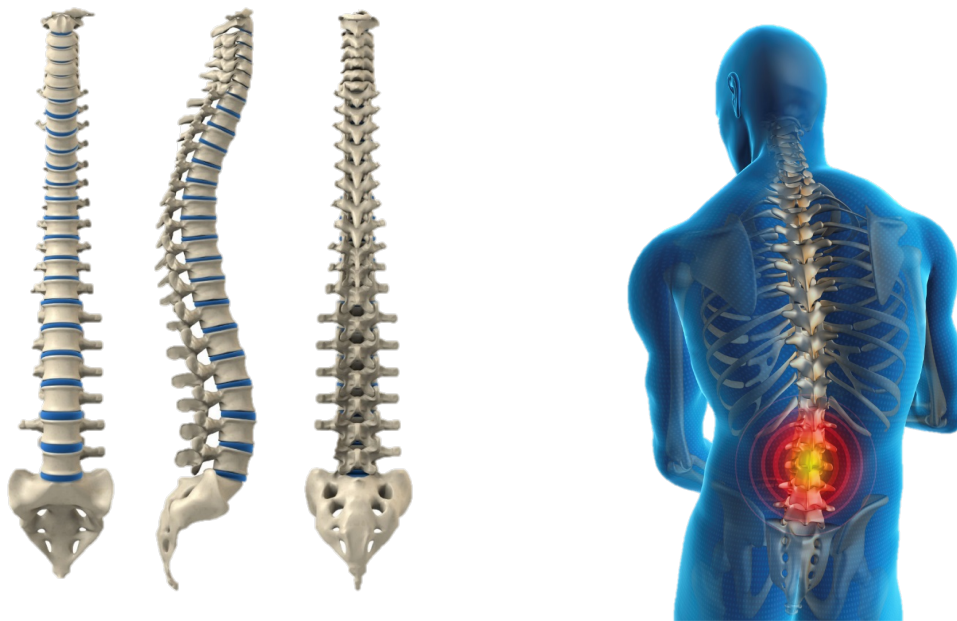


Case-centred Team Based Learning (cTBL)
Dysgu Grŵp Tîm sy'n canolbwyntio ar achosion (cTBL)

“My back is killing me and I can't get out of bed”
“Mae fy ngefn i'n fy llad i a dwi'n methu codi o'r gwely”



Facilitator Guide / Canllaw Hwylusydd

Year / Blw: 25 / 26
Unit / Uned: Adult / Oedolyn
Year / Blw: 2
Case / Achos 14

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Case 14 Timetable/ Achos 14 Amserlen

	Monday	Tuesday	Wednesday	Thursday	Friday
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Week 1

Morning	0900 Plenary Intro Case 14 1000 Plenary Normal Nerve Physiology / Nerve Injury 1100 Plenary Normal Bone Health / Disease	Case 14 CTBL SDL (Reading List) First Aid	Clinical Skills (Cochrane) SDL (Reading List)	Clinical Skills (Llandough / Gwent) OR Community Clinical Learning Pharmacy / People First	0900 Plenary Spinal Pathology 1 1000 Plenary Spinal Pathology 2 1100 Plenary Spinal Pathology 3
Afternoon	1300 Plenary Anatomy Watch Clinical Skills Video Read Anatomy	Case 14 CTBL SDL (Reading List) First Aid 1600 Plenary Spinal Radiology	SDL / Sport	Clinical Skills (Llandough / Gwent) OR Community Clinical Learning Pharmacy / People First	1400 Anatomy Lab OR SDL (Reading List)

Week 2

Morning	Anatomy Lab OR 1000-1130 Lumbar Puncture / Cord Syndromes 1130-1300 Lumbar Puncture / Cord Syndromes	Case 14 CTBL OR Anatomy Lab OR SDL (Reading List)	Clinical Skills (Cochrane) SDL (Reading List)	Clinical Skills (Llandough / Gwent) OR Community Clinical Learning Pharmacy / People First	Case 14 CTBL Conclusion
Afternoon	1400-1530 Lumbar Puncture / Cord Syndromes 1530-1700 Lumbar Puncture / Cord Syndromes	Case 14 CTBL OR Anatomy Lab OR SDL (Reading List)	SDL / Sport	Clinical Skills (Llandough / Gwent) OR Community Clinical Learning Pharmacy / People First	SDL

Unit 6 Overview / Trosolwg Uned 6

This is the second visit to the adult part of the life course and will build on work undertaken in the first year.

The first case introduces learning about the endocrine system and its effects on body homeostasis will be the focus of the first part of this Unit of Study. The basic science underlying glucose metabolism and the pathophysiology of diabetes mellitus will be explored. This will expand prior knowledge of this common and important condition. Abnormal glucose metabolism will be used to illustrate electrolyte and acid/base metabolism, which in turn will lead into the basic anatomy and physiology of kidney function. Diabetes-induced eye diseases are a global health problem and will form the basis of the introduction to the anatomy and physiology of the eye.

The patient centred aspects of this case will introduce the concept of a diabetic follow up assessment and ophthalmoscopy, which will complement the basic science that has been learned. The impact of chronic illness on individuals and the community in which they live and the sociological concepts of chronic disease will be explored. Pharmacological management of the condition will also be described and the principles of patient compliance explored. This will give you an example of a well-rounded approach to chronic disease management to act as a model for your future learning.

In the second case the effects of head or spinal trauma will be used to expand knowledge of the central and peripheral nervous system further. Traumatic injury will allow you to explore other important aspects of clinical care. Although not the leading cause of hearing deficit, head trauma may result in deafness, so this case links to the functional anatomy of the ear.

The third case will be used to explore the common symptom of back pain. You will learn about the normal functional anatomy of the spine and will discover the many different causes of back pain and their underlying pathophysiology. The impact of spinal disease on the normal functioning of the nervous system will allow you to expand your knowledge of the physiology of motor and sensory nerve conduction and explore further some of the pain pathways. You will also be introduced to the concept of red flag symptoms and signs and how they are used to identify patients with significant disease.

The fourth and final Phase 1b case, provides an opportunity to consolidate learning across the previous sixteen cases, bringing together student knowledge of anatomy and physiology and applying it to the presentation of an acutely unwell patient presenting with shock. The emphasis in this case is on the physiological basis of the vital signs of the patient. Therefore, students are challenged with understanding the mechanisms involved in the development of multi-organ failure and the basic scientific principles underpinning the attempts made to manage and monitor the declining vital signs of the patient. The case will also be used to highlight the distinction between urban and rural clinical practice, enabling students to develop knowledge of the way in which health care can be delivered in more remote settings. As part of this theme students will have the opportunity to participate in road traffic collision training involving a live multiagency simulation event. Thus, students will have exposure to the 'acute care' in the pre-hospital arena in a setting remote/distant from secondary care facilities.

Welcome/ Croeso

Introduction to Case 14 from the Case Lead

Welcome to Case 14! During the next two weeks, you will gain a vast amount of knowledge about the spine and about low back pain. Cardiff University is one of the first medical schools to dedicate a whole two weeks of study to the spine and low back pain. In General Practice, low back pain is second only to the common cold as a presenting complaint and most General Practitioners see one to two patients a day complaining of low back pain. Despite being exceedingly common, low back pain is poorly understood. During this two-week module, you will learn how to take a low back pain history, identify things called red flags (and other ones), perform a physical examination of the spine and a neurological examination of the upper and lower limbs. You will learn anatomy, physiology and pathology of the spine. Neurology is often one of the most challenging and worrying parts of the undergraduate curriculum. This module will make you more confident and comfortable in assessing neurological symptoms and signs. This is the 12th Year we have run Case 14 and 3 years ago we critically analyzed the feedback of over 1700 students with over 5600 feedback comments to further improve the Case.

The plenary sessions are all face to face and held in the lecture theatres. They are delivered by Consultants who have cancelled clinical commitments to teach you. We therefore expect you all to attend. All the lectures / plenaries / tutorials will be made available to you after the sessions. You will be provided with EVERYTHING that you need to pass / do well in the exams. I would strongly advise you to actively learn during the sessions and not constantly scribble mountains of notes. Listen and engage with the lecturer - there will be break points throughout the talks to ask questions. The same faculty have delivered the case for over 10 years and, for very good reasons, we have taken the decision NOT to give you the full lectures before the live sessions. Instead, we will give you truncated “gapped” lecture notes and “cheat sheets” for those that wish to “prepare” beforehand. You will be provided with all the presentations in pdf format including notes and additional slides after the live sessions. Panopto recordings will also be made available. Those students with learning needs are welcome to contact me – be rest assured that students in the previous years have all agreed that they were not disadvantaged in any way.

Prior to the clinical sessions you are expected to watch the 4 Essential Clinical Examination Videos (less than 1 hour of your time – THERE ARE NO ERRORS ON THE VIDEOS). On the Wednesday you will be taught the examination skills on each other and on the Thursday, you will practice on patients. Dress appropriately according to the Medical Schools code of practice. **On the Wednesdays, please wear appropriate clothes to be examined in. On the Thursdays, please wear smart clothes or your scrubs.** The skills will be taught in a standardized format to minimize variability and confusion. There have been clear guidelines written on exactly what we expect you to know, so, do not worry! (see below)

The reading list is extensive, but reading is how you will learn throughout your medical careers. There is ample time in your schedule for study. Remember, you don't have to read “everything”!

Over the years the feedback for this Case has been excellent and I am sure that you will enjoy it. Please make sure you do. Finally, please remember that I am an Orthopaedic Surgeon and you will need to keep things simple for me to understand. I will try my best to do the same for you!

Professor Michael J H McCarthy
BMedSci BMBS(Hons) FRCS(Tr&Orth) MSc(OrthEng)
Consultant Spinal Surgeon and Honorary Professor

Case Scenario / Senario Achos

Week 1: Background

You are a general practitioner and are in your busy morning surgery. Rhodri, a 35-year-old man is your first patient. He complains of low back pain that has been waxing and waning over a period of 6 months. He is a manual laborer in a warehouse. He has noticed that the pain is worse after a heavy day's work, in which he has to repeatedly bend and twist while moving heavy boxes. He complains of stiffness mainly in the mornings, usually lasting approximately 30 minutes. He generally finds it difficult to get going and has noticed that the pain tends to reoccur towards the end of the day, when he is relaxing. The pain is exaggerated on changing posture from seating to standing and on straining. Generally, he has found that the pain usually settles over 3-4 days with some ibuprofen. However, he has been in constant pain for the last 2 weeks and is off work, on the sick. He is keen to try some stronger medication and has borrowed some codeine from his rugby mates.

He is married, has a toddler aged 18 months and is the sole wage earner in his household. His wife is annoyed that due to pain he is not able to help around the house with household duties or play with his child. He likes rugby but presently is not able to play. He loves gardening and his vegetables are beginning to suffer, as he cannot tend to them. He is a non-smoker.

On examination, there is tenderness in the lumbar paraspinal muscles especially over the lumbosacral junction. There is acute pain at the extremes of lumbar extension and flexion but otherwise examination is unremarkable. His legs and all joints are normal to examine. Neurological examination is normal.

Week 2

Three weeks later Rhodri re-attends for a further assessment. He is still off work. He outlines that he has been trying to help his wife at home, and while bending over to pick up his son he felt 'something go' in his back. He thinks the back pain has settled however, he now complains of severe pain in his right leg. The pain starts in his buttock and radiates down the back of his right thigh, calf and into the side and sole of his right foot. He complains of numbness on the outer border of his right foot and little toe. He also thinks there is some weakness of his right leg, most noticeable when climbing stairs, as he pushes off from one stair to the next. He has no bladder or bowel symptoms.

He is scared of becoming paralyzed and ending up in a wheelchair. He is worried about paying the bills and losing his job. He wants to get back to work but can't because he is in so much pain. He is angry because nobody seems to be taking his pain seriously and he tells you that he is beginning to believe that people are thinking he is putting it all on for show. All he wants is for the pain to go and to get back to his normal lifestyle.

