Health & Medical Sciences

James' case - Spinal cord Injuries (SCI)

Drs. Farhan Noordali, Surangi Jayakody and Dawn Collins

UNIVERSITY OF WARWICK

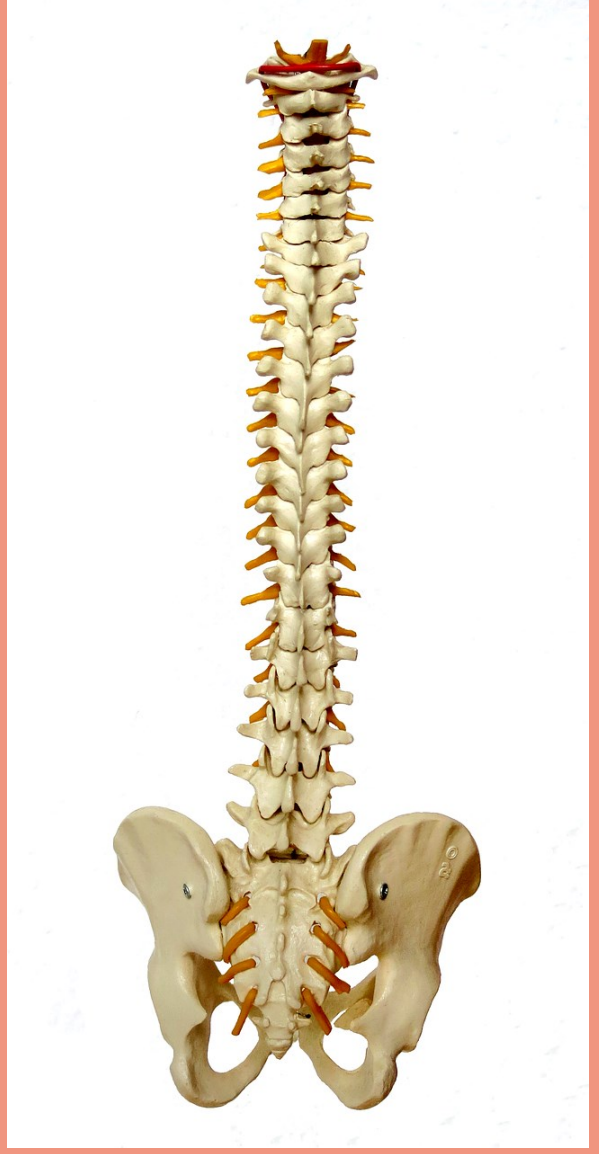
Session Overview

1. Introduction – what is SCI and how does it happen?
2. Case-based learning
3. Risk-taking behaviour
4. Break
5. Neuroanatomy of SCI
6. Clinical Skills
7. Conclude

What is spinal cord injury (SCI)?

Spinal Cord Injury (SCI) is damage to the spinal cord resulting from trauma (e.g. from falls and road traffic injuries) or non-traumatic causes like tumours, degenerative and vascular conditions, infections, toxins or birth defects.

The extent of SCI related impairment depends on injury severity and location in the spinal cord.



NIH National Institute of Neurological Disorders and Stroke

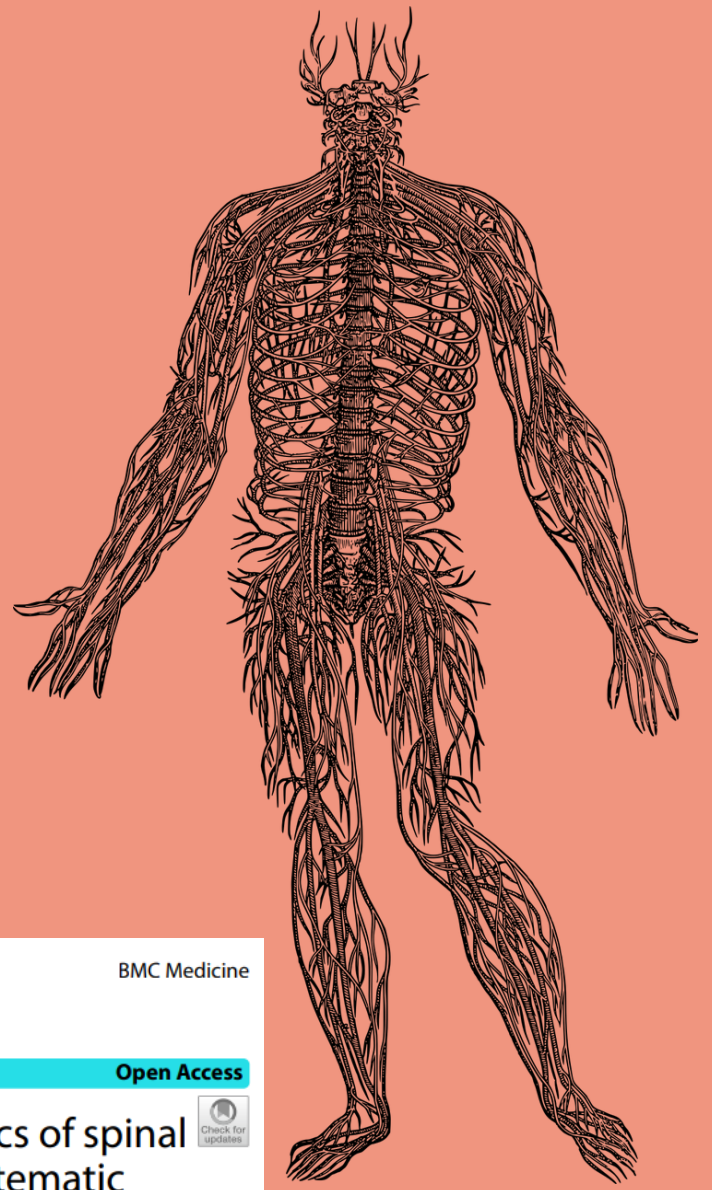
World Health Organization

Prevalence of SCI

In the UK, the annual incidence of acute SCI is 19 new cases per million population, contributing to an estimated 50,000 people who are currently living with SCI (Patek and Stewart, 2023).

Globally, over 15 million people are living with SCI (WHO, 2024)

Age at the time of SCI has a bimodal distribution, with spikes in young adulthood and then in later life, males are more likely to suffer SCI than females (Patek and Stewart, 2023).



Lu et al. BMC Medicine (2024) 22:285
https://doi.org/10.1186/s12916-024-03514-9

BMC Medicine

RESEARCH Open Access

Global incidence and characteristics of spinal cord injury since 2000–2021: a systematic review and meta-analysis

Yubao Lu[1,2,3†], Zhizhong Shang[1,2,3,4†], Wei Zhang[1,2,3†], Mao Pang[1,2,3†], Xuchang Hu[5], Yu Dai[1], Ruoqi Shen[1,2,3], Yingjie Wu[1,2,3], Chenrui Liu[1,2,3], Ting Luo[1,2,3], Xin Wang[4*], Bin Liu[1,2,3*], Liangming Zhang[1,2,3*] and Limin Rong[1,2,3*]

Aetiology of SCI

- SCI can be divided into two aetiological categories – traumatic and non-traumatic SCI.
- Trauma is the most common cause of SCI both globally and locally.

▸ Spine (Phila Pa 1976). 2023 Apr 11;48(17):E288–E301. doi: 10.1097/BRS.0000000000004669

Sex-related Differences in Epidemiology, Treatment, and Economic Burden of Traumatic Spinal Cord Injury in China (2013–2018)

