Normal Nerve Anatomy, Physiology and Response to Injury

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Objectives

- Review normal nerve physiology
  - Potentials
  - Propagation
  - Synapses
- Discuss the afferent and efferent pathways
- Understand how nerves can be injured
  - Mechanisms
  - Classifications
  - Nerve regeneration
- Introduce the clinical applications of nerve physiology

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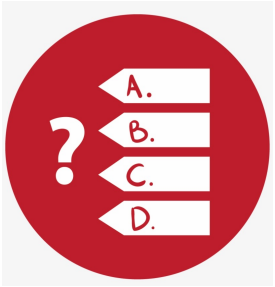

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Neurophysiology SBAs

- A 26 year old professional computer gamer presents to his GP with intermittent paraesthesia in a ulnar nerve distribution. The most likely cause is:

A. Ulnar nerve neurapraxia
B. Ulnar nerve axonotomesis
C. Ulnar nerve Wallerian degeneration
D. T1 Wallerian degeneration
E. T1 neurapraxia

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Neurophysiology SBAs

- A 26 year old psychiatric patient deliberately self harms and stabs their wrist with a knife. The wound is washed out and sutured closed in a minor injuries unit. Two weeks later they are still complaining of sensory loss in the median nerve distribution. The most likely mechanism of injury is:

A. Median nerve neurapraxia
B. Median nerve neurotmesis
C. Median nerve Wallerian degeneration
D. Recurrent branch of median nerve neurapraxia
E. Recurrent branch of median nerve neurotmesis

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Neurophysiology SBAs

- Lidocaine is a local anaesthetic which blocks sodium channels. Which part of the nerve actional potential does lidocaine act on?

A. Stimulus
B. Resting membrane potential
C. Depolarisation
D. Repolarisation
E. Hyperpolarisation

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Disclaimer

This talk contains images of live surgical procedures

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The Nervous System

?

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Things you already know

10

Things you already know

And if you don't will need to know for assessment

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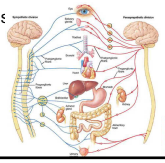
The Nervous System

- Integrates…
  - Basic "survival" functions
    - Higher "voluntary" functions
      - … essentially controlling everything
- Assisted by all other body systems



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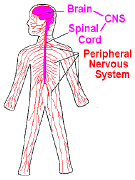
The Nervous System

Central Nervous System (CNS)
- Brain
- Spinal cord

Peripheral Nervous System (PNS)
- Cranial nerves
- Spinal nerves

- Sensory (afferent)
- Motor (efferent)



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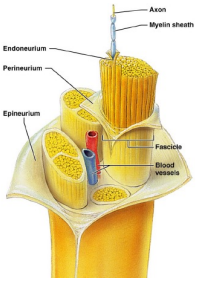
Nerve Anatomy



- Ordered arrangement
- Epineurium
- Perineurium
- Endoneurium
- Nerve fibre
  - Sheath
  - Axon

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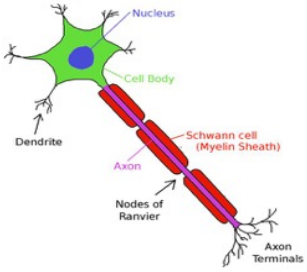
Myelin



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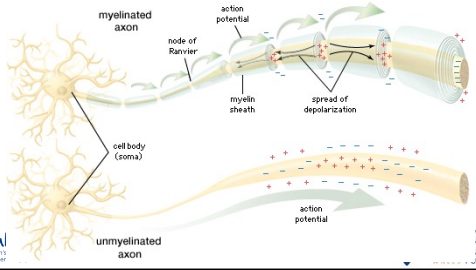
Saltatory Conduction



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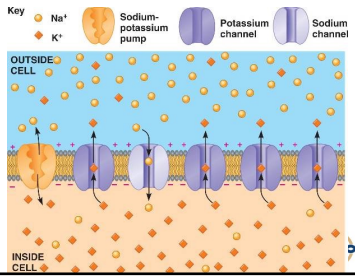
Resting Potential



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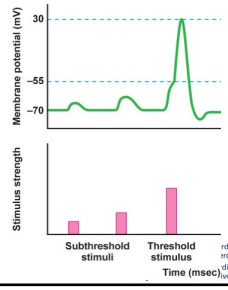
Stimulus