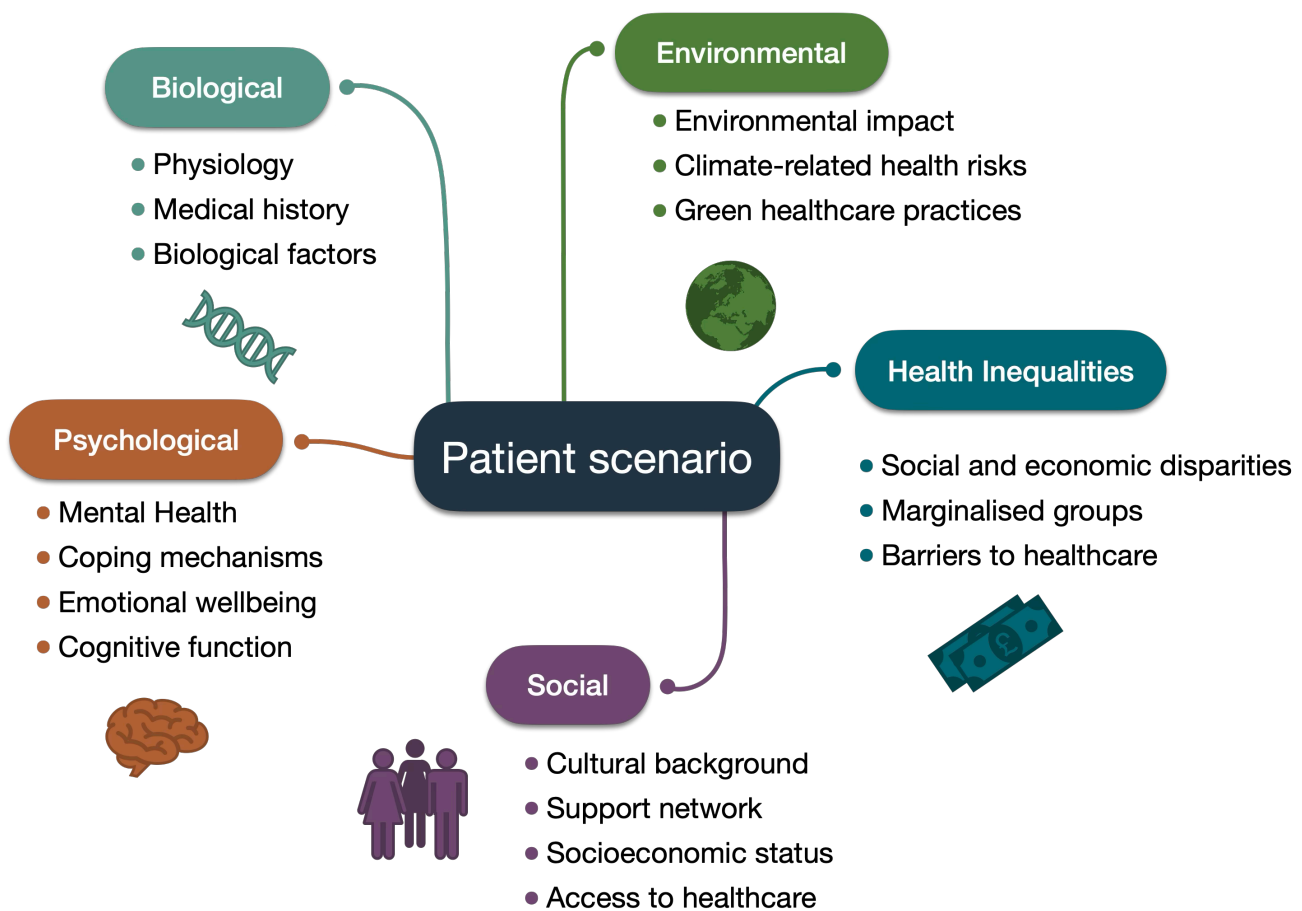
On examination, straight leg raising is limited due to pain at 30 degrees, worse with ankle dorsiflexion with resultant pain radiating into this right leg. There is MRC (Medical Research Council) grade 4 power in right plantar flexion, his right ankle reflex is absent and there is decreased sensation to light touch over the lateral malleolus of the right ankle. He has normal pedal pulses.

Defining and Exploring Key Features / Diffinio ac archwilio nodweddion allweddol

When considering the main factors and features of the case scenario, students are encouraged to adopt a patient-centred perspective whereby biological, psychological and social factors (and the complex interplay between these factors) are considered.

Students should be discouraged from separating clinical factors from social factors when dissecting the case scenario. Instead, they should be implementing a holistic approach when considering the patient's background, presentation and management.

Students should be encouraged to dissect key features in a multidimensional, holistic and patient-centred manner, for example:



This approach will help prepare students for clinical practice by enabling them to reflect on the wide range of important, and interacting, factors that should be considered when taking a history from a patient, composing a differential diagnosis, and implementing a management plan.

Learning Outcomes/ Amcanion Dysgu

Higher Level Learning Outcomes (mapped to Outcomes for Graduates)

Science Outcomes

- H1. Describe the structure and function of the back and spine (22a)
- H2. Outline the functional anatomical and physiology of the spinal cord and peripheral nerves (22a)
- H3. Describe the anatomical relationship of the spinal cord and peripheral nerve roots to the vertebral column (22a)
- H4. Explain the difference between upper and lower motor neurone lesions (22a, 22b)
- H5. Explain the pathological mechanisms responsible for the development of back-pain (22a, 22b)
- H6. Describe the features of medically significant causes of back pain in the adult and the child (red flag symptoms and signs) including metastatic disease, spinal infection, spinal trauma and cauda equina syndrome (15 22a 22b)
- H7. Outline the physiology of bone health (22a)
- H8. Describe the epidemiology of back pain and sickness related absence from work (25a 25c 25d 25e 25j)
- H9. Apply knowledge about the social aspects of chronic illness to understanding patients experiences of back pain, and to clinical practices of information, support and referral (9c 10b 20a 25a)

Practice Outcomes

- H10. Perform a peripheral neurological examination of the arms and legs (14b)
- H11. Perform an examination of the spine (14b)

Professional behaviour outcomes

- H12. Describe the legal framework of work and ill health and processes for sickness and disability certification (4)

Evidence based medicine and numeracy

- NUM. Demonstrate competence to compute, analyse and interpret numerical data, evidence-based medicine data and physiological data.

Specific Learning Outcomes

The higher-level learning outcomes above have been used to create lower level learning outcomes that form the basis of the support sessions for this case. The learning outcomes are divided between the small group case team based learning sessions, the plenaries, practical, support materials and e-learning resources, and community learning. There is some overlap between sessions in terms of learning outcomes, although most learning outcomes have been allocated to a particular session.

For the purpose of the case team based learning sessions, and to avoid repetition of content that is covered in the other support sessions, the lower level learning outcomes are classified as being essential, adding value or of academic/specialist interest only, to help guide group discussions. **Essential** lower level learning outcomes to be covered and met during case team based learning sessions are highlighted in **green**, learning outcomes that **add value** but don't require detailed discussion (may also be covered in other support sessions) are highlighted in **orange**. Learning outcomes of academic or **specialist interest** only can just be touched on in case team based learning sessions and are highlighted in **red**.

Case Team Based Learning Outcomes

By the end of the CTBL sessions, students should be able to:

Science-focused CTBL Outcomes

1. Identify key anatomical structures of the lumbar spine relevant to low back pain presentations (vertebrae, discs, nerve roots). (Supports H1, H3)
2. Distinguish between mechanical, inflammatory, neuropathic, referred visceral, and vascular pain patterns using history alone. (Supports H5)
3. Recognise dermatomal, myotomal, and reflex patterns consistent with single-level lumbar nerve root compression. (Supports H2, H3, H4)
4. Explain, in simple terms, how disc prolapse can result in radicular leg pain and neurological deficit. (Supports H5)
5. Identify clinical features that differentiate non-specific low back pain from serious spinal pathology. (Supports H6)

Practice-focused CTBL Outcomes

1. Extract and prioritise clinically relevant information from mixed clinical documents (history, examination, patient-generated material). (Supports H10, H11)
2. Use negative findings appropriately to reduce the likelihood of serious spinal pathology. (Supports H6)
3. Apply basic neurological examination findings to localise a lumbar nerve root lesion. (Supports H10)
4. Propose an initial, proportionate primary-care management plan for low back pain based on clinical presentation. (Supports H11)
5. Identify changes in symptoms or signs that would mandate urgent investigation or escalation of care. (Supports H6)

Professional Behaviour & Communication CTBL Outcomes

1. Recognise psychosocial ("yellow flag") factors that influence pain experience, recovery, and work absence. (Supports H9)
2. Justify reassurance and conservative management to a patient using clear, non-dismissive language. (Supports H9, H12)
3. Construct a clear and patient-appropriate safety-net statement identifying specific red-flag symptoms. (Supports H6, H12)

Evidence-Based Medicine & Numeracy (CTBL-appropriate)

1. Use guideline-based reasoning to justify when imaging is not indicated in low back pain. (Supports NUM, H6)
2. Interpret population-level data on low back pain prevalence and work absence to contextualise clinical decision-making. (Supports H8, NUM)

WEEK 1 – CSI Spine

Purpose:

To train students in safe, proportionate clinical reasoning for uncomplicated low back pain in a primary care context, with emphasis on diagnostic restraint, reassurance, and safety-netting. This session deliberately challenges the assumption that “doing more” equals better care. Students work in teams of 6–7 as a simulated GP team. They receive a sealed evidence pack containing mixed information (history, examination, patient quotes, social context, misinformation). Different teams approach the same case through different thematic lenses (pain type, psychosocial factors, red flags, management, misinformation), but all teams address the same clinical problem.

Each team must produce one agreed answer sheet including:

- Working diagnosis (concise)
- Key positive findings
- Important negative / reassuring findings
- GP-appropriate management plan
- Clear safety-net statement

This task is designed to help students understand that:

- Most low back pain is mechanical / non-specific
- Absence of red flags is clinically meaningful
- Reassurance is an active, evidence-based decision
- Imaging and escalation are often unnecessary and harmful
- Psychosocial (“yellow flag”) factors influence recovery
- Uncertainty is intentional and reflects real GP decision-making.

Key Learning Messages to Reinforce

- “Mechanical back pain” is a diagnosis of exclusion
- Negative neurological findings matter
- Advice to stay active is therapeutic
- Pain severity ≠ serious pathology
- Safety-netting is part of management, not an afterthought

Resources Given to Students (and Why)

- NICE low back pain guidance → Supports conservative management and avoidance of imaging
- GP-style consultation notes → Trains prioritisation and use of negative findings
- Patient quotes / pain diagrams → Introduces psychosocial context and yellow flags
- Examples of misinformation → Encourages filtering noise and managing expectations

Facilitator Role

- Clarify instructions only
- Encourage justification of decisions
- Highlight use of negative findings
- Do not resolve uncertainty for the group

Teaching and consolidation occur in the wrap up session.

WEEK 2 – Spine Escape Lab

Purpose:

To train students to recognise deterioration, localise neurological pathology, and escalate care appropriately when low back pain becomes unsafe. This session deliberately contrasts with Week 1. Students revisit the same patient after clinical deterioration. Working in teams of 6–7, they complete a timed Escape Lab consisting of five sequential “locks”, each representing a critical clinical decision:

- Recognising radicular (not mechanical) pain
- Anatomical localisation (disc, nerve root)
- Classifying urgency and risk
- Deciding on investigation and escalation
- Identifying cauda equina syndrome

Teams may only progress once each decision is verified. This task demonstrates that:

- Reassurance is correct only until the presentation changes
- Neurological symptoms fundamentally alter risk
- Pattern recognition is essential in spinal pathology
- Delay in escalation can have catastrophic consequences
- Students must learn when reassurance becomes unsafe.

Key Learning Messages to Reinforce

- Leg pain > back pain suggests radiculopathy
- Dermatomes, myotomes, and reflexes localise pathology
- Weakness changes urgency
- Normal bladder/bowel ≠ no risk
- Cauda equina is a spectrum, not a single sign

Resources Given to Students (and Why)

- NICE / BMJ guidance on sciatica → Supports escalation and imaging when neurology is present
- Dermatome, myotome, reflex charts → Enables anatomical localisation
- ASIA-style neurological documentation → Introduces structured neurological assessment
- Symptom lists including red flags → Trains prioritisation (routine vs urgent vs emergency)

Facilitator Role

- Verify answers, not reasoning pathways
- Maintain task flow and time discipline
- Resist giving clinical hints
- Allow teams to feel pressure - it is intentional

Teaching and consolidation occur in the wrap up session.