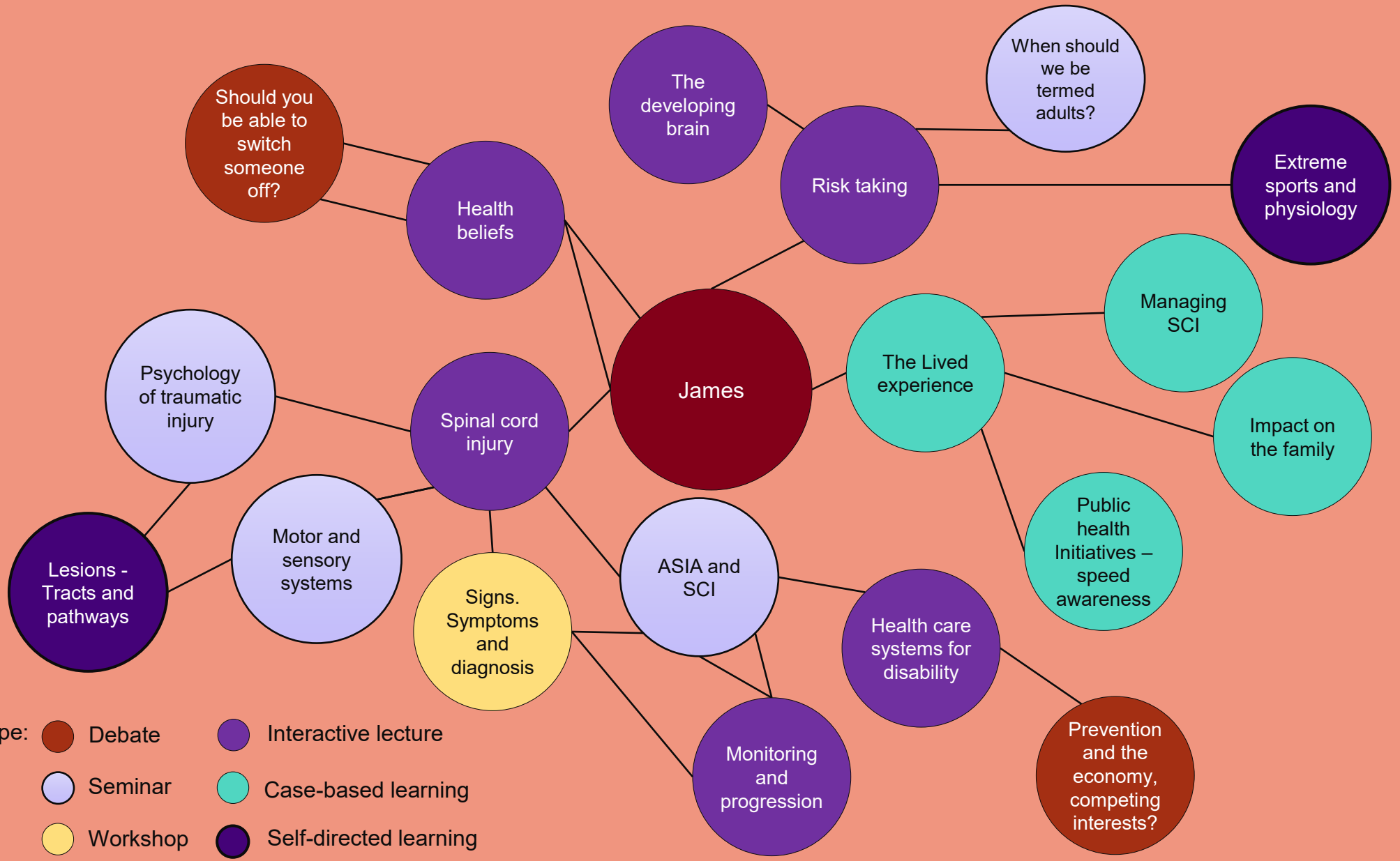
Shenghui Shang [a], Chaoyu Wang [b], Wei Wang [a], Jinghua Wang [c,d], Yongfu Lou [a,e], Chi Zhang [a], Wenzhao Wang [a], Yi Kang [e], Huan Jian [e], Yigang Lv [e], Mengfan Hou [e], Hua Zhao [a], Lingxiao Chen [a,f,✉], Hengxing Zhou [a,g,✉], Shiqing Feng [a,e,h,✉]

Case study

James, a 23-year-old male, is brought into the Emergency Department after being involved in a road traffic collision. The driver was dead on admission and had not been wearing a seatbelt.

James was found in a semi-conscious state in the passenger seat and had suffered major traumatic injury when the Christmas gifts that were stacked on the back seat of the car smashed through the back of his seat.

How would HMS students approach this learning?



Have a go at CBL?

What do you think is important in the case?

UNIVERSITY OF WARWICK

In your group...

These are the steps in CBL

1. Clarify, define and understand new words and terminology
2. Identify key cues and statements
3. Identify and discuss relevant areas that you already know about
4. Identify relevant areas that you need to research/investigate further
5. Generate learning areas
6. Agree tasks and distribution
7. Self-directed learning and guided learning

Pick a chair and a scribe

Pick out elements that might link to health or medical sciences learning

Discuss what you know about these

Try and find something new out about the topics

What do you think are the important things in this case scenario?

James, a 23-year-old male, is brought into the Emergency Department after being involved in a road traffic collision. The driver was dead on admission and had not been wearing a seatbelt.

James was found in a semi-conscious state in the passenger seat and had suffered major traumatic injury when the Christmas gifts that were stacked on the back seat of the car smashed through the back of his seat.

What do you think are the important things in this case scenario?

James, a 23-year-old male, is brought into the Emergency Department after being involved in a road traffic collision. The driver was dead on admission and had not been wearing a seatbelt.

James was found in a semi-conscious state in the passenger seat and had suffered major traumatic injury when the Christmas gifts that were stacked on the back seat of the car smashed through the back of his seat.

The psychology of Risk-taking behaviour

"Any behaviour that puts an individual or others around them at an increased chance of harm, where the individual weighs up the possible outcomes of their actions" (Sitkin & Pablo, 1992)

Adolescent males and young men are more likely to engage in risk-taking behaviour (Duell et al., 2018)

But why engage in potentially harmful behaviour?

Research suggests risk-taking behaviour is evolutionary (Ellis et al., 2012)

The brain is not fully developed until the mid-20s, late developing faculties include:

- Emotional regulation
- Mentalising
- Inhibitory control

The psychology of Risk-taking behaviour

- Thrill seeking
- Social influence
- Psychological profile
- Substance misuse

Thrill-Seeking & Sensation-Seeking

- Zuckerman's (1979) **Sensation Seeking Theory**: people differ in their need for novel, intense, and varied stimulation. High sensation seekers actively seek out risk

- Linked to the **dopaminergic reward system.** Risk-taking triggers dopamine release, which is reinforcing, especially in the still-developing adolescent brain

- Young males consistently score highest on sensation-seeking scales

- **Optimism bias**: is the tendency to underestimate personal risk ("it won't happen to me"). It helps explain why James may not have felt wearing a seatbelt was necessary

Social influence

- **Normative social influence**: if peers don't wear seatbelts or encourage speeding, this becomes the perceived norm (pressure to conform even without explicit coercion)
- **The audience effect**: research shows young male drivers take significantly more risks when peers are present in the vehicle (Gardner & Steinberg, 2005)
- **Risky shift / group polarisation**: individuals make riskier decisions in groups than alone
- **Masculine identity**: risk-taking can be tied to social performance of masculinity i.e. being seen as fearless or dominant by peers

Psychological profile:
Mental health, impulsivity and neurodiversity

- **Depression & reduced future orientation**: lower concern for long-term consequences ("nothing to lose" mindset) can increase risk tolerance

- **Emotional dysregulation**: difficulty managing negative emotions can lead to impulsive, high-risk behaviour as a coping mechanism

- **ADHD**: one of the strongest psychiatric predictors of risk-taking- characterised by poor inhibitory control, impulsivity, and reduced sensitivity to consequences

Important note: mental health doesn't *cause* risk-taking,but it can significantly *amplify* vulnerability. This isrelevant when considering James's wider context

Substance misuse

- Alcohol **directly impairs prefrontal cortex function**, the area responsible for judgement, impulse control, and risk assessment (the very area already underdeveloped in young men)
- Young male drivers are disproportionately represented in drink/drug-drive statistics
- **Dual risk effect**: substance use is itself a risk behaviour, and it simultaneously lowers inhibitions and increases the likelihood of *other* risk behaviours (e.g., not buckling up, speeding)
- Cannabis, stimulants, and sedatives all impair reaction time and hazard perception, compounding danger behind the wheel

Break

UNIVERSITY OF WARWICK

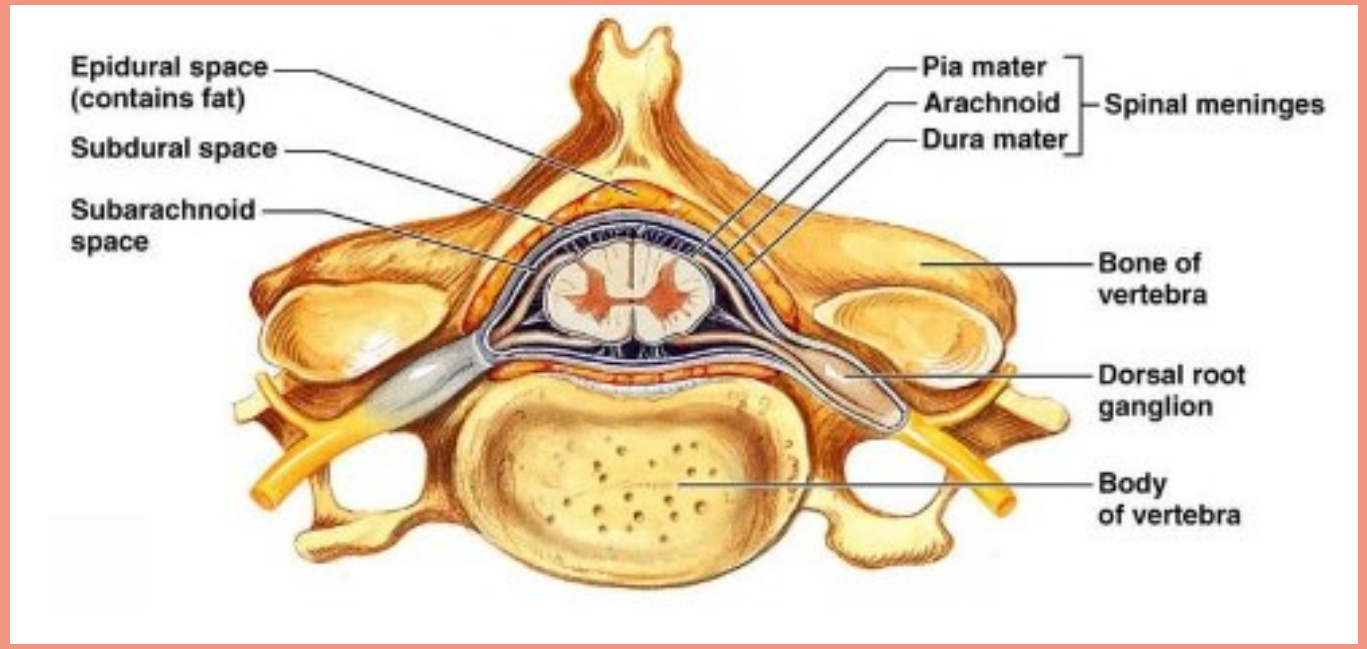
What do you think are the important things in this case scenario?