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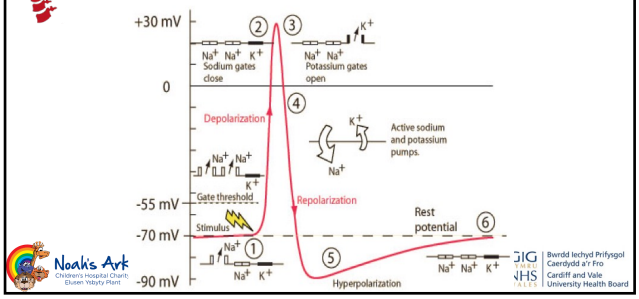
Action Potential



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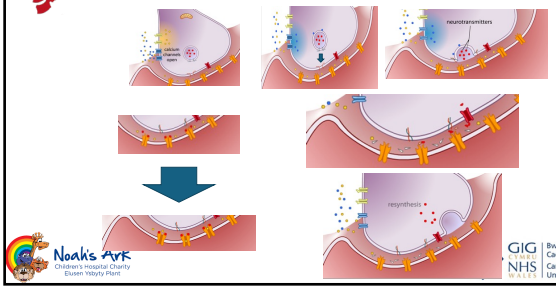
Synaptic Transmission



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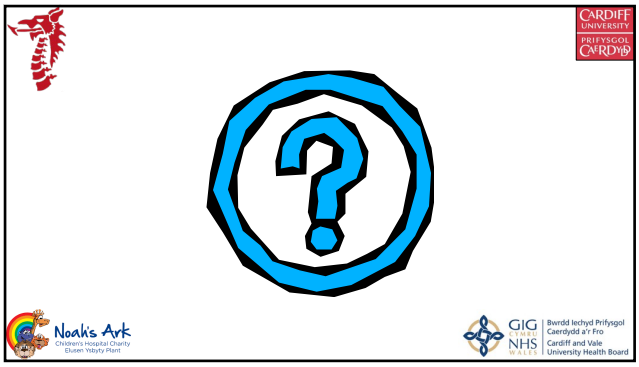

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... and then?

Excitatory **Inhibitory**

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Clinical Implications

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Local Anaesthetic

- Prevent or relieve pain
- Stop sensory conduction
- Membrane stabilisers
- Bind Na+ channels

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Cautions?

- Toxicity
- Adrenaline

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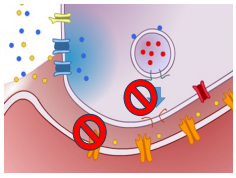
Neuromuscular Blockade



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Neuromuscular-blocking drugs

Non-depolarising Agents

Depolarising Agents

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Nerve Injury

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Injury

- Damage to axon

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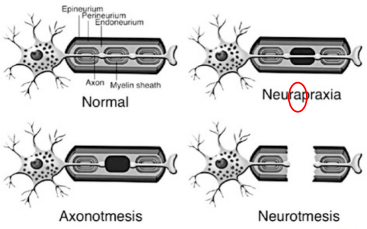
Classification of Nerve injury



Seddon classification

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Classification of Nerve Injury

Seddon	Sunderland	Description
Neurapraxia	I	
Axonotmesis	II	
	III	
	IV	
Neurotmesis	V	
	VI (Mixed)	

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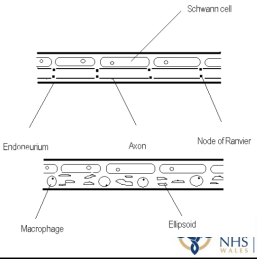
Wallerian Degeneration



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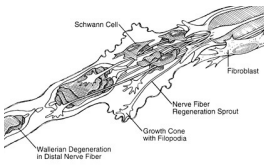
Regeneration



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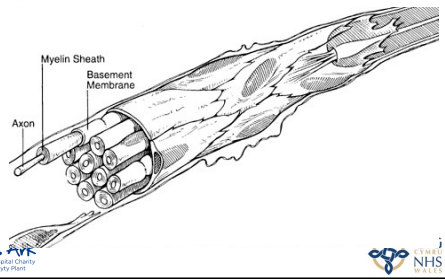
Nerve regeneration



