests, cerebrospinal fluid investigations and muscle biopsies, aid in diagnosis.
- Non-surgical management may include orthotics, physiotherapy, pain management and self-management.
- Surgical interventions tailored to specific underlying neurological pathologies, such as nerve compression, injury or spinal cord compression, play a critical role in providing relief and restoring function in severe or refractory cases.

Assessment

1. A 60-year-old patient presents with complaints of weakness and tingling in the right arm and hand. The symptoms radiate from the neck to the arm and the patient reports difficulty in performing fine motor tasks. Physical examination reveals reduced sensation in the right index and middle fingers and a positive Spurling's test. Which condition is most likely responsible for these symptoms, and what additional investigation is crucial for confirming the diagnosis?

A. Lumbar radiculopathy; CT of the lumbar spine

B. Carpal tunnel syndrome; electromyography (EMG) and nerve conduction studies

C. Cervical radiculopathy; MRI of the cervical spine

D. Spinal stenosis; plain x-rays of the spine

The answer is (C). The patient's presentation with radiating symptoms from the neck to the arm, along with reduced sensation in specific fingers test, strongly suggests cervical radiculopathy. MRI of the cervical spine is crucial for confirming the diagnosis, as it can reveal the site and extent of nerve root compression or irritation.

2. Which of the following is NOT part of the surgical management of neurological symptoms in orthopaedics?

A. Nerve grafting

B. Discectomy

C. Epidural steroid injections

D. Nerve transfers

The answer is (C). Epidural steroid injections are part of non-surgical management, specifically used for reducing inflammation and pain in cases of radiculopathy. The other options are all part of surgical management, addressing specific underlying neurological pathologies.

3. A patient presents with difficulty walking, muscle weakness and paraesthesia in both legs. Imaging reveals compression of the spinal cord. What is the most likely diagnosis?

A. Carpal tunnel syndrome

B. Lumbar radiculopathy

C. Peripheral nerve compression

D. Spinal stenosis

The answer is (D). The patient's presentation of difficulty walking, muscle weakness and paraesthesia in both legs, along with imaging showing compression of the spinal cord, is indicative of spinal stenosis, which can occur in conditions like cervical or thoracic spinal stenosis.

4. A 50-year-old patient presents with neurological symptoms characterised by tingling, numbness and weakness in specific areas supplied by the ulnar nerve. The symptoms are worsened when the elbow is flexed or pressure is applied to the medial elbow. Which condition is most likely responsible for these symptoms?

A. Carpal tunnel syndrome
B. Lumbar radiculopathy
C. Ulnar nerve compression (cubital tunnel syndrome)
D. Cervical radiculopathy

The answer is (C). The patient's presentation of symptoms in specific areas supplied by the ulnar nerve, along with the aggravation of symptoms with elbow flexion or pressure on the medial elbow, is indicative of ulnar nerve compression at the cubital tunnel.

5. A 50-year-old patient presents with neurological symptoms, including weakness and reduced mobility in the wrist and hand. Physical examination shows a weakened grip and reduced sensation in the affected hand. Which surgical procedure is most appropriate for this patient?

A. Carpal tunnel release
B. Laminectomy with discectomy
C. Ulnar nerve transposition
D. Cervical fusion

The answer is (A). The patient's presentation of neurological symptoms, including weakness and reduced mobility in the wrist and hand, along with findings of a weakened grip and reduced sensation, indicates that carpal tunnel release is the most appropriate surgical procedure to address carpal tunnel syndrome and restore function in the affected hand.

References and further reading

Dunn. R., Kruger, N., Apley, A.G., & Solomon, L. Injuries of the spine. In A. Blom, D. Warwick, M.R. Whitehouse (Eds.). Apley & Solomon's System of Orthopaedics and Trauma. (10th ed). Boca Raton, Florida: CRC Press; 2018. p. 835–61.

Dunn R, Kruger N, Apley AG, Solomon L. The back. In A. Blom, D. Warwick, M.R. Whitehouse (Eds.). Apley & Solomon's System of Orthopaedics and Trauma. (10th ed). Boca Raton, Florida: CRC Press; 2018. p. 514–5.