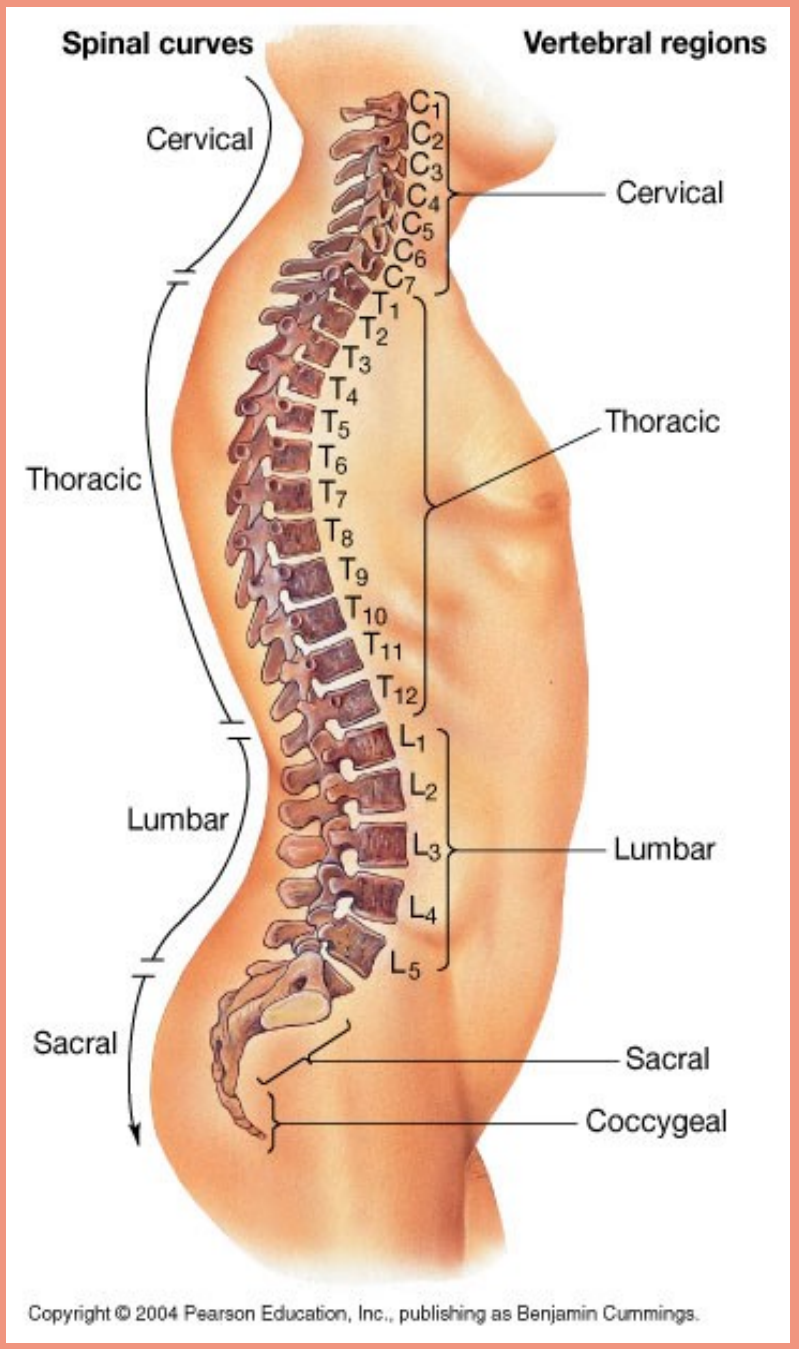
James, a 23-year-old male, is brought into the Emergency Department after being involved in a car crash. The driver was dead on admission and had not been wearing a seatbelt.

James was found in a semi-conscious state in the passenger seat and had suffered major traumatic injury when the Christmas gifts that were stacked on the back seat of the car smashed through the back of his seat.

Neuroanatomy of the vertebral column

Vertebral column provides the protection for the spinal cord



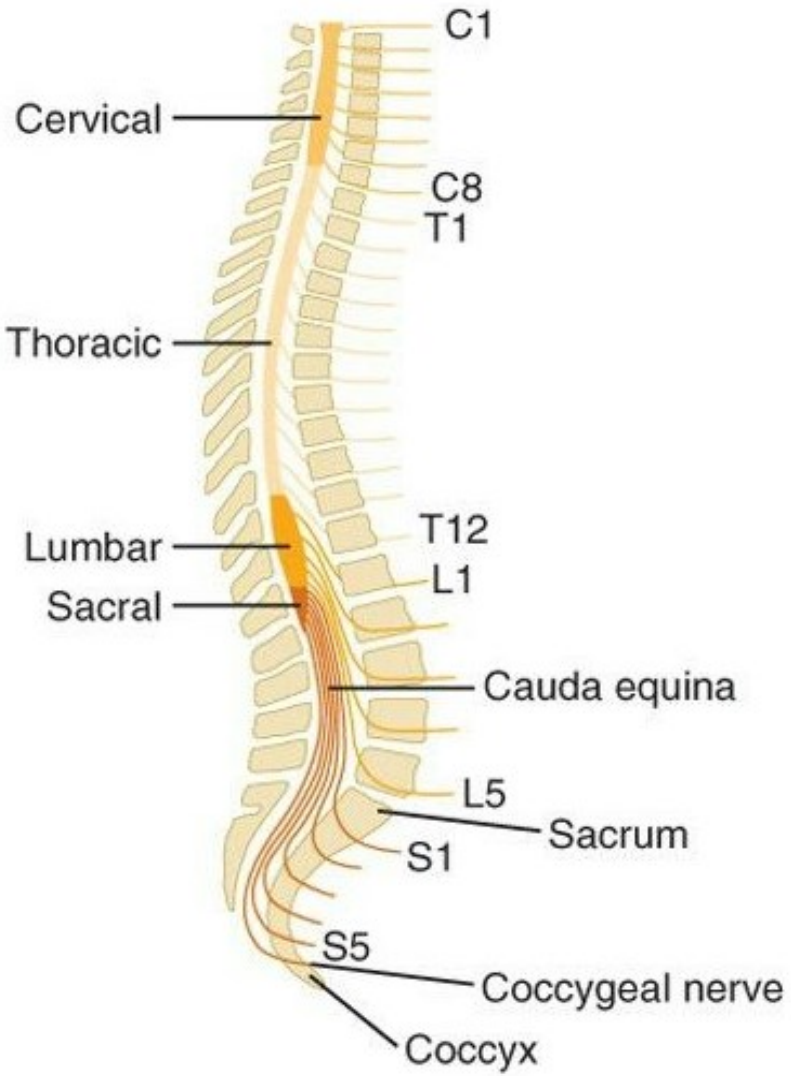


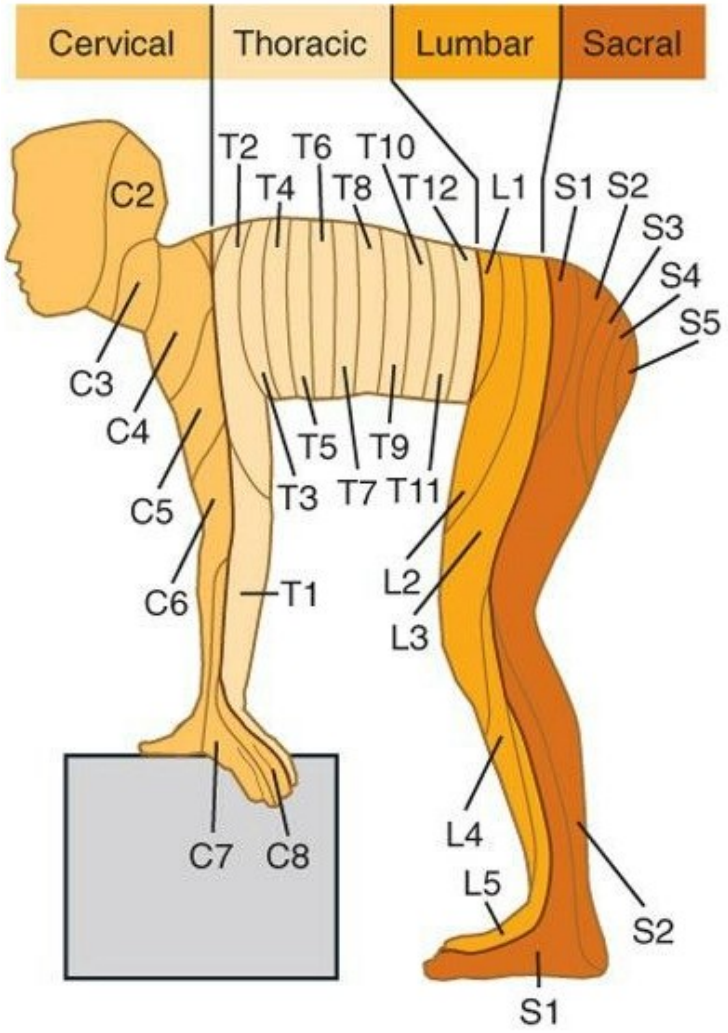
Spinal segments

Spinal nerves leave at approx. the correct level on the vertebral column.