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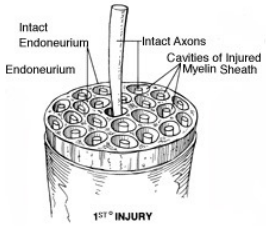
1st Degree (Neurapraxia)



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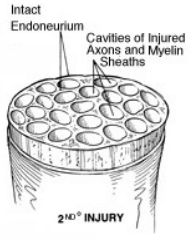
2nd Degree (Axonotmesis)



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3rd Degree

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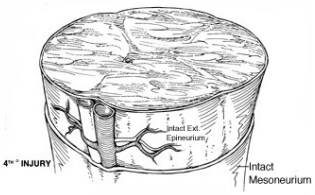
4th Degree



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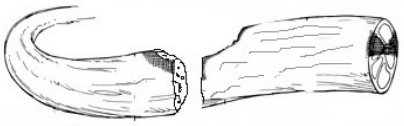
5th Degree (Neurotmesis)



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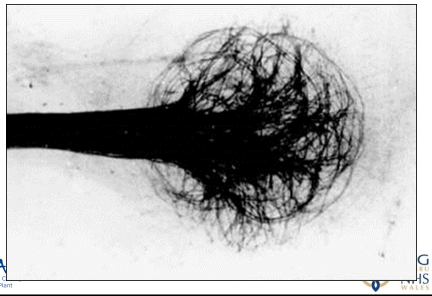

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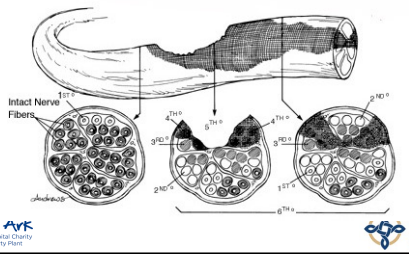
6th Degree (Mixed pattern)



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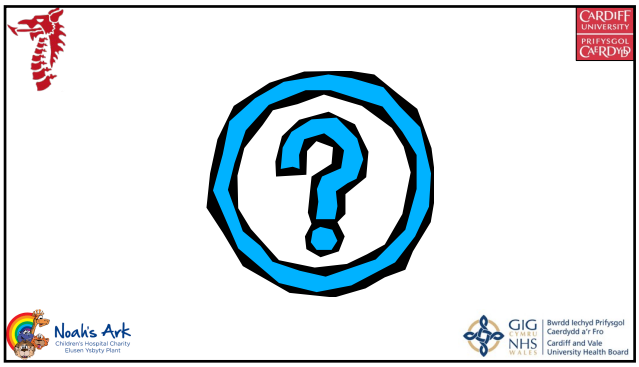

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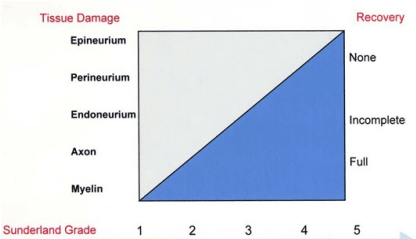
So what?



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So what?

Seddon	Sunderland	Tinel's sign	Advancing Tinel's	Recovery	Surgery
Neurapraxia	I				
Axonotmesis	II				
	III				
	IV				
Neurotmesis	V				
	VI (Mixed)				

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A race to the End Organ

Sensory Receptors **Motor End Plates**

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End organs

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Cases

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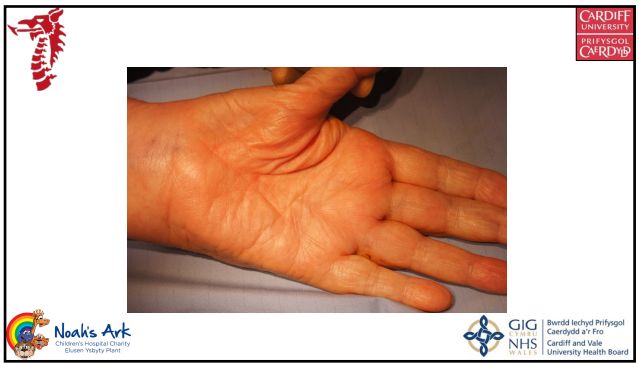