Spiral Curriculum/ Cwricwlwm Troellog

Prior Learning that will Relate to this Case

These are examples of what you have already covered and will expect to cover during the course.

Platform for Clinical Science

Neurology practical
Cell and tissue structures and biochemical functions
Organ structure and function
Spinal Anatomy
Neurophysiology

Cases

Case 1: Musculoskeletal assessment, Analgesics and Pain plenaries, bone structure and fracture healing, osteoporosis (diagnosis and management), arthritis (Bone health plenary)
Case 8: Anaesthetics plenary (Regional and Spinal anaesthesia)
Case 10: Neurophysiology plenary (Brain)
Case 13: Head Injury and Trauma

Clinical Skills

You have had introductory teaching to musculoskeletal examination and history in Year 1.

Forthcoming Learning that will Relate to this Case

Year 3: Chronic disease module
Year 3: Hospital front door
Year 4: Lumbar Puncture

Feed FORWARD

From the feedback that your predecessors provided us last year we have kept;

EVERYTHING

We have changed;

From CBL to CTBL...with Team Tasks

The reading list – has been reduced

Truncated “gapped” lecture notes released before the lectures along with cheat sheets

Think FORWARD - SSCs

If there is a subject area that you are interested in, look for the practicals and sessions on the topic. Then, please, introduce yourself to a staff member involved in the session to see if you could work together on an SSC in the future.

Understanding People / Deall Pobl

Work and Health Workbook

[available on Learning Central within the Case 14 Understanding People folder]

Employment is a primary determinant of health, impacting both directly and indirectly on the individual, their family and communities. This workbook will help you to consider the relationship between work and health, and will introduce you to the **Work and Health App**. This App provides key information about Work and Health that will help you to achieve the learning outcomes listed at the start of this workbook. The App includes videos showing different perspectives about work and health, how you can talk to patients about work and health, and also two decision aids: The 'Shared Decision Making Tool' and the 'Fit Note Decision Aid'.

Low Back Pain e-module

(available on Learning Central within the case 14 e-learning folder)

This e-module focuses on appropriate and timely management of low back pain and aims to support the provision of evidence based care of this common condition. The module covers: managing patients presenting with acute back pain; psychosocial factors associated with back pain; identifying 'at risk' patients who may go on to develop chronic pain; managing patients with chronic low back pain.

Resources / Adnoddau

The recommended reading list for this case can now be viewed through the Library reading list software on Learning Central. This will keep the reading list current and avoid duplication of reading material.

Link here: https://whelf-cardiff.alma.exlibrisgroup.com/leganto/public/44WHELP_CAR/lists/9422569370002420?auth=SAML&courseCode=2122-MEDIC-CRS-YR2-ADULT

Plenary Sessions / Sesiynau Llawn

INTRODUCTION TO CASE 14

- See Anatomy Practical Below

NORMAL NERVE PHYSIOLOGY AND NERVE INJURY

- Describe the physiology of normal nerve conduction at a cellular level including the maintenance of a resting and action potentials via sodium and potassium gated channels
- Describe transmission of an electrical signal along a nerve axon and the role of the myelin sheath
- Describe the release of neurotransmitters at pre-synaptic junctions and subsequent generation of a post-synaptic action potential
- Describe the afferent and efferent pathways involved in the detection of a peripheral stimulus and the resulting motor response
- Describe the response of a nerve to injury in terms of neural regeneration, comparing and contrasting the peripheral and central nervous systems
- Demonstrate understanding of nerve physiology and synapses with specific example of mechanism of action of local anaesthetic and other agents e.g. depolarising muscle relaxants

NORMAL BONE HEALTH AND BONE DISEASE

- Understand the structure and function of bone and articular cartilage
- Explain the role of osteoblasts and osteoclasts in normal bone remodelling
- Understand the relationship between calcium, vitamin D and parathyroid hormone in normal bone remodelling
- Describe the bones response to injury and the normal healing process for a fracture
- Describe the factors that prevent normal fracture healing
- Understand the concept of osteoporosis as a state of reduced bone mineral density and the resultant increased risk of fracture
- List protective factors and risk factors for the development of osteoporosis
- Name at least two medications used in osteoporosis for fracture prevention
- Describe the clinical consequences of vitamin D insufficiency (rickets and osteomalacia)

SPINAL RADIOLOGY

- Understand normal radiological imaging of the spine (X-rays, CT and MRI) and be able to demonstrate anatomical structures
- Understand the key concepts, indications, contraindications and basic physics principles behind X-Ray, CT, MRI, Bone scan, Myelogram and DEXA scan

SERIOUS SPINAL PATHOLOGY 1 – LOW BACK PAIN IN THE CHILD AND SPINAL INFECTIONS

- List the presenting features and risk factors for spinal infections
- Explain the ways in which spinal infections can cause spinal cord compression
- Recognise spinal infection as a serious condition and understand the initial steps in its investigation and management
- Recognise epidural abscess as a surgical emergency
- List the more common infective agents that can cause spinal infections (including tuberculosis)
- Recognise the serious causes of back pain in a child
- Understand the principles and causes of childhood spinal deformity

SERIOUS SPINAL PATHOLOGY 2 – SPINAL TRAUMA

- Be familiar with the epidemiology and main causes of spinal cord injury
- Be familiar with the presenting features of spinal cord injury including spinal shock, neurogenic shock and autonomic dysfunction
- Explain the initial physiological consequences of spinal cord injury on the cardiovascular and respiratory systems
- Explain the concept of complete and incomplete spinal cord injury
- Explain the initial management and investigation of patients with spinal cord injury

SERIOUS SPINAL PATHOLOGY 3 – METASTATIC SPINAL CORD COMP / STENOSIS / SPONDYLOLISTHESIS

- Be familiar with the epidemiology of spinal metastases and metastatic spinal cord compression
- Identify key clinical features that would raise suspicion of metastatic spinal disease
- List the more common malignancies which metastasize to bone
- Explain the ways in which spinal metastases can cause spinal cord compression
- Recognise metastatic spinal cord compression as a medical / surgical emergency and understand the initial steps in its investigation and management
- Recognise the difficulty in the management of some cases of metastatic spinal cord compression and be aware of sources of support (palliative care / oncology / Macmillan / support groups etc.)
- Understand and explain the pathology and clinical features of spinal stenosis and spondylolisthesis
- Be able to differentiate spinal stenosis from vascular claudication

Practical and Tutorials / Sesiwn Ymarferol a Thiworialau

PRACTICAL AND TUTORIALS:

Anatomy Practical / Lumbar Puncture / Cord Syndromes (and the Introductory Lecture)

- Know the macroscopic and microscopic anatomy of the bones, ligaments and muscles around the spine, the intervertebral disc, the spinal cord, meninges and nerves
- Demonstrate the main spinal cord motor and sensory tracts and the deficits that result as a consequence to injury
- Explain the different spinal cord syndromes – anterior, posterior, central, Brown-Sequard and cervical myelopathy
- Explain the difference between upper and lower motor neuron lesions with clinical examples
- Explain the presenting features of cauda equina syndrome
- Identify the main causes of cauda equina syndrome
- Recognise cauda equina syndrome as a surgical emergency and understand the initial steps in its investigation and management
- Demonstrate the anatomical landmarks and principles for performing epidural and spinal injection / catheter insertion

Clinical Skills / Sgiliau Clinigol

- Be able to conduct an appropriate history from a patient with a spinal complaint / condition
- Perform an examination of the spine
- Perform a neurological examination of the upper and lower limbs

History and Examination Session:

Wednesday Morning Weeks 1 and 2 – Year Split

Thursday Weeks 1 and 2 – Year Split

History

- Be able to conduct an appropriate history from a patient with a spinal condition
- Describe and determine the nature of the pain in terms of Site, Onset, Character, Radiation, Associations, Time course, Exacerbating / relieving factors and Severity (SOCRATES)
- Describe and determine any associated features such as arm / leg pain, weakness, numbness, bladder / bowel involvement
- Be able to screen for any red flag features
- Be able to screen for any yellow flag features
- Assess risk factors for the complaint / condition
- Determine the medications / treatments which have been utilised
- Outline a full employment history and its impact on the clinical problem
- Determine the functional limitations as a consequence of the pain
- Outline a full social history including smoking history and sports activities
- Make an enquiry as to the emotional consequences of the spinal condition
- Ascertain and address the ideas, concerns and expectations of a patient with a spinal complaint

Back Examination

Look

- Be able to conduct an appropriate physical examination on a patient
- Perform a physical inspection of the spine (assess for normal thoracic kyphosis and lumbar lordosis, presence of any spinal deformities, scoliosis, skin changes etc)

Feel

- Palpate vertebral spinous processes for tenderness and paraspinal muscles for muscle spasm
- Palpate over the sacroiliac joints / PSIS for tenderness
- Palpate any region of interest for tenderness

Move

- Assess cervical and thoracolumbar spine movements actively and passively
 - Flexion
 - Extension
 - Lateral bending
 - Left and right rotation (fix hips for thoracolumbar rotation)

Special Tests

- Perform Schober's test – measure the lumbar spine flexion – place fingers on 5th lumbar vertebrae; patient touch toes, your fingers should separate; reduced in example ankylosing spondylitis
- Perform Adams forward bending test to assess for any fixed spinal deformity – patient bends forward; stand behind and look for abnormality of spinal curve – lordosis/kyphosis/asymmetry/tilt etc
- Assess straight leg raising (Lasègue's sign)

Neurological Examination of the Upper and Lower Limbs

Inspection

- Look!

Tone

- Assess muscle tone – passive movements elbow wrist flexion / extension / supination / pronation; knee flexion / extension – rigidity / flaccidity?

Power

- Assess power / strength (MRC – Medical Research Council grading) according to the myotomes described by the American Spinal Injury Association (ASIA) (see extra sheet)
- MRC Grading – 5 muscle contracts against full resistance; 4 strength reduced but still move against resistance; 3 further reduced – move only against gravity; 2 movement only if gravity removed; 1 – trace movement; 0 no movement

Reflexes

- Assess deep tendon reflexes – hyper and hyporeflexia – Biceps C5/6; Brachioradialis C5/6; Triceps C7/8; Patellar L3/4; Achilles/Ankle S1/2

Sensation

- Assess sensation according to the dermatomes described by the American Spinal Injury Association (ASIA) (see extra sheet)
- Modalities of sensory testing (pain, temperature, light touch, vibration, joint position sense)

Coordination

- Finger movements, finger nose test, heel shin test
- Assess gait and Romberg's sign – patient stands and closes eyes – shouldn't wobble or fall – tests proprioception through the dorsal column of spinal cord

Special Tests

- Assess plantar responses
- Perform Hoffmann's test – flick terminal phalanx of middle finger – when abnormal induces flexion in terminal phalanx of thumb (problems in corticospinal tract)
- Assess for clonus – rapidly dorsiflex foot – watch gastrocnemius – should be no more than 5 beats of clonus
- Assess for saddle anaesthesia and anal sphincter tone

Other

- Briefly assess other non-spinal joints for sources of pain / pathology e.g. shoulder, elbow, wrist, hand, sacroiliac joint, hip, knee, ankle, foot (GALS screen)
- Be familiar with Waddell's signs – non organic physical signs in low back pain. Tenderness tests: superficial and diffuse tenderness and/or nonanatomic tenderness. Simulation tests: these are based on movements that produce pain, without actually causing that movement, such as axial loading and pain on simulated rotation. Distraction tests: positive tests are rechecked when the patient's attention is distracted, such as a straight leg raise test. Regional disturbances: regional weakness or sensory changes that deviate from accepted neuroanatomy. Overreaction: subjective signs regarding the patient's demeanour and reaction to testing

Professionalism

- Learn to be respectful and courteous to both staff and patients in both verbal and non-verbal communication
- Dress appropriately

Year 2 Spine and Neurological Examination

Dear All,

Please find below clarification of the clinical examination skills taught to the 2nd Year medical students with respect to Spine and Neurological Examination. The students always find this topic stressful and this document is intended to facilitate standardization. Please note that this is the first time the students have been formally taught neurological examination and that they are only in their second year. Therefore, we have taught the students a foundation on which to further their skills in future years. These notes are very basic and in short form for quick key reference. Nuances / specifics are not covered. The students are aware that they can perform the examination with or without a verbal description to the examiner. They must show good communication with and, give clear instructions to the patient.