The spinal cord ends at L1-2

This knowledge helps neurologists and neurosurgeons determine where in the cord the damage has occurred



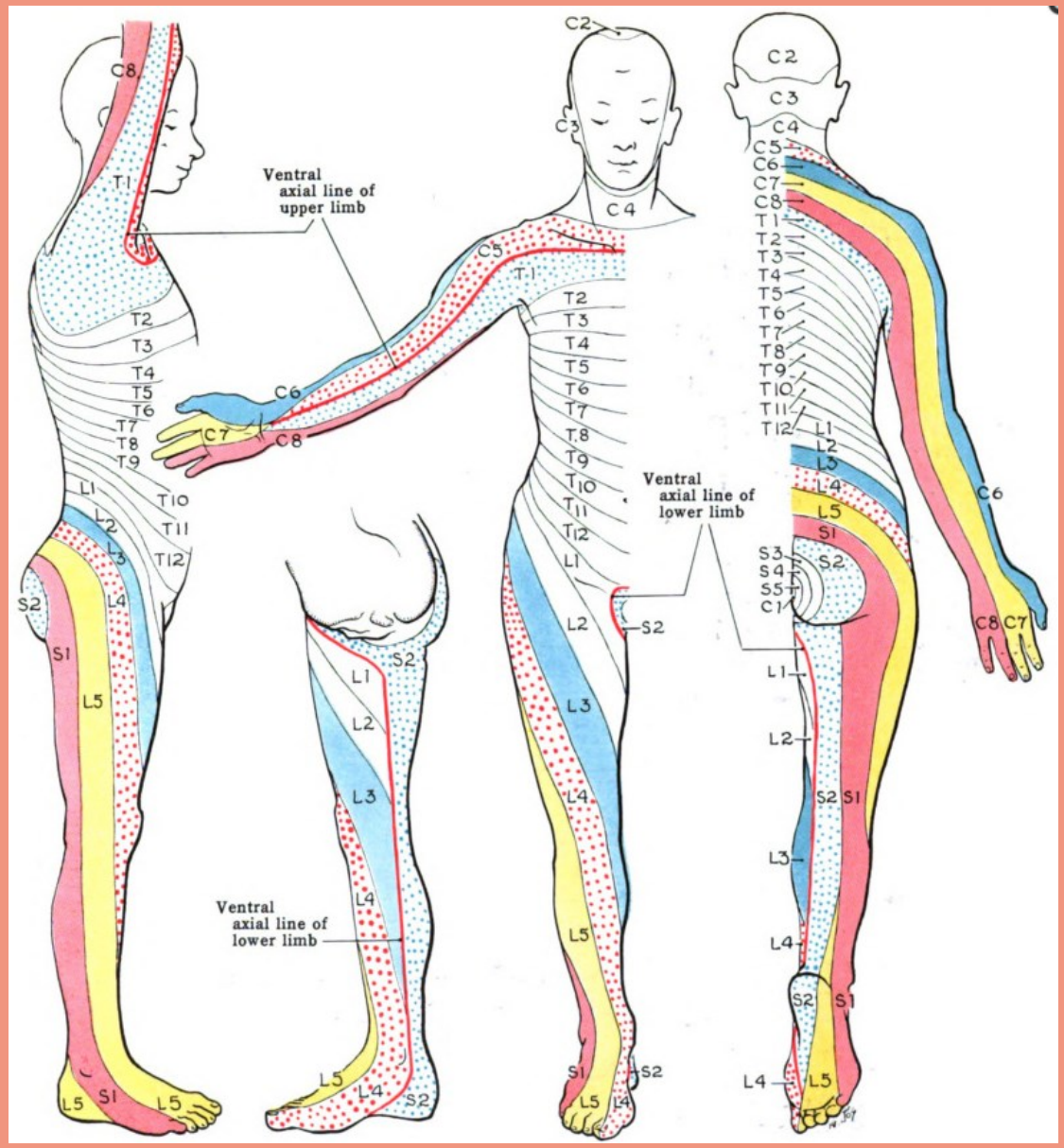


Dermatomes

Dermatomes divide the skin according to sensory nerve distribution

Which spinal levels innervate:

- Thumb
- Little finger
- Nipple
- Umbilicus
- Medial knee
- Dorsal surface of foot and toes 1-3?

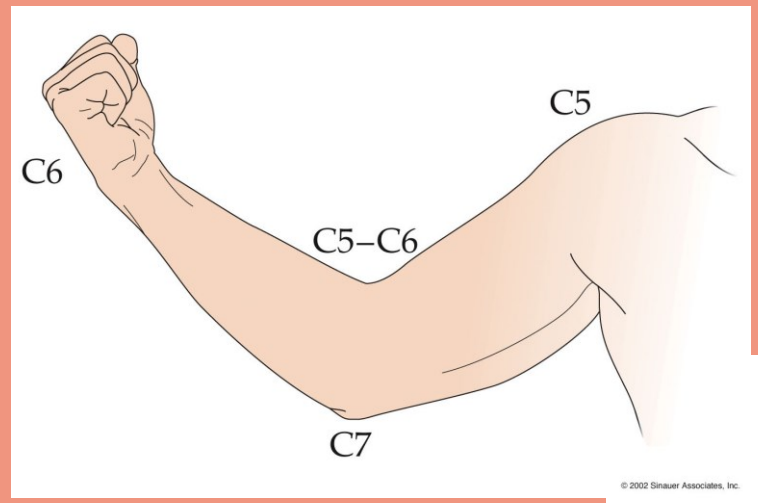


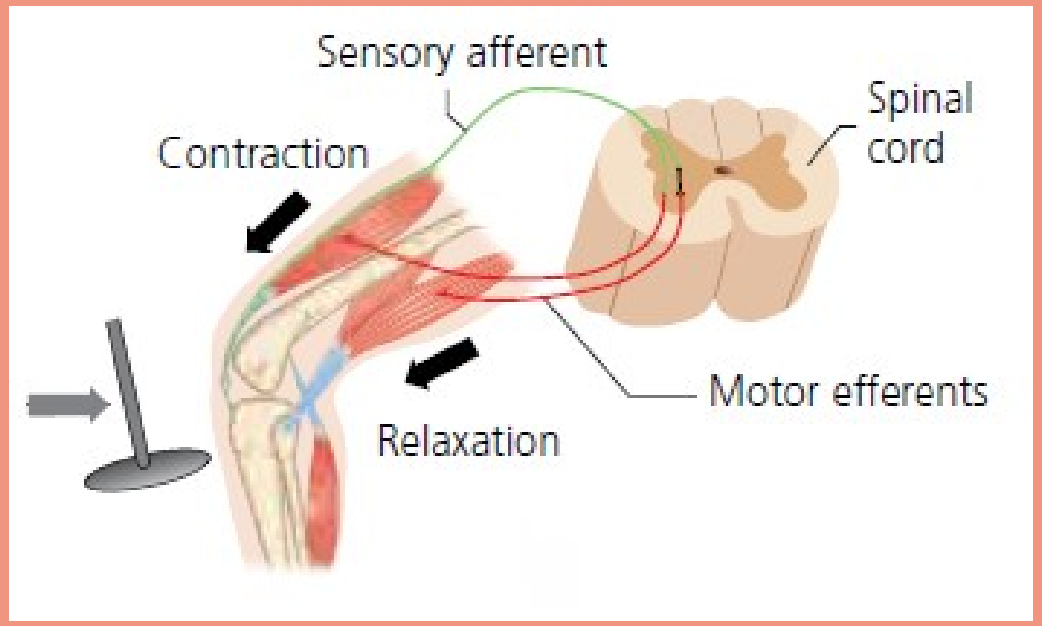
Reflexes

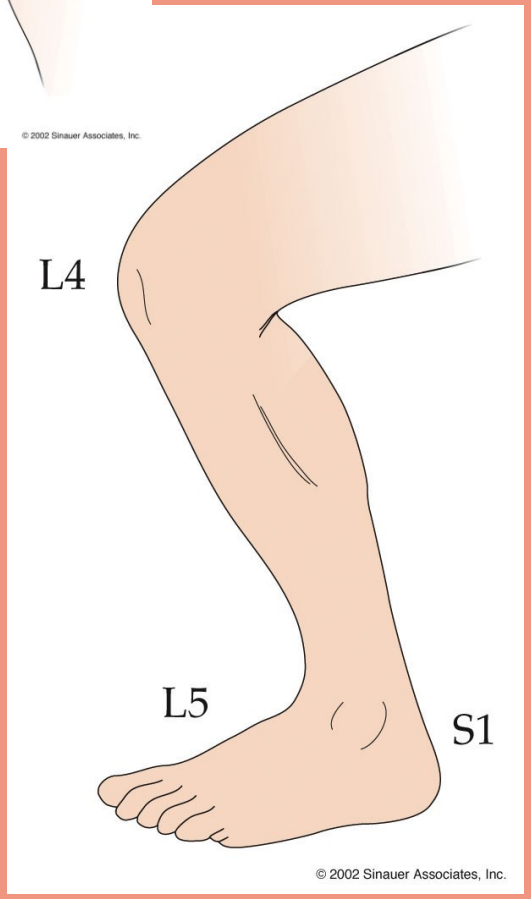
Certain reflexes are used in the clinic to check the integrity of the nervous system. These arise from specific regions of the cord (and cranial nerves).