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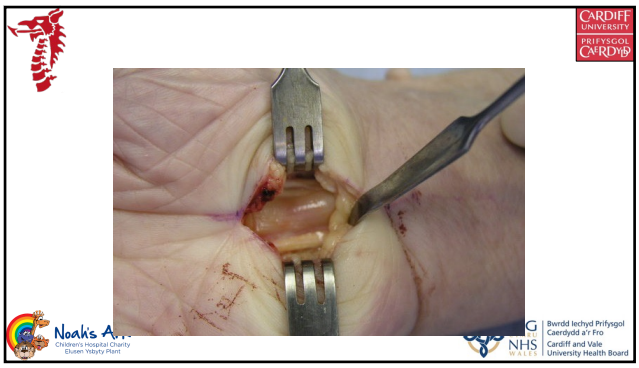

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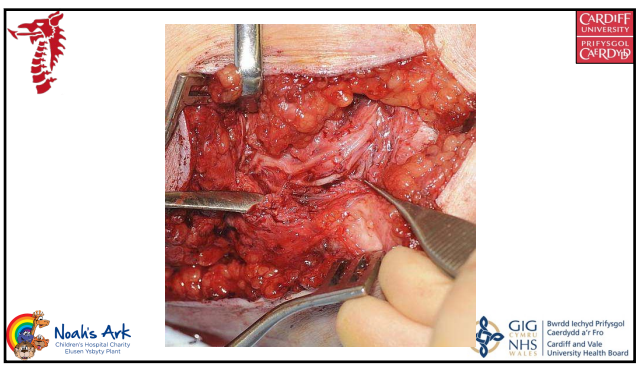

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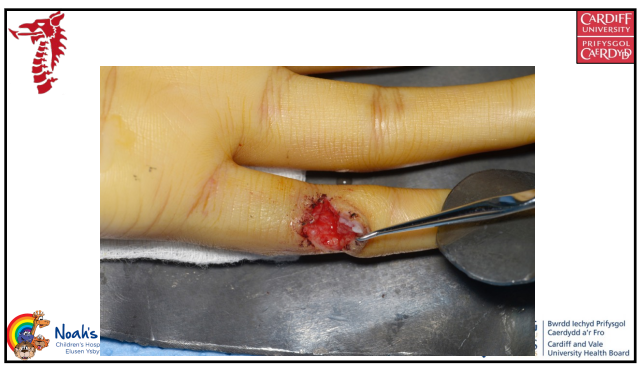

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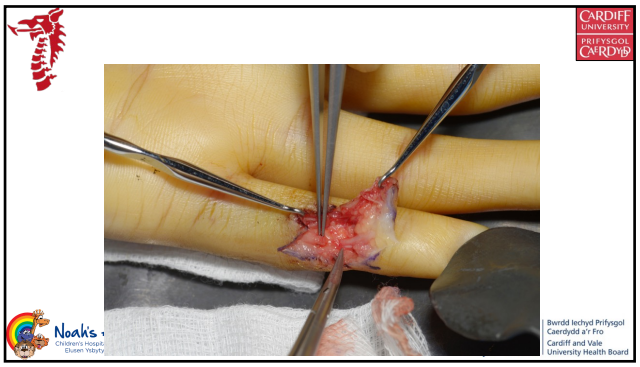

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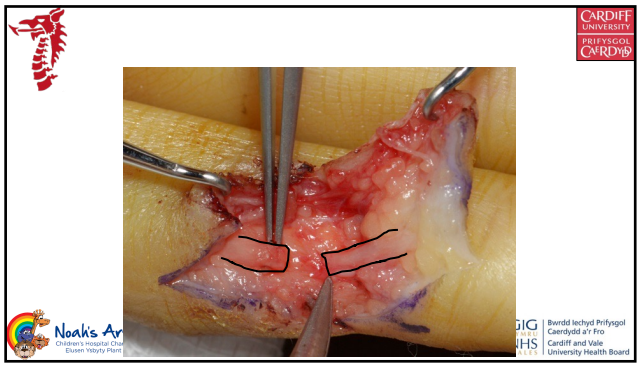