1. Spinal Examination

The students have been specifically taught how to examine the whole spine using the look, feel, move and special tests approach. They have been taught to:

LOOK:

Assess for normal cervical lordosis, thoracic kyphosis and lumbar lordosis, presence of any spinal deformities, scoliosis, kyphosis, skin changes, scars etc.

Check that the head is above pelvis from in front and from the side.

FEEL:

Palpate - spinous processes in the midline, paraspinal muscles, over the sacroiliac joints / the Posterior Superior Iliac Spines (using one finger in one place at one time).

MOVE:

Assess cervical (C) thoracic (T) and lumbar (L) spine movements actively (+/- then passively)

C- Flexion / extension, left and right rotation, lateral bending then

L - Flexion / extension, lateral bending then

T - Thoracic rotation done with pelvis secured sitting on the edge of the bed.

SPECIAL TESTS:

3 tests were chosen at the inception of C21.

1. Perform Schober's test to measure lumbar spine flexion:

For this test the students have been made aware of its principles – the test confirms that the lumbar spine is actually moving. The students have been told to place their fingers on the lower lumbar spinous processes and observe that their fingers move apart and together during flexion and extension. The students are aware that the original description was using a marker pen and measuring tape to quantify the movement.

2. Perform Adams forward bending test to assess for any fixed spinal deformity:

For this test the students have been made aware that they have already partly performed the test when assessing lumbar spine flexion. The student asks the patient to bend forward until the hips and spine are at approximately 90 degrees. The arms should hang perpendicularly, and the patient should gently place their chin on their chest (neck flexion). The student looks from behind and from the side to assess the shape of the spine i.e. is it normal or is there any deformity - scoliosis, rib hump or exaggerated kyphosis? The test makes structural deformity more obvious and reduces the presence of any nonstructural deformity (i.e. muscle spasm).

3. Assess straight leg raising (Lasègue's sign):

The students are aware that this test assess the presence of radicular leg pain possibly arising from a lumbar spine disc prolapse tenting a nerve root. The patient is laid flat on the examination couch (pillow under head).

The normal leg is passively lifted from the ankle with the knee kept straight. The angle between the bed and leg is normally greater than 70 degrees. The affected leg is then examined. The angle at which the patient feels radicular pain going down the leg is recorded. This is a positive straight leg raise test or Lasègue's sign. The patient might only feel back pain – this is a negative test, but the presence of back pain should be recorded. The test can be reinforced by dorsiflexing the ankle or flexing the cervical spine. Flexing the knee should relieve the symptoms.

2. Neurological Examination

The students have been specifically taught how to examine upper and lower limb neurology using the inspection, tone, power, reflexes, sensation and coordination approach. The teaching is specific to the spine and not peripheral nerves. To standardize and simplify the teaching we have adopted the American Spinal Injuries Association (ASIA) International Standard Examination Chart which is used worldwide in assessing spinal cord injury. The students have been taught the following with the patient lying comfortably inclined on an examination couch:

INSPECTION:

Posture, Contractures, Scars, Wasting, Involuntary movements, Fasciculations, Tremor etc.

TONE:

Assess muscle tone – gently move the limb passively – assess for flaccidity / rigidity / normality.

POWER:

Assess power / strength using the MRC grading (out of 5 – see chart below).

Assess myotomes as per American Spinal Injury Association (ASIA) Chart (see chart below).

The students can choose to do one limb at a time, or they can test each myotome left versus right one at a time.

Please note that at this stage in their training they have been specifically taught:

C5 - elbow flexion

C6 - wrist extension

C7 - elbow extension

C8 - finger flexion

T1 - little finger abduction

L2 - hip flexion

L3 - knee extension

L4 - ankle dorsiflexion

L5 - great toe extension

S1 - ankle plantar flexion

REFLEXES:

Assess deep tendon reflexes.

The students have been taught how to perform the following reflexes:

Biceps (C5/6) / Brachioradialis (C5/6) / Triceps (C7/8)

Knee (L3/4) / Ankle (S1/2) / Plantar response (Babinski).

The students are aware that there are different ways of performing tendon reflexes. They are expected to demonstrate competency in the technique that they chose to perform. They have to know basic anatomy (i.e. they are hitting the correct tendon structure and not other structures – e.g. the patella itself), how to swing the tendon hammer safely and not to hurt the patient.

The students are aware of the following:

Assess for inverted radial reflex and Hoffman's sign

Assess for ankle clonus.

SENSATION:

The students have been taught to use the dermatome map as per the American Spinal Injury Association (ASIA) Chart (see chart below). The students are aware that they can assess for Pain / Temperature / Light touch / Vibration / Joint Position Sense. But, for the current stage of their training and for the time available during an

ISCE we have told the students that the most important thing is that they know the key dermatomes and they start with a crude assessment – i.e. explain to the examiner that they can test all of the above but that they will start with a crude assessment using their finger to touch the key dermatomes (this assesses pain sensation modality in the spinothalamic tract). They can then ask the examiner, or the examiner can specifically instruct the student to test the different sensory modalities per dermatome (spinal cord level).

COORDINATION:

The students have been taught to assess coordination using:

Finger nose test – patient touches the students’ finger with their finger and then they touch their nose and repeat.

Hand dexterity – touching thumb with fingers sequentially and repeat.

Heel shin test – patient actively lifts leg off couch and runs heel down contralateral shin, lift and repeat. The student should passively show the patient how to do this first.

Gait – the student should ask the patient to get off the couch and walk or should indicate that they would like to do this (if appropriate i.e. not in an acutely injured or stroke patient).

Romberg’s test – the student should ask the patient to stand up and perform this test or should indicate that they would like to do this (again if appropriate). The student asks the patient to stand with their feet together and arms by their side. They then ask the patient to close their eyes and they assess for unsteadiness / swaying / loss of balance. This indicates a positive test / Romberg’s sign.

Finally, the students must know the difference between upper and lower motor neuron signs:

Sign	UMN	LMN
Weakness	More diffuse	More focal
Atrophy	Mild general	Severe focal
Atrophy vs Weakness	Severe weakness Mild atrophy	Severe atrophy Mild weakness
Fasciculations	Never seen	+/-
Muscle Tone	Increased	Decreased
Muscle Stretch Reflexes	Increased	Decreased / Absent
Clonus	+/-	Never present
Plantar Response	+/-	Absent

Kind regards,

Professor Michael J H McCarthy
 BMedSci BMBS(Hons) FRCS(Tr&Orth) MSc(OrthEng)
 Consultant Spinal Surgeon and Honorary Professor

Community and Clinical Learning/ Dysgu Clinigol Cymunedol

Students will take part in 2 community learning opportunities during Case 14. Both will run in person.

- Joint teaching with Pharmacy Students, looking at the role of the GP and that of the Community Pharmacist with an emphasis on pain management. A student guide for the session guide will go on Learning Central at the beginning of the case. Students should download / update the free electronic BNF app in advance of this session. This will be used during the session.
- Understanding People with Learning Disabilities in conjunction with People First.

Joint Teaching with Pharmacy Students

- Students will undertake small group work with the groups including both Medical and Pharmacy students, so you learn with and from each other. You will be taught by GP Tutors from the Community Learning team and our colleagues from the School of Pharmacy to gain an understanding of the roles and remit of both.
- Students will work through a series of tasks relating to a patient case study.
- With the support of facilitators from the appropriate team, students will work through scenarios looking at prescribing decision making and factors influencing this; what happens to the prescription when it reaches the Pharmacy including what factors affect the dispensing, other roles that the Pharmacist undertakes, Standard Operating Procedures and Independent Prescribing using resources provided on the day.
- The prescribing issues will be with reference to prescribing for pain management.

Learning Outcomes for the Session

- Understand the symptom iceberg and how patients access different services for health care: Apply theoretical framework of sociology to explain the varied responses of individuals, groups and societies to disease.
- Explain compliance issues and how Dositte boxes and other aids help: Discuss sociological aspects of behaviour change and treatment compliance.
- Be able to give minor illness advice: Demonstrate ability to select appropriate forms of management for common diseases and explain their modes of action and their risks. Make an initial assessment of a patient's problems and a differential diagnosis. Make clinical judgements and decisions based on the available evidence as appropriate for the graduate's level of training and experience. Support the patient in caring for themselves.
- Be able to give lifestyle advice including smoking cessation: Determine the extent to which patients want to be involved in decision-making about their care and treatment, and provide explanation advice, reassurance and support.
- Understand the problems of polypharmacy; medication history; drug interactions (Medical Use Reviews): Demonstrate knowledge of drug actions: therapeutics and pharmacokinetics; drug side effects and interactions, including multiple treatments, long term conditions and non-prescribed medication.
- Be able to take an accurate drug history, covering both prescribed and other medication. Plan appropriate drug therapy for common indications. Provide patients with appropriate information about their medicines; Access reliable information about medicines, detect adverse drug reactions.
- Demonstrate awareness that many patients use complementary and alternative therapies and how this might affect other types of treatment that patients are receiving.
- Inter-professional learning: Understand and respect the roles and expertise of health and social care professionals in the context of working and learning as a multi-professional team.
- Understand the role and scope of the Pharmacist in the community setting: Understand the framework in which medicine is practiced in the UK.

Inclusion and Accessible Communication for Year 2 Medical Students

This session aims to facilitate understanding of and exposure to common issues faced by adults with a learning disability. The session will take place centrally, led by a Trainer with a learning disability.

Learning Objectives for Personal and Portfolio Development

The following learning objectives are **stipulated by the GMC** as part of your on-going development. These are professional behaviours that will help develop you as a doctor and help you to be the best practitioner that you can be. Although, these are not formally assessed, be mindful of these explicit learning objectives and to adhere to them. If it is identified that you are behaving in a manner that is contradictory or inconsistent with these objectives, your case will be escalated on professional behaviour misconduct (ME2103).

- Communicate clearly, sensitively and effectively with individuals and groups regardless of their age, social, cultural or ethnic backgrounds or their disabilities, including when English is not the person's first language. (15b)
- Be polite, considerate, trustworthy and honest, act with integrity and maintain confidentiality. (20c)
- Respect all colleagues and others regardless of their age, colour, culture, disability, ethnic or national origin, gender, lifestyle, marital or parental status, race, religion or beliefs, sex, sexual orientation, or social or economic status. (20d)
- Recognise the rights and the equal value of all people (20e)
- Acquire, assess, apply and integrate new knowledge, learn to adapt to changing circumstances. (21a)
- Establish the foundations for lifelong learning and continuing professional development, including a professional development portfolio containing achievements. (21b)
- Manage time and prioritise tasks and work autonomously when necessary and appropriate. (21d)
- Recognise own personal and professional limits and seek help from colleagues and supervisors when necessary. (21e)
- Understand and respect the roles and expertise of professionals in the context of working and learning as a team. (22a)
- Work with colleagues in ways demonstrating flexibility, adaptability and a problem-solving approach. (22c)
- Demonstrate ability to build team capacity and positive working relationships and undertake various team roles including leadership and the ability to accept leadership by others. (22d)

Wrap Up / Crynhoi

The case writers will go over the case, feedback to the students and provide some formative questions that cover the material that they should have learnt. The morning will be concluded with a question and answer session.

Cheat Sheets / Taflenni Twyllo

(Topics in order of Case 14 Timetable)

Spinal Anatomy:

1. General Structure:

- The spine is divided into several regions: cervical (neck), thoracic (upper back), lumbar (lower back), sacral (pelvis), and coccygeal (tailbone).
- There are 33 vertebrae in total: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral (fused into the sacrum), and 4 coccygeal (fused into the coccyx).