Eastwood D, Apley AG, Solomon L. Neuromuscular disorders. In A. Blom, D. Warwick, M.R. Whitehouse (Eds.). Apley & Solomon's System of Orthopaedics and Trauma. (10th ed). Boca Raton, Florida: CRC Press; 2018. p. 232–255.

Fox M, Warwick D, Srinivasan H, Apley AG, Solomon L. Peripheral nerve disorders. In A. Blom, D. Warwick, M.R. Whitehouse (Eds.). Apley & Solomon's System of Orthopaedics and Trauma. (10th ed). Boca Raton, Florida: CRC Press; 2018. p. 282.

Houlden H, Charlton P, Singh D. Neurology and orthopaedics. Journal of Neurology, Neurosurgery & amp; Psychiatry. 2006;78(3):224–32. doi:10.1136/jnnp.2006.092072

Martini FH, Nath JL, Bartholomew EF. The appendicular skeleton. In: Fundamentals of Anatomy & Physiology. eleventh, global ed. Harlow, England: Pearson; 2018. p. 297.

Mineiro J, Lanca N, Apley AG, Solomon L. The neck. In: Blom A, Warwick D, Whitehouse MR, editors. Apley & Solomon's System of Orthopaedics and Trauma. Tenth ed. Boca Raton, Florida: CRC Press; 2018. p. 455–8.

Myelopathy [Internet]. 2021 [cited 2023 Aug 10]. Available from: https://www.hopkinsmedicine.org/health/conditions-and-diseases/myelopathy

OpenAI. ChatGPT [Internet]. San Francisco, CA: OpenAI; c2021 [cited 2023 Aug 2]. Available from: https://openai.com/chatgpt

Wakeley C, Apley AG, Solomon L. Diagnosis in orthopaedics. In A. Blom, D. Warwick, M.R. Whitehouse (Eds.). Apley & Solomon's System of Orthopaedics and Trauma. (10th ed). Boca Raton, Florida: CRC Press; 2018. p. 10–2.

Editor: Michael Held

Conceptualisation: Maritz Laubscher & Robert Dunn

Publishing Manager: Michelle Willmers

Cover design: Adapted from first edition cover design by Carlene Venter

Proofreading and page layout: Robyn Brown

ABOUT THE BOOK

This is the second volume of the *Orthopaedics for Primary Health Care* textbook edited by Michael Held, first published in 2021.

Most patients with orthopaedic pathology in low- and middle-income countries are tested by non-specialists. This book was based on a Delphi consensus study* with experts from Africa, Europe and North America to identify topics, skills and cases concerning orthopaedic trauma and infection that need to be prioritised in order to provide guidance to these health care workers.

The aim of this book is to be student-centred.

*Held et al. Topics, Skills, and Cases for an Undergraduate Musculoskeletal Curriculum in Southern Africa: A Consensus from Local and International Experts. JBJS. 2020 Feb 5;102(3):elO.

DISCLAIMER

Although the authors, editor and publisher of this book have made every effort to ensure that the information provided was correct at press time, they do not assume and hereby disclaim any liability to any party for any loss, damage, or disruption caused by errors or omissions, whether such errors or omissions result from negligence, accident, or any other cause.

This textbook is not intended as a substitute for the medical advice of physicians.

The information in this book is meant to supplement, not replace, orthopaedic primary care training.

The authors, editor and publisher advise readers to take full responsibility for their safety and know their limits. Before practicing the skills described in this book, be sure that your equipment is well maintained, and do not take risks beyond your experience, aptitude, training or comfort level.

The individual authors of each chapter are responsible for consent and rights to use and publish images in this book.

ACKNOWLEDGEMENTS

Thanks to the Orthopaedic Department in the Faculty of Health Sciences and the Centre for Innovation in Learning and Teaching in the Centre for Higher Education Development at the University of Cape Town for the support received in the development of this publication.