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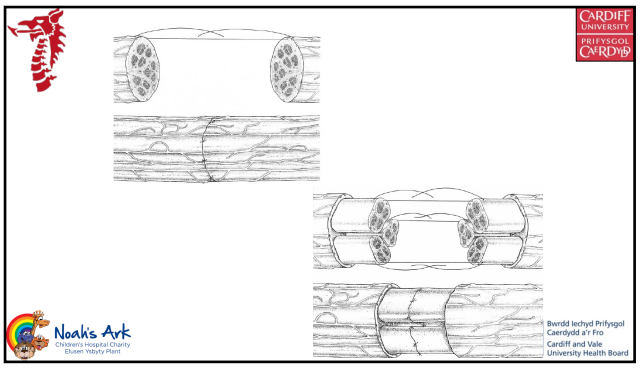

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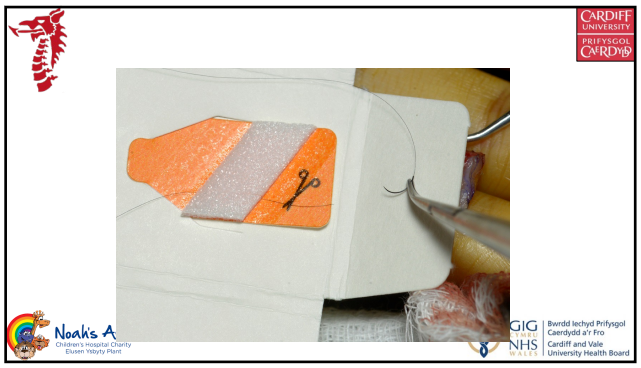

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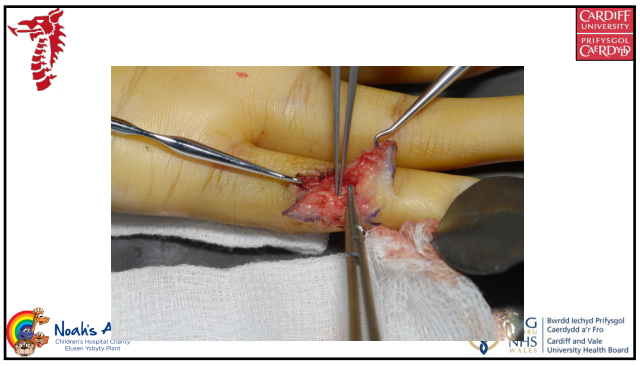

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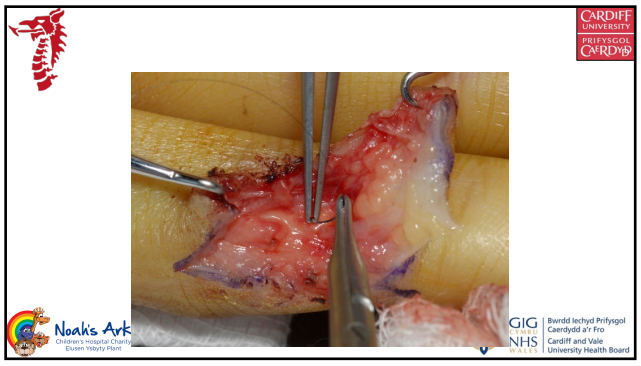

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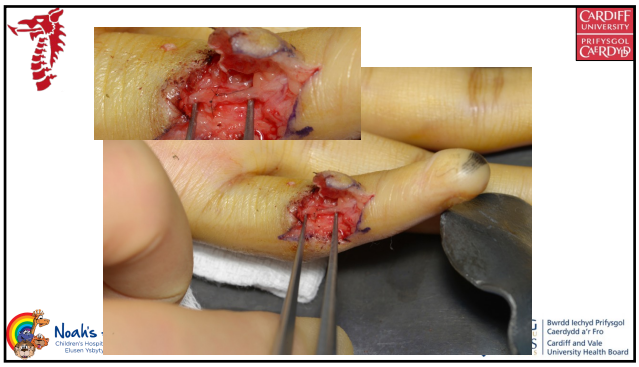

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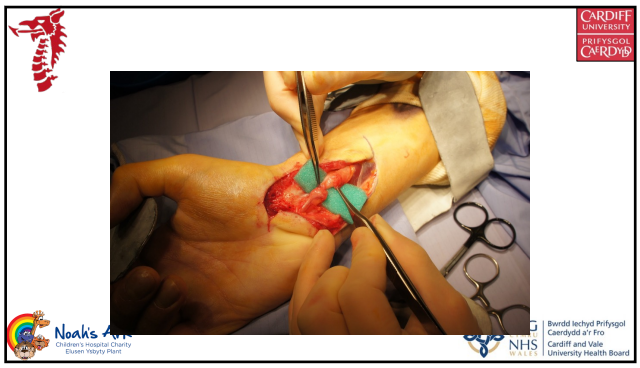