The reflexes often tested include:

- Knee-jerk - L3/L4
- Ankle-jerk – S1
- Plantar – UMN if extensor
- Biceps – C5/C6
- Triceps – C6/C7
- Jaw – CNV (trigeminal)







Introduction to Clinical Skills

Clinical Scenario:

Patient name: James

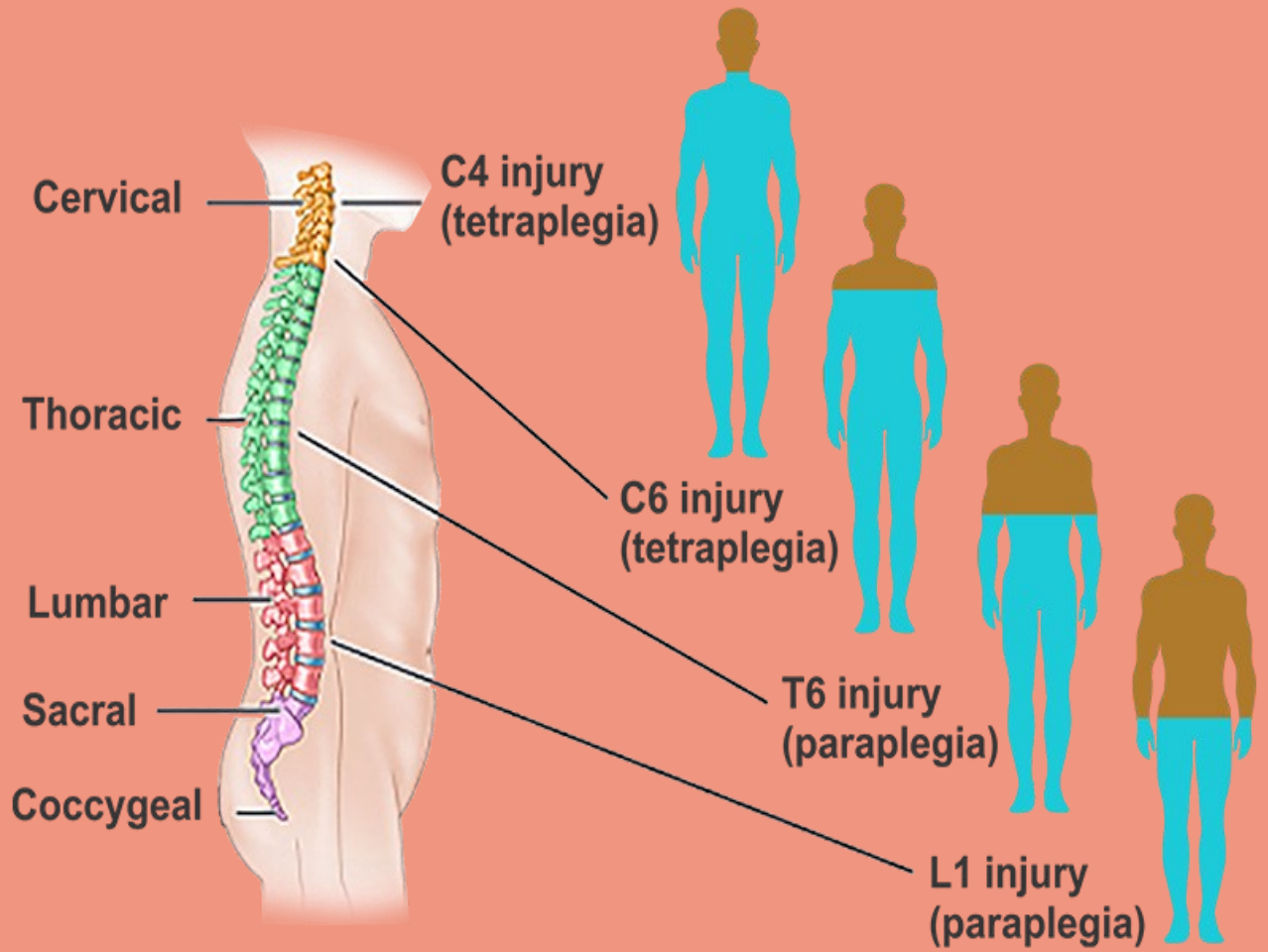
Age :23 years

Doctor noticed that he couldn't move his legs

Can they feel their legs?

Can they move their legs?

Are their reflexes normal?



Introduction to Clinical Skills Cont....

What is a reflex?

Examples:

- Pulling your hand away from a hot pan
- Blinking when something comes close to your eye
- Knee "jerk" after a tendon is tapped

Key point

The brain does **not** need to make the initial decision.

The spinal cord can produce the response on its own.

THE REFLEX ARC

A reflex is a fast, automatic response to a stimulus.

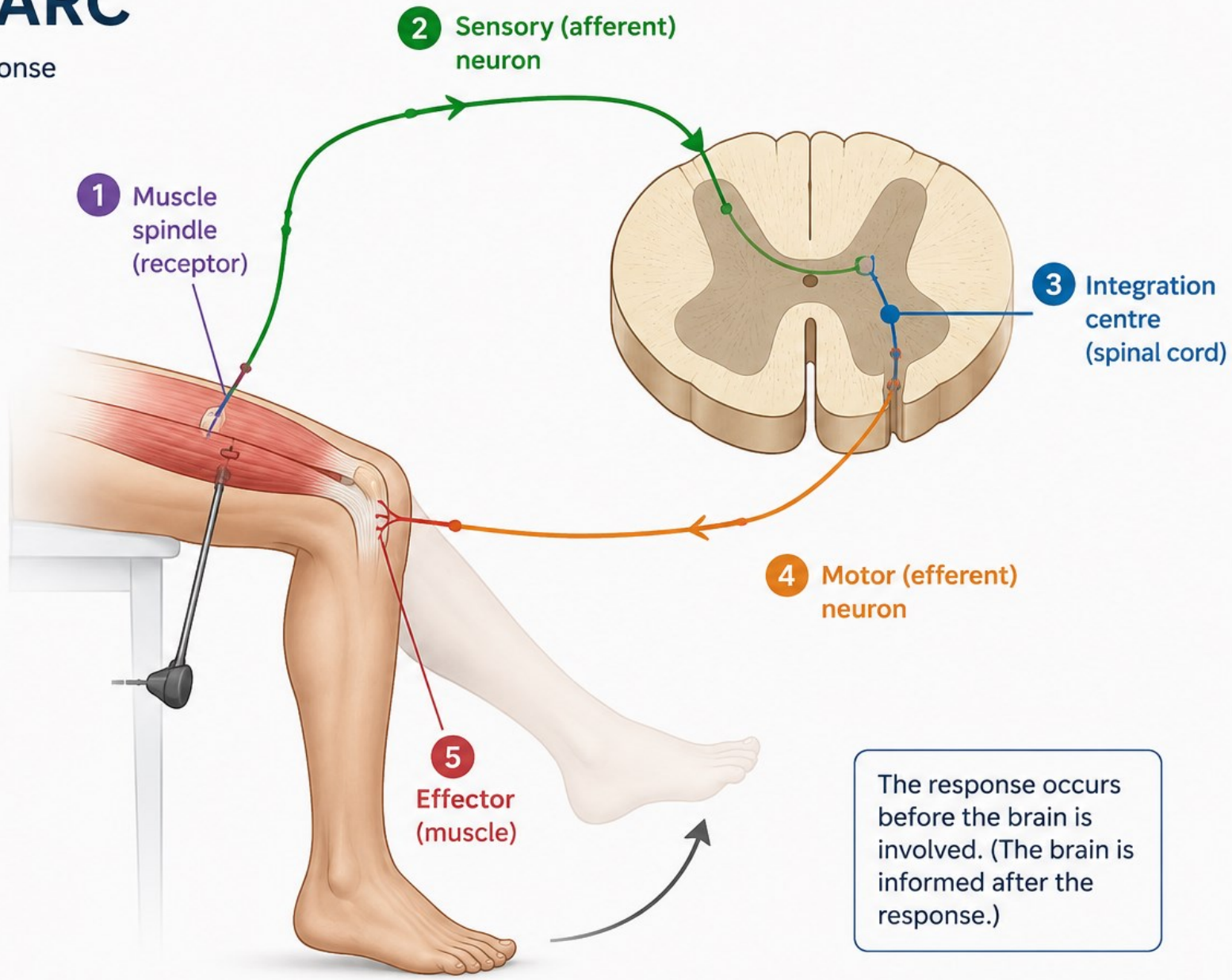
1 RECEPTOR
Muscle spindle in the quadriceps detects the stretch.