2. Vertebrae Structure:

- **Body:** The anterior, weight-bearing part.
- **Vertebral Arch:** Posterior to the body, consists of pedicles, laminae, and a spinous process.
- **Transverse Processes:** Project laterally from the junction of pedicles and laminae.
- **Articular Processes:** Superior and inferior, form facet joints with adjacent vertebrae.

3. Intervertebral Discs:

- Situated between adjacent vertebral bodies.
- Consist of an outer fibrous ring (annulus fibrosus) and an inner gel-like core (nucleus pulposus).
- Act as shock absorbers and facilitate movement.

4. Spinal Cord and Nerves:

- The spinal cord extends from the brainstem to the lower back, terminating in the conus medullaris.
- Nerve roots emerge from the spinal cord and exit through intervertebral foramina.
- Cauda equina: A bundle of spinal nerves and spinal nerve roots below the conus medullaris.

5. Ligaments and Muscles:

- Ligaments support the spine, including the anterior and posterior longitudinal ligaments, ligamentum flavum, interspinous ligaments, and supraspinous ligament.
- Numerous muscles support and facilitate movement of the spine.

6. Vascular Supply:

- The spinal cord is supplied by the anterior and posterior spinal arteries.
- Vertebrae and discs receive blood supply from segmental arteries.

7. Regional Characteristics:

- **Cervical:** C1 (atlas) and C2 (axis) have unique structures for head rotation.
- **Thoracic:** Articulate with ribs and are characterized by longer spinous processes.
- **Lumbar:** Larger bodies to bear more weight.
- **Sacral and Coccygeal:** Fused vertebrae forming the back of the pelvis and the tailbone, respectively.

8. Spinal Curvatures:

- Normal spinal curvatures include cervical lordosis, thoracic kyphosis, lumbar lordosis, and sacral kyphosis.
- Help in weight distribution and shock absorption.

Neurophysiology:

1. Basic Structure of a Nerve:

- **Neurons:** The basic functional units of the nervous system.
- **Cell Body:** Contains the nucleus and essential organelles.
- **Dendrites:** Receive signals from other neurons.
- **Axon:** Conducts electrical impulses away from the cell body.
- **Myelin Sheath:** Insulates axons to speed up signal transmission.
- **Nodes of Ranvier:** Gaps in the myelin sheath where action potentials are regenerated.

2. **Types of Neurons:**
 - **Sensory (Afferent) Neurons:** Carry signals to the CNS from sensory receptors.
 - **Motor (Efferent) Neurons:** Transmit signals from the CNS to muscles or glands.
 - **Interneurons:** Facilitate communication within the CNS.
3. **Nerve Impulse Transmission:**
 - **Resting Membrane Potential:** A voltage difference across the neuron's membrane at rest.
 - **Action Potential:** A temporary reversal of the membrane potential that propagates along the neuron.
 - **Depolarization:** Inward flow of sodium ions, making the inside of the cell more positive.
 - **Repolarization:** Outward flow of potassium ions, restoring the resting membrane potential.
4. **Synaptic Transmission:**
 - **Synapse:** Junction between neurons or between a neuron and an effector cell.
 - **Neurotransmitters:** Chemicals released by neurons to send signals across synapses.
 - **Receptors:** Proteins on the receiving cell's surface that bind neurotransmitters.
5. **Types of Neurotransmitters:**
 - **Excitatory:** Promote the generation of an action potential (e.g., glutamate).
 - **Inhibitory:** Prevent action potentials (e.g., GABA).
6. **Nerve Conduction:**
 - **Myelinated Axons:** Conduct impulses quickly via saltatory conduction.
 - **Unmyelinated Axons:** Slower conduction due to the continuous propagation of action potentials.
7. **Neuroplasticity:**
 - The ability of the nervous system to change its structure and function in response to experience.
8. **Peripheral Nervous System (PNS):**
 - **Somatic Nervous System:** Controls voluntary movements.
 - **Autonomic Nervous System:** Regulates involuntary functions, divided into sympathetic and parasympathetic divisions.
9. **Central Nervous System (CNS):**
 - Comprises the brain and spinal cord.
 - Processes sensory information and issues motor commands.
10. **Blood-Brain Barrier:**
 - A selective barrier that protects the brain from foreign substances in the blood.
11. **Glial Cells:**
 - **Astrocytes:** Provide support and nutrition, maintain homeostasis.
 - **Oligodendrocytes and Schwann Cells:** Form myelin in the CNS and PNS, respectively.
 - **Microglia:** Act as immune cells in the CNS.
12. **Neural Repair and Regeneration:**
 - Limited in the CNS but more effective in the PNS.
 - Involves processes like axon sprouting and remyelination.

Nerve Injury:

1. **Types of Nerve Injuries:**
 - **Neurapraxia:** The mildest form, with temporary loss of function due to myelin sheath damage.
 - **Axonotmesis:** Involves axonal damage with preservation of the myelin sheath; can lead to Wallerian degeneration.
 - **Neurotmesis:** The most severe form, involving complete disruption of the nerve and its surrounding structures.
2. **Aetiology:**
 - Trauma (most common).
 - Compression or entrapment (e.g., carpal tunnel syndrome).
 - Stretch injury.

- Ischemic injury.
 - Iatrogenic (surgical) injury.
 - Infectious, inflammatory, or autoimmune conditions.
3. **Clinical Presentation:**
 - Loss of sensory function in the nerve distribution.
 - Muscle weakness or paralysis.
 - Pain or discomfort, which may include burning, tingling, or shooting pain.
 - Changes in autonomic functions, if autonomic fibres are involved.
 4. **Diagnosis:**
 - Clinical history and physical examination.
 - Electromyography (EMG) and nerve conduction studies.
 - Imaging (MRI or ultrasound) for anatomical details.
 - Blood tests if a systemic cause is suspected.
 5. **Treatment:**
 - Conservative management includes physical therapy, occupational therapy, and pain management.
 - Pharmacologic interventions: Pain medications, corticosteroids, or nerve growth factors.
 - Surgical intervention might be necessary for severe injuries or when conservative management fails.
 6. **Recovery and Prognosis:**
 - Depends on the type of injury; neurapraxia usually recovers fully.
 - Axonotmesis and neurotmesis have more variable outcomes.
 - Nerve regeneration occurs at a rate of approximately 1 mm/day after the initial lag phase.
 7. **Prevention:**
 - Minimizing risk factors for trauma and compression.
 - Proper ergonomic practices to avoid repetitive strain injuries.
 - Careful surgical techniques to avoid iatrogenic nerve damage.
 8. **Complications:**
 - Chronic pain or neuropathic pain syndromes.
 - Muscle atrophy.
 - Permanent sensory or motor deficits.
 - Complex regional pain syndrome (CRPS).
 9. **Rehabilitation:**
 - Focus on maintaining muscle strength and flexibility.
 - Neuromuscular re-education.
 - Adaptive techniques and use of assistive devices if necessary.
 10. **Emerging Therapies:**
 - Nerve grafting and nerve transfer techniques.
 - Stem cell therapy and regenerative medicine approaches.

Bone Physiology:

1. **Basic Structure of Bone:**
 - **Compact Bone:** Dense outer layer that provides strength and rigidity.
 - **Spongy Bone (Cancellous Bone):** Lighter, porous inner layer that contains bone marrow.
 - **Bone Marrow:** Red marrow produces blood cells; yellow marrow stores fat.
 - **Periosteum:** Outer fibrous layer covering bones, containing nerves and blood vessels.
2. **Cell Types in Bone:**
 - **Osteoblasts:** Responsible for bone formation.
 - **Osteocytes:** Mature bone cells that maintain bone tissue.
 - **Osteoclasts:** Involved in bone resorption (breakdown).
3. **Bone Formation and Growth:**
 - **Intramembranous Ossification:** Direct conversion of mesenchymal tissue to bone; forms flat bones like the skull.

- **Endochondral Ossification:** Cartilage is replaced by bone; responsible for the formation of long bones.
4. **Bone Remodelling:**
 - Continuous process of bone resorption by osteoclasts and formation by osteoblasts.
 - Influenced by mechanical stress, hormones (e.g., parathyroid hormone, calcitonin), and dietary factors (calcium and vitamin D levels).
 5. **Hormonal Regulation:**
 - **Parathyroid Hormone (PTH):** Increases blood calcium levels by stimulating bone resorption.
 - **Calcitonin:** Lowers blood calcium levels by inhibiting bone resorption.
 - **Vitamin D:** Promotes calcium absorption in the gut and maintains calcium and phosphate levels for bone formation.
 6. **Mechanical Stress and Bone Density:**
 - Wolff's Law: Bone density and shape adapt to the mechanical stresses placed upon it.
 - Weight-bearing exercises and physical activity can increase bone strength.
 7. **Bone Healing:**
 - In response to a fracture, involves stages of hematoma formation, fibrocartilaginous callus formation, bony callus formation, and bone remodelling.
 8. **Blood Supply and Innervation:**
 - Bones are richly supplied by blood vessels.
 - Nerves mostly accompany these blood vessels, providing sensation to the periosteum.
 9. **Aging and Bone:**
 - Bone density peaks in early adulthood and then gradually decreases.
 - Osteoporosis is a common condition in older adults, characterized by reduced bone mass and increased fracture risk.
 10. **Common Disorders:**
 - **Osteoporosis:** Reduced bone density and strength.
 - **Osteomalacia/Rickets:** Softening of bones due to vitamin D deficiency.
 - **Osteoarthritis:** Degeneration of joint cartilage and underlying bone.
 - **Paget's Disease:** Disorganized bone remodelling.

Bone Injury and Healing:

1. **Types of Bone Injuries:**
 - **Fractures:** Breaks in the continuity of the cortex of a bone, which can range from simple (clean break, no displacement) to complex (multiple fragments, displacement).
 - **Stress Fractures:** Small cracks in the bone, often caused by repetitive forces.
 - **Avulsion:** Occurs when a fragment of bone tears away due to a tendon or ligament pulling on the bone.
2. **Phases of Bone Healing:**
 - **Inflammatory Phase:** Starts immediately after the injury. Blood vessels break, forming a hematoma around the fracture site. Inflammation occurs, drawing in cells that begin the healing process.
 - **Reparative Phase:** Includes the formation of a soft callus as new blood vessels develop, and the migration and proliferation of osteoblasts. This is followed by a hard callus formation as the mineralization increases.
 - **Remodelling Phase:** The final phase where the bone gradually returns to its original shape. The hard callus is remodelled by osteoclasts and osteoblasts, restoring the bone's normal structure and function.
3. **Factors Influencing Healing:**
 - **Age:** Younger patients typically heal faster.
 - **Nutrition:** Adequate nutrition, including calcium and vitamin D, is crucial for bone healing.
 - **Smoking and Alcohol Use:** Can impair bone healing.

- **Medical Conditions:** Diabetes, osteoporosis, and other conditions can slow the healing process.
 - **Medications:** Some medications, like corticosteroids, can impede bone repair.
4. **Treatment of Bone Injuries:**
 - **Fracture Management:** Includes realignment (reduction) and immobilization (casts, splints).
 - **Surgery:** May be required for complex fractures; involves the use of metal plates, screws, or rods to stabilize the bone.
 - **Physical Therapy:** Essential for restoring function after the bone has healed.
 5. **Complications:**
 - **Non-union or Malunion:** When the bone doesn't heal properly or heals in a wrong position.
 - **Infection:** Particularly in open fractures or after surgery.
 - **Osteonecrosis:** Death of bone tissue due to a lack of blood supply.
 - **Chronic Pain:** Can occur, especially in cases of complex fractures.
 6. **Prevention:**
 - Adequate calcium and vitamin D intake.
 - Regular exercise to strengthen bones.
 - Fall prevention strategies, especially in the elderly.
 7. **Rehabilitation:**
 - Gradual return to activity and exercises to strengthen muscles and improve flexibility.