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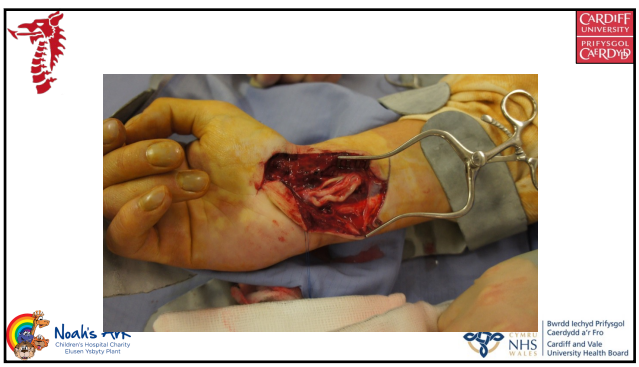

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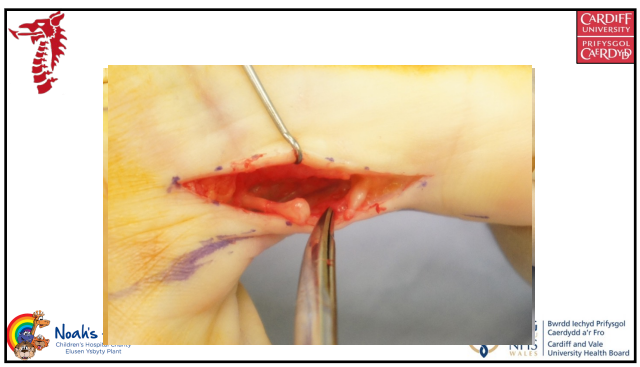

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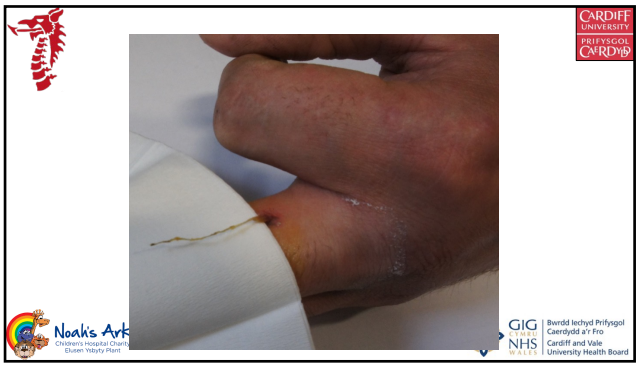

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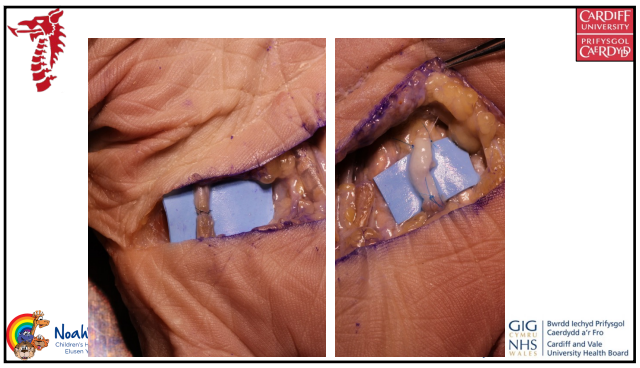

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Questions?

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Summary

- Hierarchical anatomy
  - CNS/PNS
  - Nerve
- Physiology
  - Resting potential
  - Action potential
  - Nerve repair after injury
- Implications for
  - Anaesthesia
  - Paralysis
  - Treating nerve injuries

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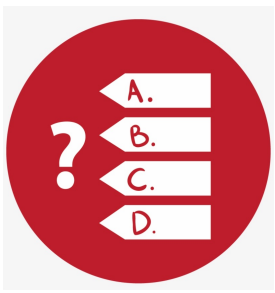

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Noah's Ark Children's Hospital Charity Elusen Ysbyty Plant

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"I knew I was right – the finger bone's connected to the hand bone..."

Noah's Ark Children's Hospital Charity Elusen Ysbyty Plant

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