2 SENSORY (AFFERENT) NEURON
Sends the message to the spinal cord.

3 INTEGRATION CENTRE
The message is processed in the spinal cord.

4 MOTOR (EFFERENT) NEURON
Sends the response back to the muscle.

5 EFFECTOR
Muscle contracts and produces the response (knee extension).



The response occurs before the brain is involved. (The brain is informed after the response.)

Deep tendon reflexes

Reflex	Spinal nerve roots	Peripheral nerve	How to test	Normal response
Biceps	C5–C6 (primarily C5)	Musculocutaneous	Tap thumb over biceps tendon	Elbow flexion
Brachioradialis (supinator)	C5–C6 (primarily C6)	Radial	Tap tendon ~2–3 cm above radial styloid	Elbow flexion with forearm supination
Triceps	C7–C8 (primarily C7)	Radial	Tap triceps tendon above olecranon	Elbow extension
Patellar (knee jerk)	L2–L4 (primarily L4)	Femoral	Tap patellar tendon	Knee extension
Achilles (ankle jerk)	S1–S2 (primarily S1)	Tibial	Tap Achilles tendon while foot is dorsiflexed	Plantarflexion

Practicing Clinical Skills

Have a go at testing your reflexes

Which nerves are involved in this reflex?

Try the **Jendrassik manoeuvre**
– What does this do to the reflex?

What will happen to reflexes after spinal injury?

Immediately after injury:
Reflexes may disappear.
This is called **spinal shock**.

Days to weeks later:
⬆ Reflexes often become exaggerated.
This happens because the brain can no longer regulate spinal reflexes.

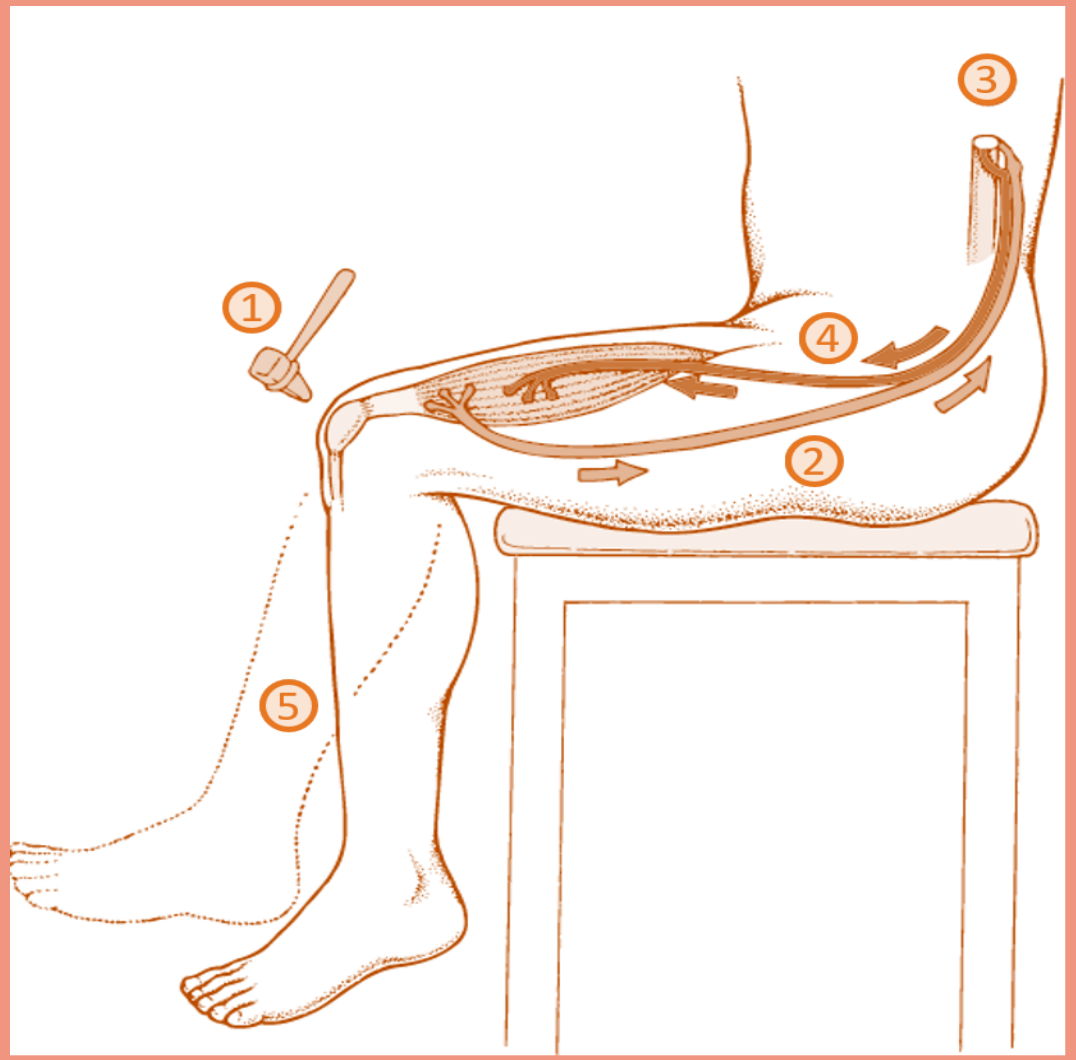


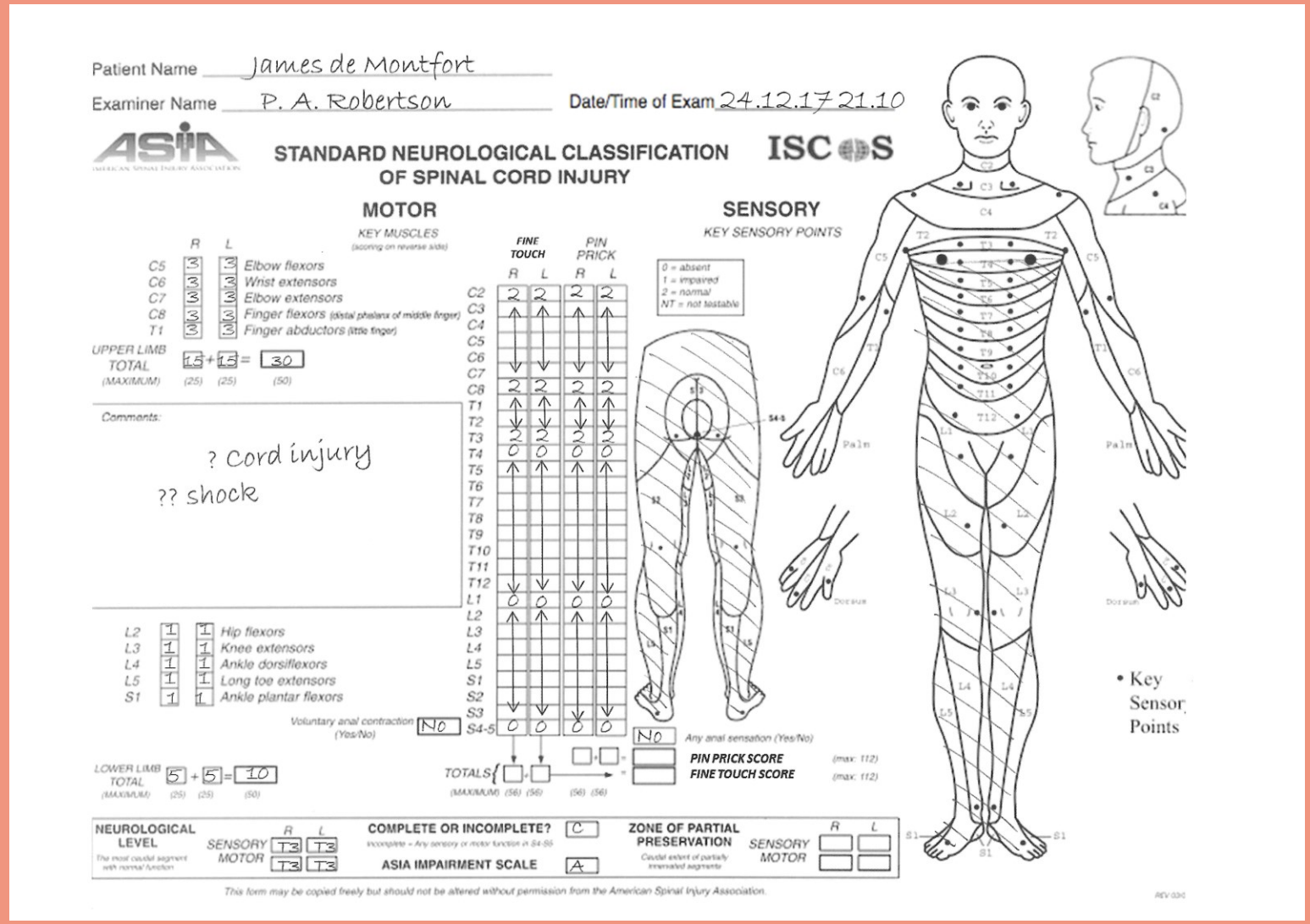
Image:Reflex Arc: A No-Brainer-MSD Manual Consumer Version