Bone Diseases:

1. **Osteoarthritis:**
 - Degenerative joint disease; wear and tear of joint cartilage and bone.
 - Common in older adults, affecting knees, hips, hands, and spine.
 - Symptoms: Joint pain, stiffness, limited motion.
2. **Rheumatoid Arthritis:**
 - Autoimmune disorder causing chronic inflammation of joints.
 - Symmetric polyarthritis, often affecting hands and feet.
 - Systemic symptoms: Fatigue, weight loss, anaemia.
3. **Ankylosing Spondylitis:**
 - Chronic inflammation of the spine and sacroiliac joints.
 - More common in men and often begins in late adolescence or early adulthood.
 - Symptoms: Back pain, stiffness, reduced range of motion; may have systemic features.
4. **Gout:**
 - Metabolic disorder characterized by elevated serum uric acid levels and deposition of urate crystals in joints.
 - Acute and chronic arthritis, commonly affecting the big toe.
 - Associated with renal impairment, hypertension, obesity, and alcohol intake.
5. **Pseudogout:**
 - Similar to gout but caused by calcium pyrophosphate dihydrate (CPPD) crystal deposition.
 - Affects larger joints, such as knees.
 - May be associated with aging, trauma, or metabolic diseases.
6. **Osteoporosis:**
 - Reduction in bone mass and density, increasing fracture risk.
 - Common in postmenopausal women and older adults.
 - Often asymptomatic until a fracture occurs.
7. **Hyperparathyroidism:**
 - Overactivity of the parathyroid glands leading to high levels of parathyroid hormone (PTH).
 - Causes bone resorption, hypercalcemia, renal stones, and osteopenia.
 - Primary (gland dysfunction) or secondary (response to low calcium/vitamin D).
8. **Renal Osteodystrophy:**
 - Bone disorder resulting from chronic kidney disease.

- Imbalance of calcium, phosphate, PTH, and vitamin D.
 - Presents with bone pain, fractures, and altered bone mineral metabolism.
- Rickets/Osteomalacia:**
 - Rickets in children and osteomalacia in adults.
 - Softening and weakening of bones due to vitamin D deficiency or phosphate metabolism disorders.
 - Symptoms: Bone pain, weakness, deformities.
 - Paget's Disease of Bone:**
 - Chronic disorder of bone remodelling; excessive bone breakdown and disorganized new bone formation.
 - Common in older adults; often affects pelvis, skull, spine, and legs.
 - Symptoms: Bone pain, deformities, fractures; may be asymptomatic.
 - Bone Metastases:**
 - Secondary tumours in bone originating from other sites (e.g., breast, prostate, lung cancer).
 - Causes pain, fractures, hypercalcemia.
 - Diagnosis often involves imaging and biopsy.
 - Hypophosphatasia:**
 - Rare genetic disorder affecting bone mineralization.
 - Leads to rickets in children and osteomalacia in adults.
 - Symptoms: Bone pain, fractures, muscle weakness.

Spinal Radiology:

- Imaging Modalities:**
 - **X-ray (Radiographs):** First-line imaging for initial assessment of spinal anatomy, alignment, bone density, and any gross pathology.
 - **Computed Tomography (CT):** Provides detailed images of bone structures. Useful for assessing fractures, bone spurs, and other bony abnormalities.
 - **Magnetic Resonance Imaging (MRI):** Best for soft tissue evaluation including discs, nerves, spinal cord, ligaments, and muscles. Preferred in suspected spinal cord pathology, disc herniation, or infections.
 - **Myelography:** Involves injecting contrast dye into the spinal canal, followed by X-ray or CT. Useful for evaluating the spinal canal and nerve root compression, especially in patients who cannot undergo MRI.
- Common Findings and Pathologies:**
 - **Degenerative Changes:** Disc space narrowing, vertebral osteophytes, facet joint arthropathy.
 - **Disc Herniation:** Displacement of disc material beyond the intervertebral disc space.
 - **Spinal Stenosis:** Narrowing of the spinal canal or neural foramina, often evident on CT or MRI.
 - **Spondylolisthesis:** Forward slippage of one vertebra over another.
 - **Fractures:** Assessed by CT for detail; MRI can evaluate associated soft tissue injury.
 - **Infections (e.g., Osteomyelitis, Discitis):** MRI is more sensitive in early stages.
 - **Spinal Tumours:** MRI provides detailed information about tumour size, location, and involvement of adjacent structures.
- Interpreting Spinal Radiographs:**
 - **Alignment:** Check for any curvature abnormalities like scoliosis or kyphosis.
 - **Bones:** Look for fractures, alignment, bone density, and lesions.
 - **Cartilage:** Disc space narrowing can indicate degenerative changes.
 - **Soft Tissues:** Evaluate for any signs of swelling or other abnormalities.
- Special Views and Techniques:**
 - **Flexion and Extension Views:** Assess spinal stability, especially in trauma cases.
 - **Oblique Views:** Can help in visualizing certain structures like neural foramina and facet joints.
 - **CT Myelography:** Used when MRI is contraindicated or in postsurgical assessments.
- Radiological Signs of Specific Conditions:**

- **Ankylosing Spondylitis:** Bamboo spine appearance on X-ray.
 - **Vertebral Compression Fractures:** Height loss of the vertebral body; may indicate osteoporosis or metastatic disease.
 - **Cauda Equina Syndrome:** MRI to assess compression of the nerve roots.
6. **Radiation Safety:**
 - Always consider the necessity and frequency of radiological exams, especially CT, to minimize radiation exposure.
 - Use of shielding and appropriate imaging protocols.
 7. **Advanced Imaging:**
 - **Nuclear Medicine Scans (e.g., Bone Scan):** For detecting metastases, infections, or other pathologies involving bone metabolism.

Spinal Trauma:

1. **Types of Spinal Trauma:**
 - **Fractures:** Can occur in vertebral bodies, spinous processes, or facets.
 - **Subluxations / Dislocations:** Misalignment of vertebrae, which can cause cord compression (partial and complete loss of continuity of a joint).
 - **Fracture-Dislocations:** A combination of both, often leading to severe instability and high risk of neurological injury.
2. **Mechanism of Injury:**
 - **Flexion Injuries:** Often lead to compression fractures or dislocations anteriorly.
 - **Extension Injuries:** Typically result in injuries to the posterior elements of the spine.
 - **Rotation Injuries:** Can cause fracture-dislocations, leading to high instability.
 - **Vertical Compression Injuries:** Can result in burst fractures, with potential retropulsion of bone fragments.
3. **Common Sites of Injury:**
 - **Cervical Spine:** Particularly vulnerable due to its mobility; C1-C2 and C5-C7 are common sites.
 - **Thoracolumbar Junction:** T12-L2, a transition area from the rigid thoracic spine to the more mobile lumbar spine.
4. **Clinical Presentation:**
 - Pain and tenderness at the site of injury.
 - Neurological deficits, ranging from radiculopathy to complete spinal cord injury.
 - Signs of shock in severe cases, especially with high cervical spine injuries.
5. **Assessment and Management:**
 - Initial assessment following Advanced Trauma Life Support (ATLS) protocols.
 - Spinal immobilization is crucial until spinal injury is ruled out.
 - Detailed neurological examination to assess the level and severity of injury.
 - Imaging: X-rays, CT, and MRI as indicated based on the clinical and initial radiologic evaluation.
6. **Classification of Spinal Cord Injury:**
 - **Complete:** No sensory or motor function below the level of injury.
 - **Incomplete:** Partial preservation of sensory or motor function below the injury level.
 - Common syndromes: Central cord syndrome, Anterior cord syndrome, Brown-Séquard syndrome, Conus medullaris and Cauda equina syndromes.
7. **Treatment:**
 - **Non-operative:** For stable injuries; includes pain management and rehabilitation.
 - **Operative:** Indicated in unstable fractures, dislocations, or when there is cord compression. Techniques include decompression, realignment, and stabilization.
8. **Complications:**
 - Chronic pain, bladder and bowel dysfunction.
 - Respiratory complications, especially in high cervical injuries.
 - Pressure ulcers, deep vein thrombosis, pulmonary embolism.
 - Long-term disability and need for rehabilitation.
9. **Rehabilitation:**

- Early intervention for mobilization, physical therapy, occupational therapy.
 - Multidisciplinary approach including pain management, psychological support, and adaptation to new functional capabilities.
10. **Prevention:**
- Education on safe practices, use of protective gear in sports, and workplace safety measures.

Spinal Cord Injury:

1. **Aetiology:**
 - Traumatic SCI is most commonly due to motor vehicle accidents, falls, violence (e.g., gunshot wounds), and sports injuries.
 - Non-traumatic SCI can result from diseases like cancer, infection, spinal disc degeneration, or inflammation.
2. **Anatomy and Physiology:**
 - The spinal cord extends from the base of the brain to the lower back and is protected by the vertebral column.
 - It transmits signals between the brain and the rest of the body.
 - Segments of the spinal cord correspond to different body regions and functions.
3. **Classification of SCI:**
 - **Complete SCI:** Total loss of motor and sensory function below the level of injury.
 - **Incomplete SCI:** Partial preservation of sensory or motor function below the level of injury.
 - Incomplete injuries are further classified based on patterns of weakness and sensation loss (e.g., anterior cord syndrome, central cord syndrome, Brown-Séquard syndrome).
4. **Assessment and Diagnosis:**
 - Initial assessment using the ABCs (Airway, Breathing, Circulation) of trauma care.
 - Neurological examination to determine the level and completeness of the injury.
 - Imaging studies (X-rays, CT, MRI) to evaluate the spine.
5. **Acute Management:**
 - Spinal immobilization and careful transportation to prevent further injury.
 - Surgical intervention may be required to stabilize the spine or relieve pressure on the spinal cord.
6. **Complications:**
 - Respiratory issues, especially in cervical or high thoracic injuries.
 - Loss of bowel and bladder control.
 - Skin breakdown and pressure ulcers.
 - Cardiovascular problems, such as blood pressure instability and heart rate abnormalities.
 - Chronic pain and spasticity.
7. **Rehabilitation:**
 - Begins as soon as the patient is medically stable.
 - Goals include maximizing physical functioning, preventing complications, and adapting to new lifestyle changes.
 - Involves a multidisciplinary team including physiotherapists, occupational therapists, nurses, social workers, and psychologists.
8. **Long-term Management:**
 - Ongoing medical care to manage complications and secondary conditions.
 - Adaptive equipment and home modifications may be necessary.
 - Psychological support and counselling.
9. **Research and Emerging Therapies:**
 - Ongoing research into neuroprotective strategies, nerve regeneration, and stem cell therapy.
 - Development of advanced assistive technologies and neuroprosthetics.

Back Pain in the Child:

1. **Epidemiology:**

- Less prevalent than in adults but not uncommon, especially in older children and adolescents.
 - Often related to physical activity but can also indicate an underlying pathology.
2. **Common Causes:**
 - **Muscular Strain:** From sports, heavy backpacks, or poor posture.
 - **Spondylolysis and Spondylolisthesis:** Stress fractures in the vertebrae, common in athletes.
 - **Scheuermann's Kyphosis:** A developmental disorder causing abnormal curvature of the spine.
 - **Discitis or Vertebral Osteomyelitis:** Infection in the disc space or vertebrae.
 - **Injury or Trauma:** Falls or accidents.
 - **Juvenile Idiopathic Arthritis:** An autoimmune disorder causing inflammation of the joints.
 3. **Red Flags:**
 - Persistent pain, especially in young children.
 - Night pain or pain at rest.
 - Fever, weight loss, or general malaise.
 - Neurological symptoms like weakness, numbness, or bladder/bowel changes.
 - History of trauma.
 - Pain that is worsening or not responding to conservative treatment.
 4. **Diagnosis:**
 - Thorough history and physical examination.
 - Imaging studies if indicated (X-rays, MRI, CT scans) especially if red flags are present.
 - Laboratory tests to rule out infection or inflammatory conditions.
 5. **Treatment:**
 - Depends on the underlying cause.
 - For most benign causes (like muscular strain), conservative treatment with rest, physical therapy, and pain management is sufficient.
 - Specific treatments for underlying conditions like antibiotics for infection, rest for spondylolysis, or surgery in severe cases of spondylolisthesis.
 6. **Prognosis:**
 - Generally good for benign causes.
 - Long-term prognosis depends on the underlying condition and its management.
 7. **Prevention:**
 - Encouraging good posture.
 - Proper backpack ergonomics.
 - Regular physical activity and stretching.
 8. **Parental and Patient Education:**
 - Importance of reporting symptoms early.
 - Understanding the nature of the child's back pain and the treatment plan.
 9. **When to Refer:**
 - Persistent, worsening, or unexplained back pain.
 - Presence of any red flags.