SCI assessment – ASIA sheets

Clinical assessment maps the motor and sensory loss

ASIA Sheets are used to help identify the region of damage

See if you can work out what the pattern of sensory and motor loss is



Patient Name James de Montfort

Examiner Name P. A. Robertson Date/Time of Exam 30.12.17 08.00

STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ASIA (American Spinal Injury Association) ISCOS

MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5	5	5	Elbow flexors
C6	5	5	Wrist extensors
C7	5	5	Elbow extensors
C8	5	5	Finger flexors (distal phalanx of middle finger)
T1	5	5	Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM): 25 + 25 = 50 (25) (25) (50)

Comments:

Started feeling catheter tug
Sensations partially returned

	R	L	
L2	3	1	Hip flexors
L3	3	1	Knee extensors
L4	3	1	Ankle dorsiflexors
L5	3	1	Long toe extensors
S1	3	1	Ankle plantar flexors

Voluntary anal contraction (Yes/No): Yes

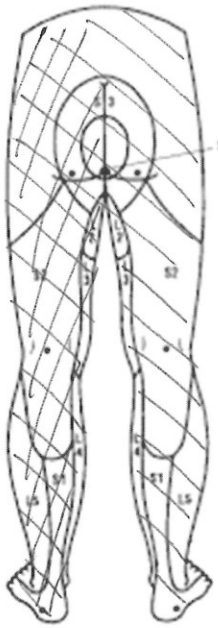
LOWER LIMB TOTAL (MAXIMUM): 15 + 5 = 20 (25) (25) (50)

SENSORY

KEY SENSORY POINTS

	FINE TOUCH R	FINE TOUCH L	PIN PRICK R	PIN PRICK L
C2	2	2	2	2
C3				
C4				
C5				
C6				
C7	2	2	2	2
C8				
T1				
T2				
T3	2		2	2
T4	2	1	2	2
T5			1	
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1	2	1	1	2
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5	2	1	1	2
TOTALS (MAXIMUM)	(56)	(56)	(56)	(56)

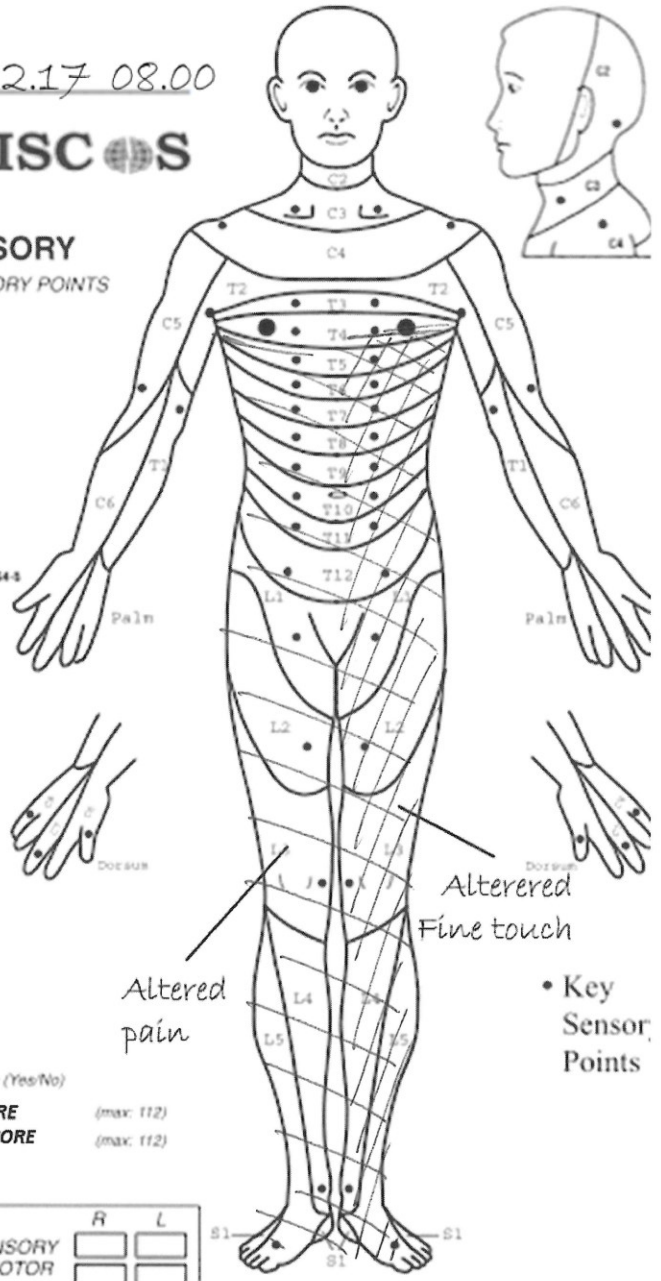
0 = absent
1 = impaired
2 = normal
NT = not testable



Yes — Any anal sensation (Yes/No)

PIN PRICK SCORE (max: 112)

FINE TOUCH SCORE (max: 112)



NEUROLOGICAL LEVEL (The most caudal segment with normal function)		R	L
	SENSORY	T4	T3
	MOTOR		

COMPLETE OR INCOMPLETE? (Incomplete = Any sensory or motor function in S4-S5): IC

ASIA IMPAIRMENT SCALE: D

ZONE OF PARTIAL PRESERVATION (Caudal extent of partially innervated segments)

	R	L
SENSORY		
MOTOR		

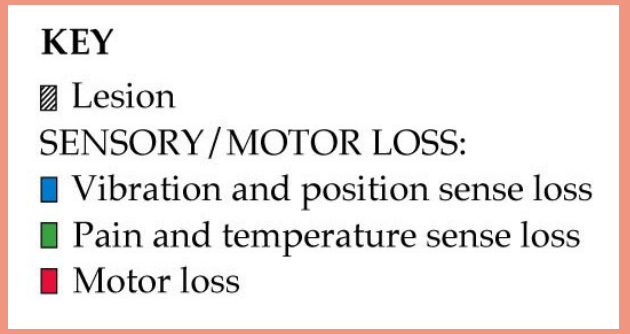
REV 02/0

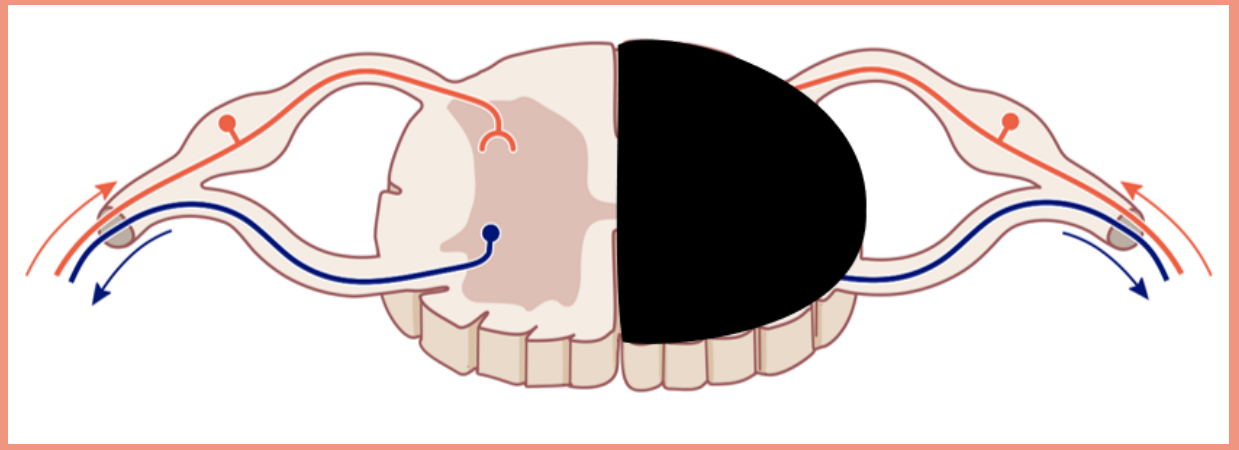
Cord hemisection (Brown Séquard Syndrome)

The pattern of sensory and motor loss allows clinicians to determine that half of James' cord has been damaged in the collision