Spinal Deformity:

1. **Types of Spinal Deformities:**
 - **Scoliosis:** Lateral curvature of the spine, often accompanied by vertebral rotation.
 - **Kyphosis:** Excessive outward curvature of the spine, resulting in a hunched back.
 - **Lordosis:** Excessive inward curvature of the lower spine.
2. **Aetiologies:**
 - **Idiopathic:** Cause unknown, most common in adolescent scoliosis.
 - **Congenital:** Due to malformations of the spine present at birth.
 - **Neuromuscular:** Associated with conditions like cerebral palsy or muscular dystrophy.
 - **Degenerative:** Due to wear and tear, more common in older adults.
 - **Traumatic:** Resulting from spinal injuries.
3. **Clinical Presentation:**
 - Asymmetry in shoulder height, scapular or flank shape, or hip height.

- Back pain, which may be more common in degenerative cases.
 - Neurological symptoms, such as numbness or weakness, can occur in severe cases.
4. **Diagnosis:**
 - Physical examination including the Adam's forward bend test for scoliosis.
 - Radiographic evaluation with standing X-rays to assess the curve magnitude (measured using the Cobb angle).
 - MRI or CT scans may be needed for detailed evaluation or if there are neurological concerns.
 5. **Management:**
 - **Observation:** For mild cases or non-progressive curves.
 - **Bracing:** Common in adolescents with idiopathic scoliosis to prevent curve progression.
 - **Physical Therapy:** Focuses on strengthening and flexibility exercises.
 - **Surgical:** Indicated for severe or progressive curves, significant pain, or neurological compromise. Common procedures include spinal fusion and rod placement.
 6. **Prognosis:**
 - Varies depending on the type and severity of the deformity, and the patient's age.
 - Most cases of mild idiopathic scoliosis do not progress significantly and have a normal life expectancy.
 - Severe curves can impact lung function and mobility.
 7. **Complications:**
 - Respiratory and cardiovascular problems in severe cases.
 - Chronic back pain, especially in degenerative deformities.
 - Psychosocial impact, particularly in adolescents.
 8. **Prevention and Screening:**
 - Early detection through regular screening, especially in school-aged children.
 - Maintaining good posture, core strength, and flexibility.
 9. **Patient Education:**
 - Understanding the nature of the deformity.
 - Compliance with treatment plans, especially in bracing.
 10. **Special Considerations:**
 - Pregnancy management in women with significant spinal deformities.
 - Long-term monitoring for progressive or degenerative conditions.

Spinal Infection:

1. **Aetiology:**
 - Bacterial (most common): Staphylococcus aureus, Mycobacterium tuberculosis (Pott's disease), E. coli, Pseudomonas aeruginosa.
 - Viral, fungal, and parasitic infections are less common.
2. **Risk Factors:**
 - Immunocompromised state (HIV, chemotherapy, chronic steroid use).
 - Recent spinal procedure or surgery.
 - Intravenous drug use.
 - Chronic medical conditions (diabetes, renal failure).
3. **Pathophysiology:**
 - Hematogenous spread (most common).
 - Direct inoculation during surgery or trauma.
 - Contiguous spread from adjacent tissues.
4. **Clinical Presentation:**
 - Back pain (most common symptom).
 - Fever, chills.
 - Neurological deficits depending on the level of infection (e.g., weakness, numbness).

- Radiculopathy or myelopathy if nerve roots or spinal cord are involved.
5. **Diagnosis:**
 - Laboratory tests: Elevated ESR, CRP, leukocytosis.
 - Imaging: MRI with contrast (gold standard), CT, X-ray.
 - Biopsy and culture for definitive diagnosis and antibiotic sensitivity.
 6. **Treatment:**
 - Empiric antibiotic therapy initially, then tailored based on culture results.
 - Surgical intervention may be required for abscess drainage, decompression, or stabilization.
 - Long-term antibiotic therapy (often 6-12 weeks).
 7. **Complications:**
 - Abscess formation.
 - Spinal instability.
 - Chronic pain.
 - Neurological impairment (paralysis, incontinence).
 8. **Prevention:**
 - Prompt treatment of bloodstream infections.
 - Aseptic technique during spinal procedures.
 - Monitoring in high-risk patients (e.g., immunocompromised).
 9. **Prognosis:**
 - Varies based on causative organism, patient's overall health, and timeliness of treatment.
 - Can range from complete recovery to chronic pain or disability.

Spinal Tumours:

1. **Classification:**
 - **Primary Spinal Tumours:** Originate in the spine or spinal cord.
 - **Intradural-Extramedullary:** Arise in the spinal cord's covering or nerve roots (e.g., meningiomas, schwannomas).
 - **Intramedullary:** Arise within the spinal cord (e.g., astrocytomas, ependymomas).
 - **Secondary (Metastatic) Spinal Tumours:** More common than primary tumors, originating from cancer elsewhere in the body that has spread to the spine.
2. **Symptoms:**
 - Back pain, often worsened at night or with activity.
 - Neurological symptoms depend on the tumour's location and may include weakness, numbness, or difficulty walking.
 - Bladder and bowel dysfunction in severe cases.
3. **Diagnosis:**
 - Detailed neurological examination.
 - Imaging studies: MRI is the preferred method for detailed imaging of spinal tumours; CT scans and X-rays can also be useful.
 - Biopsy may be required for definitive diagnosis and to guide treatment.
4. **Treatment:**
 - **Steroids:** Reduced the tumour swelling / oedema and reduce the cord compression.
 - **Surgery:** Mainstay for many spinal tumours, aiming to remove as much of the tumour as possible while preserving neurological function.
 - **Radiation Therapy:** Used postoperatively or as a primary treatment for tumours that are inoperable or only partially resected.
 - **Chemotherapy:** Utilized for certain types of tumours, especially systemic cancers with spinal metastasis.
 - **Targeted Therapy and Immunotherapy:** Emerging treatments for specific tumour types.
5. **Prognosis:**
 - Depends on the type of tumour, its location, size, patient's overall health, and response to treatment.
 - Primary spinal cord tumours tend to have a better prognosis than metastatic spinal tumours.

6. **Rehabilitation:**
 - Focuses on improving function, managing pain, and adapting to any neurological deficits.
 - Multidisciplinary approach involving physical therapists, occupational therapists, and pain management specialists.
7. **Complications:**
 - Permanent nerve damage and paralysis.
 - Pain syndromes and mobility issues.
 - Recurrence after treatment.
8. **Prevention and Screening:**
 - No specific prevention strategies; early detection is key in individuals with known risk factors or primary cancers prone to spinal metastasis.
 - Regular follow-up and imaging for patients with a history of cancer.

Metastatic Spinal Cord Compression:

1. **Aetiology and Epidemiology:**
 - MSCC most commonly arises from metastasis of cancers like breast, lung, prostate, and renal cell carcinoma.
 - It can occur in up to 10% of cancer patients and is a major cause of morbidity.
2. **Pathophysiology:**
 - Cancer cells spread to the vertebral column, grow, and compress the spinal cord and nerves.
 - Can occur due to direct invasion, hematogenous spread, or lymphatic spread.
3. **Clinical Presentation:**
 - Back pain is the most common and often the earliest symptom; may be localized or radicular.
 - Neurological deficits such as weakness, numbness, or paralysis.
 - Bowel and bladder dysfunction in advanced cases.
 - Symptoms often progress rapidly.
4. **Diagnosis:**
 - High suspicion in any cancer patient with new onset back pain.
 - MRI is the gold standard imaging modality for diagnosis.
 - CT scans and bone scans can also be used for evaluation.
5. **Management:**
 - **Early Recognition and Prompt Treatment:** Key to preventing irreversible spinal cord damage.
 - **Corticosteroids:** To reduce spinal cord oedema.
 - **Radiotherapy:** The mainstay of treatment for most patients.
 - **Surgery:** Indicated in selected cases for decompression and stabilization, especially if there is spinal instability or failure of radiation therapy.
 - **Chemotherapy:** Depending on the primary cancer type.
6. **Prognosis:**
 - Depends on the type of primary cancer, extent of spinal involvement, and speed of intervention.
 - Early treatment improves the chance of preserving neurological function.
7. **Complications:**
 - Permanent neurological deficits including paralysis.
 - Chronic pain.
 - Increased risk of pressure sores, urinary tract infections, and deep vein thrombosis due to immobility.
8. **Rehabilitation:**
 - Physical therapy to maintain muscle strength and flexibility.
 - Occupational therapy for adapting to any disabilities.
 - Pain management and psychological support.
9. **Prevention and Screening:**
 - Regular follow-up and imaging in patients with known cancers, especially those with a high risk of bone metastasis.

- Education of patients and healthcare providers about early symptoms of MSCC.

Spinal Stenosis:

1. **Types of Spinal Stenosis:**
 - **Lumbar Spinal Stenosis:** Most common, occurs in the lower back.
 - **Cervical Spinal Stenosis:** Occurs in the neck.
2. **Aetiology:**
 - Degenerative changes due to aging are the most common cause.
 - Other causes include congenital spinal deformities, spinal injuries, tumours, and bone diseases.
 - More common in older adults due to degenerative changes in the spine.
3. **Pathophysiology:**
 - Narrowing of the spinal canal or neural foramina due to factors such as disc herniation, thickening of ligaments, or osteophyte formation.
 - Compression of the spinal cord or nerve roots.
4. **Clinical Presentation:**
 - **Lumbar Stenosis:** Presents with neurogenic claudication (pain, numbness, or weakness in the legs that worsens with walking and improves with rest).
 - **Cervical Stenosis:** Can cause neck pain and neurological symptoms in the arms; severe cases might lead to spinal cord compression (myelopathy).
5. **Diagnosis:**
 - Based on history, physical examination, and radiological findings.
 - Imaging studies include X-rays, MRI, and CT scans.
6. **Treatment:**
 - **Conservative:** Physical therapy, anti-inflammatory medications, and epidural steroid injections.
 - **Surgical:** Laminectomy (removal of part of the vertebra), foraminotomy (widening of the nerve root canal), or spinal fusion, indicated in cases with severe symptoms not relieved by conservative measures.
7. **Prognosis:**
 - Varies based on severity and response to treatment.
 - Many patients find relief with conservative management, but some may require surgery.
8. **Complications:**
 - Chronic pain, loss of sensation, muscle weakness.
 - In severe cases, loss of bowel or bladder control.
9. **Prevention:**
 - General measures include maintaining a healthy weight, regular exercise, and good posture.
 - Early intervention in degenerative spinal conditions can slow progression.

Spondylolisthesis:

1. **Types of Spondylolisthesis:**
 - **Isthmic Spondylolisthesis:** Caused by a defect in the pars interarticularis, often due to a stress fracture; common in adolescents. L5/S1.
 - **Degenerative Spondylolisthesis:** Due to age-related degenerative changes in the spine; more common in adults over 50. L4/5.
 - Other types include traumatic, pathological, and dysplastic spondylolisthesis.
2. **Aetiology:**
 - Congenital structural abnormalities of the spine.
 - Stress fractures (common in athletes).
 - Degenerative changes in the spine (e.g., arthritis).
 - Trauma or injury to the spine.
3. **Pathophysiology:**

- Vertebra slips due to a defect or degeneration of the facet joints and intervertebral discs.
 - This slippage can narrow the spinal canal or compress nerve roots, leading to pain and neurological symptoms.
4. **Clinical Presentation:**
 - Lower back pain, which may radiate to the buttocks or legs.
 - Muscle tightness or stiffness.
 - In severe cases, nerve compression can cause numbness, tingling, or weakness in the legs.
 5. **Diagnosis:**
 - Physical examination focusing on the range of motion, flexibility, and neurologic function.
 - Imaging studies: X-rays to confirm the presence of slippage, MRI or CT scans for detailed views of the spinal anatomy.
 6. **Grading:**
 - Graded I to V based on the degree of slippage: Grade I being mild (less than 25% slippage) and Grade V being severe (spondyloptosis, where the vertebral body completely slips off the one below).
 7. **Treatment:**
 - **Conservative:** Physical therapy, anti-inflammatory medications, and pain relief measures. Bracing in some paediatric cases. Spinal injections.
 - **Surgical:** Indicated for severe pain, high-grade slippage, or neurological symptoms. Procedures include spinal fusion and decompression.
 8. **Prognosis:**
 - Many cases respond well to conservative treatment.
 - Surgical outcomes are generally positive, particularly in patients with significant symptoms and high-grade spondylolisthesis.
 9. **Prevention:**
 - General spine health maintenance, including regular exercise, maintaining a healthy weight, and proper lifting techniques.
 - Early detection and treatment of symptoms in athletes and individuals with high physical demands.
 10. **Complications:**
 - Chronic pain, increased risk of arthritis in the affected segment.
 - In severe cases, permanent nerve damage leading to weakness or loss of sensation in the legs.

Spinal Cord Anatomy:

1. **General Anatomy:**
 - The spinal cord is a long, thin, tubular structure made up of nervous tissue, extending from the brainstem (medulla oblongata) to the lumbar region of the vertebral column.
 - It's protected by the bony vertebral column and cushioned by cerebrospinal fluid in the subarachnoid space.
2. **Segments:**
 - Divided into 31 segments: 8 cervical (C1-C8), 12 thoracic (T1-T12), 5 lumbar (L1-L5), 5 sacral (S1-S5), and 1 coccygeal.
 - Each segment gives rise to a pair of spinal nerves.
3. **External Anatomy:**
 - **Cervical Enlargement:** Corresponds to the shoulders and upper limbs.
 - **Lumbosacral Enlargement:** Corresponds to the pelvis and lower limbs.
 - **Conus Medullaris:** Tapered end of the spinal cord, around the L1-L2 level.
 - **Cauda Equina:** A bundle of spinal nerves and spinal nerve roots below the conus medullaris.
4. **Internal Anatomy:**

- **Grey Matter:** Butterfly-shaped in cross-section, consisting of neuronal cell bodies, divided into dorsal (posterior) horns, ventral (anterior) horns, and lateral horns (in thoracic and lumbar regions).
 - **White Matter:** Myelinated nerve fibres, organized into tracts or columns (dorsal, lateral, and ventral).
5. **Spinal Tracts:**
 - **Ascending Tracts:** Carry sensory information to the brain (e.g., spinothalamic tract, dorsal columns).
 - **Descending Tracts:** Conduct motor signals from the brain to the body (e.g., corticospinal tract, rubrospinal tract).
 6. **Blood Supply:**
 - Supplied by the anterior spinal artery and paired posterior spinal arteries.
 - Venous drainage through a series of spinal veins.
 7. **Meninges:**
 - The spinal cord is surrounded by three protective layers: dura mater, arachnoid mater, and pia mater.
 - The space between the arachnoid mater and pia mater is the subarachnoid space, containing cerebrospinal fluid.
 8. **Spinal Nerves:**
 - Each spinal nerve arises from the combination of a dorsal root (sensory) and a ventral root (motor).
 - Exit the vertebral column through the intervertebral foramina.
 9. **Functional Anatomy:**
 - The spinal cord serves as a conduit for motor information traveling down from the brain and sensory information traveling up to the brain.
 - Involved in reflex actions via the reflex arc.
 10. **Clinical Correlation:**
 - Understanding spinal cord anatomy is crucial for diagnosing and managing spinal cord injuries, neurological disorders, and diseases affecting spinal cord function.

Spinal Cord Syndromes and Cauda Equina Syndrome:

1. **Central Cord Syndrome:**
 - Most common incomplete spinal cord injury, often due to hyperextension injuries.
 - Greater motor impairment in upper limbs than lower limbs.
 - Variable sensory loss below the level of injury.
2. **Anterior Cord Syndrome:**
 - Caused by damage to the anterior part of the spinal cord.
 - Loss of motor function, pain, and temperature sensation below the level of injury.
 - Proprioception and vibration sensation are typically preserved.
3. **Brown-Séquard Syndrome:**
 - Results from hemisection of the spinal cord.
 - Ipsilateral (same side as injury) loss of motor function, proprioception, and vibratory sense.
 - Contralateral (opposite side) loss of pain and temperature sensation.
4. **Posterior Cord Syndrome:**
 - Least common; involves the dorsal columns of the spinal cord.
 - Loss of proprioception, vibration, and fine touch sensation.
 - Motor function and pain and temperature sensation are preserved.
5. **Conus Medullaris Syndrome:**
 - Injury to the conus medullaris (terminal portion of the spinal cord).
 - Presents with lower back pain, motor weakness in the lower limbs, and bowel and bladder dysfunction.
 - May have a mix of upper and lower motor neuron signs.
6. **Cauda Equina Syndrome:**

- Caused by compression of the cauda equina (nerve roots extending from the lower end of the spinal cord).
 - Symptoms include severe low back pain, sciatica, saddle anaesthesia (loss of sensation in the buttocks, perineum, and inner thighs), bowel and bladder dysfunction, and lower limb motor weakness and sensory loss.
 - It is a surgical emergency; delayed treatment can result in permanent damage.
- 7. Diagnosis:**
 - Based on clinical presentation and confirmed by imaging studies (MRI or CT myelography).
 - Important to differentiate between spinal cord syndromes and cauda equina syndrome as the management differs.
 - 8. Treatment:**
 - Central Cord, Anterior Cord, Brown-Séguard, Posterior Cord, and Conus Medullaris Syndromes: Management involves stabilization of the spine and rehabilitation.
 - Cauda Equina Syndrome: Immediate surgical decompression to prevent permanent nerve damage.
 - 9. Rehabilitation:**
 - Early intervention with physical and occupational therapy.
 - Focus on maximizing functional recovery and adapting to limitations.
 - 10. Long-term Management:**
 - Regular follow-up for complications like chronic pain, bladder and bowel dysfunction, and psychological support.

Cervical Myelopathy:

- 1. Aetiology:**
 - Degenerative changes in the spine, such as cervical spondylosis, are the most common cause.
 - Other causes include spinal stenosis, disc herniation, and trauma.
- 2. Pathophysiology:**
 - Spinal cord compression in the cervical region leads to neurological deficits.
 - Chronic compression can result in spinal cord atrophy and irreversible damage.
- 3. Clinical Presentation:**
 - Neck pain and stiffness.
 - Progressive weakness in the arms and/or legs.
 - Numbness and tingling in the hands and fingers.
 - Difficulty with fine motor skills, such as buttoning a shirt or handwriting.
 - Gait disturbances and balance problems.
 - In advanced cases, bowel and bladder dysfunction.
- 4. Diagnosis:**
 - Clinical examination revealing hyperreflexia, muscle weakness, sensory changes, and possible Babinski sign.
 - MRI is the gold standard for imaging to visualize spinal cord compression.
 - Electrophysiological studies, like nerve conduction studies and somatosensory evoked potentials, can help assess the functional status of the spinal cord.
- 5. Treatment:**
 - **Conservative:** May include physical therapy, cervical collars, and pain management, though this is typically insufficient for moderate to severe cases.
 - **Surgical:** The primary treatment for significant or progressive symptoms. Various procedures like decompression surgery, laminectomy, and spinal fusion might be indicated to relieve pressure on the spinal cord.
- 6. Prognosis:**
 - Early surgical intervention generally offers the best outcomes.

- Delayed treatment can lead to permanent spinal cord damage and disability.
- 7. Complications:**
 - Ongoing neurological deficits, including chronic pain, muscle weakness, and impaired coordination.
 - Increased risk of falls and injuries due to balance and gait disturbances.
 - 8. Prevention and Screening:**
 - Early recognition and treatment of cervical spondylosis and other risk factors can prevent progression to myelopathy.
 - Regular follow-up for patients with known cervical spine disorders.
 - 9. Rehabilitation:**
 - Postoperative physical therapy is crucial for improving strength and function.
 - Occupational therapy for adapting to any residual disabilities.

Low Back Pain:

- 1. Definition and Epidemiology:**
 - Low back pain (LBP) is pain located below the costal margin and above the inferior gluteal folds.
 - Extremely common, affecting up to 80% of the population at some point in their lives.
- 2. Aetiology:**
 - **Mechanical causes (90% of cases):** Includes muscle or ligament strain, degenerative changes (disc degeneration, facet arthritis), spondylolisthesis, and compression fractures.
 - **Non-mechanical spinal conditions:** Includes infections (e.g., osteomyelitis), tumours, inflammatory diseases (e.g., ankylosing spondylitis).
 - **Visceral diseases:** Renal disorders, pelvic diseases, aortic aneurysms.
- 3. Risk Factors:**
 - Age (more common in middle-aged and older adults).
 - Sedentary lifestyle.
 - Excess body weight.
 - Occupational hazards (heavy lifting, prolonged sitting).
 - Smoking.
 - Psychological factors (stress, depression).
- 4. Clinical Presentation:**
 - Acute (<6 weeks), Subacute (6-12 weeks), Chronic (>12 weeks).
 - Pain, muscle spasm, limited mobility.
 - May have leg pain (sciatica) if nerve root compression.
 - Red flags: Weight loss, fever, trauma, neurologic symptoms, history of cancer.
- 5. Diagnosis:**
 - Clinical history and physical examination.
 - Imaging (X-ray, MRI, CT) generally reserved for red flag symptoms or if no improvement after conservative treatment.
 - Laboratory tests are not routinely required but may be needed for red flags.
- 6. Treatment:**
 - **Non-pharmacological:** Education and reassurance, physical therapy, exercise, heat therapy.
 - **Pharmacological:** NSAIDs, paracetamol, muscle relaxants. Opioids only in carefully selected patients.
 - **Interventional:** Spinal injections, surgery (rarely indicated and typically for cases with neurological deficits or severe, chronic pain unresponsive to other treatments).
- 7. Prevention:**
 - Regular exercise, maintaining a healthy weight, proper lifting techniques, ergonomics in the workplace.
- 8. Prognosis:**
 - Generally favourable. Most acute episodes resolve within weeks.
 - Recurrence is common.

- Chronic low back pain can be more challenging and may require a multidisciplinary approach.

Sciatica / Radicular Leg Pain:

1. Definition:

- Sciatica refers to pain radiating along the path of the sciatic nerve, which runs from the lower back down each leg.
- Radicular leg pain is a symptom of nerve root irritation or compression in the lumbar spine.

2. Aetiology:

- Most commonly caused by a herniated disc pressing on the nerve root.
- Other causes include spinal stenosis, spondylolisthesis, and piriformis syndrome.
- Less common causes: Tumours, infections, cauda equina syndrome.

3. Risk Factors:

- Age (middle-aged individuals are more susceptible).
- Obesity.
- Occupation requiring heavy lifting, prolonged sitting, or twisting movements.
- Diabetes (due to potential nerve damage).
- Sedentary lifestyle.

4. Clinical Presentation:

- Pain radiating from the lower back to the buttocks and down the back of one leg.
- Numbness, tingling, or muscle weakness in the affected leg or foot.
- Pain that worsens with sitting, coughing, or sneezing.
- Typically, symptoms are only on one side of the body.

5. Diagnosis:

- Based largely on patient history and physical examination (straight leg raise test).
- Imaging (MRI or CT scan) if severe or persistent symptoms, or if there are red flags indicating a more serious underlying condition.
- Electromyography (EMG) may be used in complex cases.

6. Treatment:

- **Conservative Treatment:** Most cases resolve with rest, physical therapy, and NSAIDs for pain relief.
- **Epidural Steroid Injections:** For persistent pain.
- **Surgery:** Considered when conservative treatment fails or in cases with significant neurological deficits (e.g., microdiscectomy).

7. Prevention:

- Regular exercise, particularly core strengthening.
- Proper body mechanics when lifting.
- Maintaining a healthy weight.
- Ergonomic workplace adjustments.

8. Prognosis:

- Good for most patients; symptoms often improve within a few weeks.
- Chronic pain or recurrent episodes can occur.
- Early intervention and treatment usually lead to better outcomes.