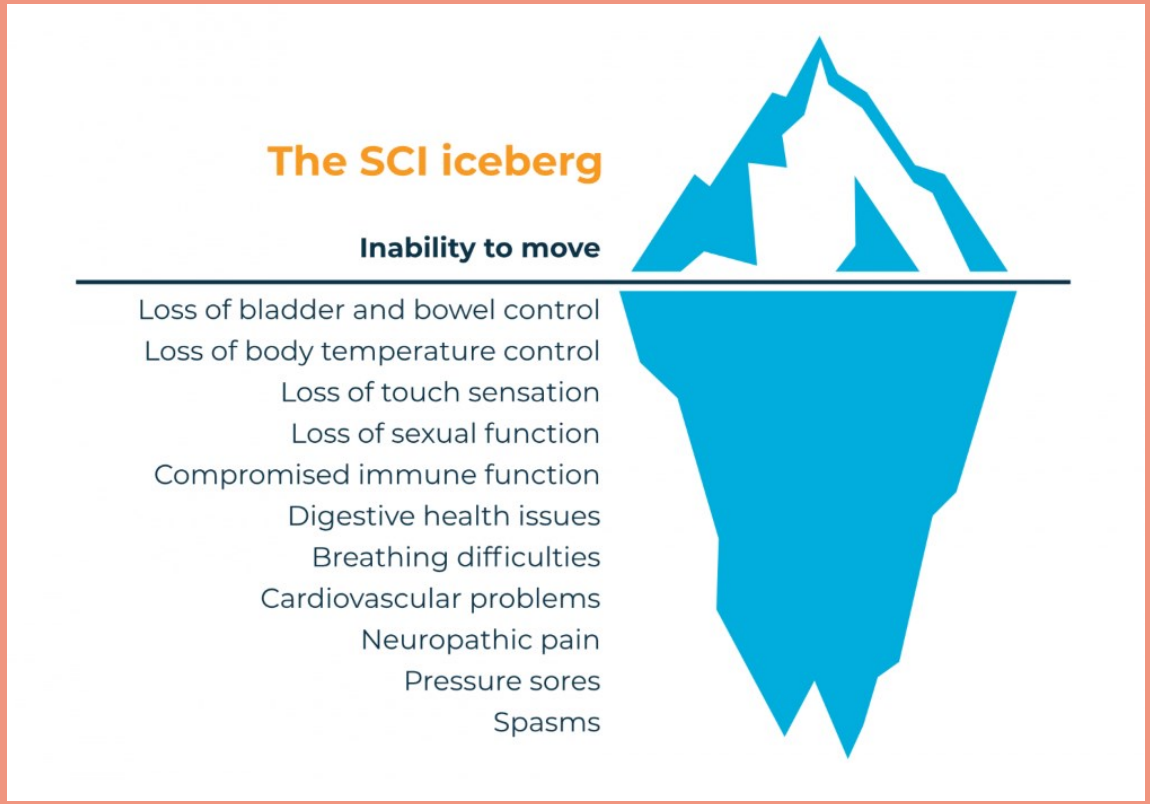
Why?

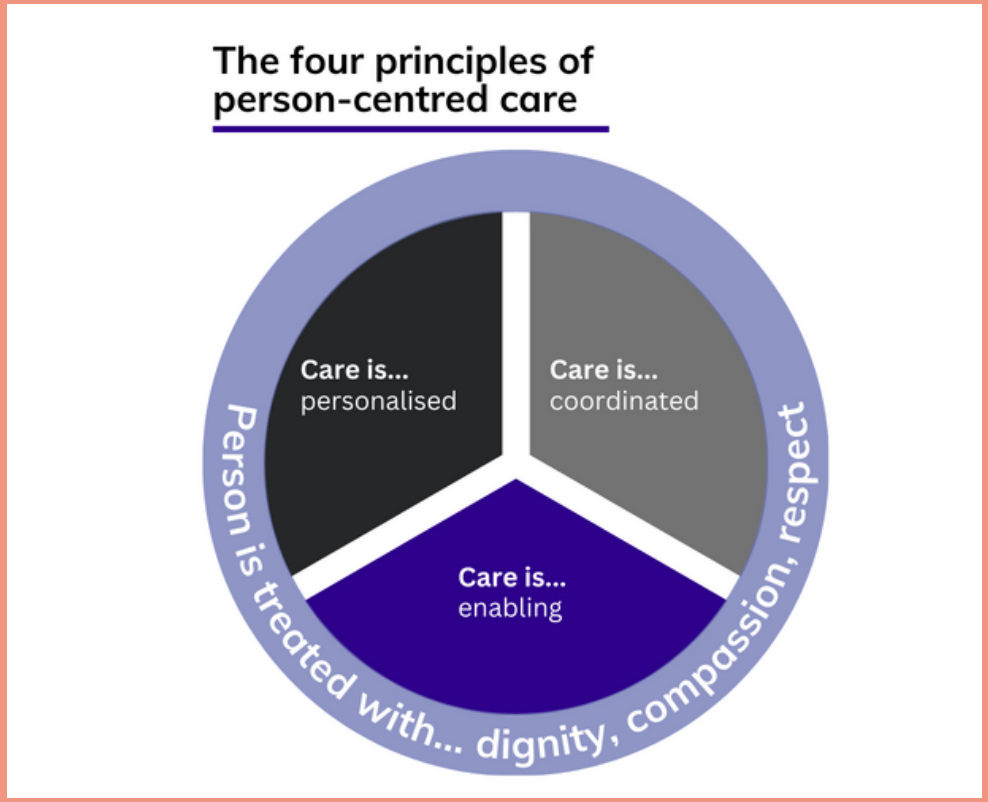
- **Motor loss is on the opposite side to loss of pain sensation**
- Pain pathways cross over as they enter the spinal cord
- **The spinal cord damage is at T4 level, this is where the loss of fine touch begins**
- Fine touch stay on the same side (in the spinal cord)
- Voluntary motor tracts stay on the same side (in the spinal cord)





The physical damage is only part of the story





Skills for Health

SpinalCure AUSTRALIA

UNIVERSITY OF WARWICK

Psychological effects of SCI

Affects mental health

Depression, anxiety, substance use disorders, and PTSD are significantly more prevalent for people with SCI

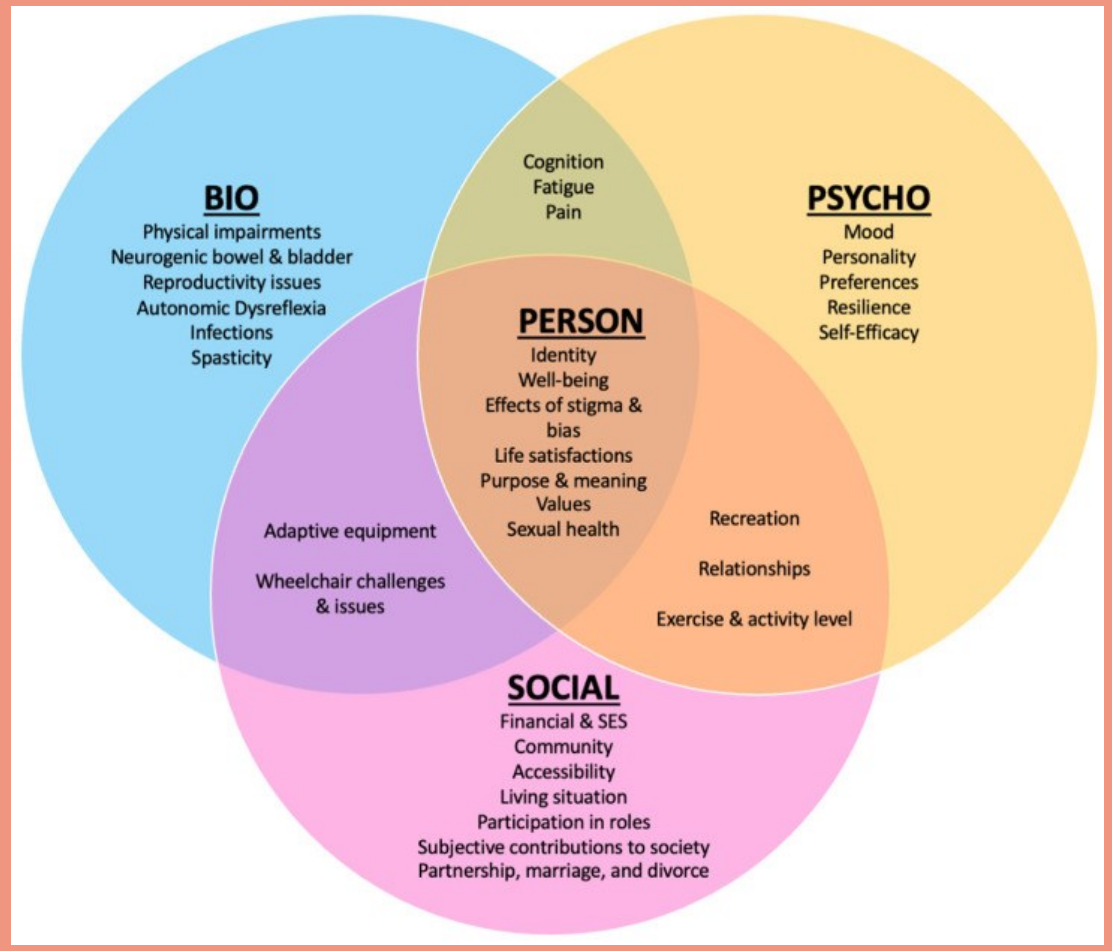
Affects self-concept

Self-perception can change with SCI. Fixation with loss of function and its social and practical benefits

Causes negative body image

Consequences for self due to bodily changes, interactions with the public become difficult, and body nostalgia

Biopsychosocial aspects of SCI



Ineffectual bias: people's assumption that disability also negatively affects the whole person such as their intelligence, abilities, or personality

Self-stigma (when a person sees themself in a stigmatised way) is worst during initial 2-3yrs of SCI

Interpersonal relationships change: role as a care receiver, loss of independence, loss of social opportunity can impede mental wellbeing

It take a holistic approach to consider all elements – the HMS way!


Any Questions?

Let's see what you've learned

https://create.kahoot.it/details/2135e1b6-a385-4dc4-b5d1-8c53550898e8

Thank-you!

UNIVERSITY OF WARWICK