



Case Presentation

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Scenario

- ▶ Supervising an intern
 - ▶ “22 year old male playing soccer yesterday, rolled ankle and unable to weightbear due to pain in lateral ankle and foot. Pt noticed loss of sensation, active dorsiflexion”
 - ▶ “Swollen lateral ankle and foot, unable to actively dorsiflex toes or foot. Absent sensation on foot with exception of little toe side. Neurovascular function normal otherwise”

Scenario



Pictures are NOT of the patient, but purely for illustration of point

Scenario



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More information needed

- ▶ Patient had knee fully extended and sustained inversion injury to ankle while changing directions at soccer (which would have likely resulted in a varus / hyperextension force to the knee)
- ▶ No PHx of knee or significant ankle problems

Assessment

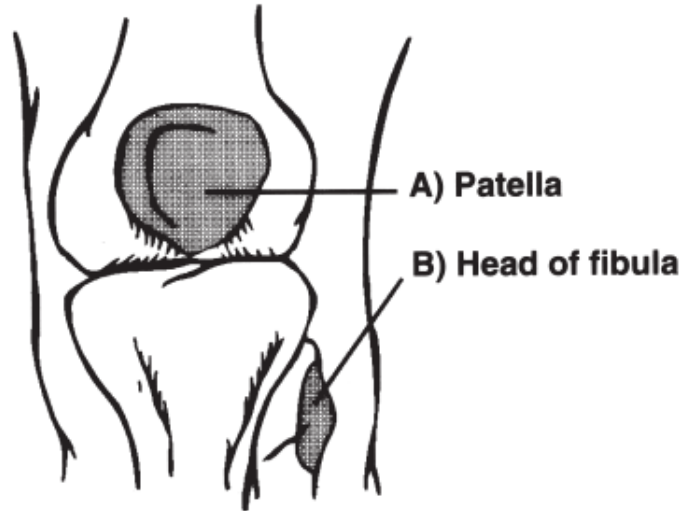
▶ Knee

- ▶ Moderate effusion to knee
- ▶ AROM 0 to 90 = pain limited at either extreme
- ▶ Valgus 0,30 = Mild pain, not lax
- ▶ Varus 0,30 = at least 15 degrees of laxity in each, with guarding limiting accurate assessment
- ▶ Lachman's = unable to relax
- ▶ Tender around lateral hamstrings and posterolateral knee, as well as LCL



OTTAWA KNEE RULE

For Knee Injury Radiography



A knee x-ray series is only required for knee injury patients with any of these findings:

1. age 55 or older
OR
2. isolated tenderness of patella (no bone tenderness of knee other than patella)
OR
3. tenderness of head of fibula
OR
4. inability to flex to 90°
OR
5. inability to bear weight both immediately and in the emergency department for 4 steps (unable to transfer weight twice onto each lower limb regardless of limping)

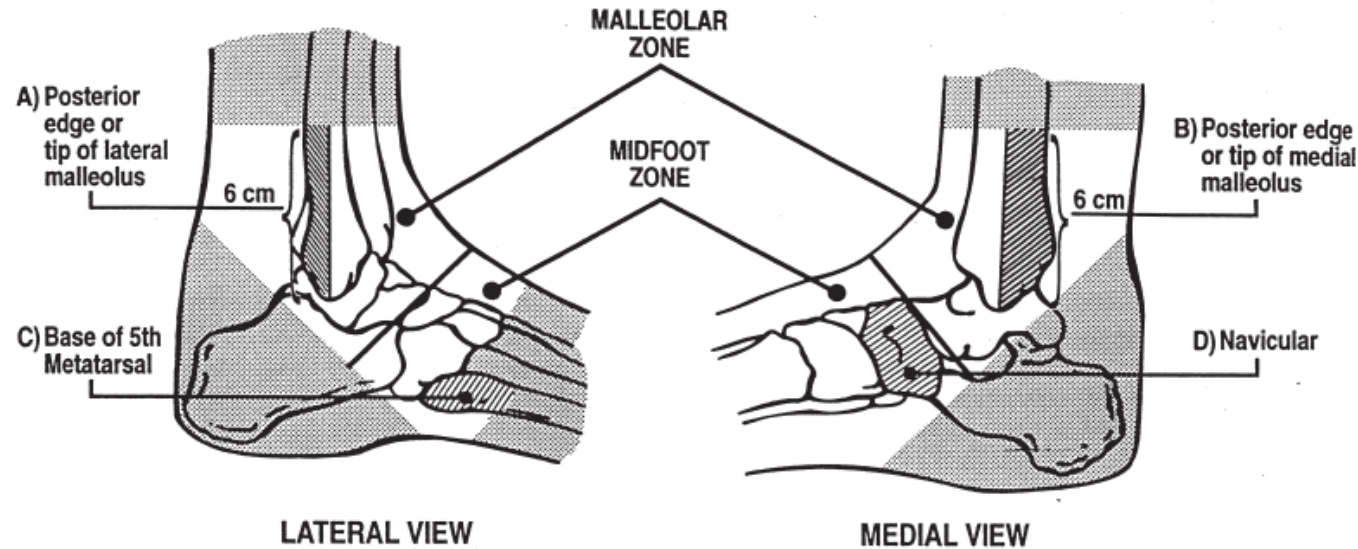
Assessment

- ▶ Ankle / Foot
 - ▶ Moderate swelling to lateral ankle and foot
 - ▶ Absent sensation to anterolateral shin and dorsum of foot with exception of 5th ray
 - ▶ Otherwise NV function normal
 - ▶ AROM
 - ▶ Dorsiflexion = nil active of ankle or toes
 - ▶ Plantarflexion = normal ROM and power
 - ▶ Eversion = minimal power / active movement
 - ▶ Inversion = painful, but normal ROM and power
 - ▶ Tender distal fibula, including posteriorly over the distal 6cm
 - ▶ Tender 5th metatarsal base



ANKLE RULES

For Ankle Injury Radiography



a) An ankle x-ray series is only required if there is any pain in malleolar zone and any of these findings:

1. bone tenderness at A
- OR
2. bone tenderness at B
- OR
3. inability to bear weight both immediately and in ED

b) A foot x-ray series is only required if there is any pain in midfoot zone and any of these findings:

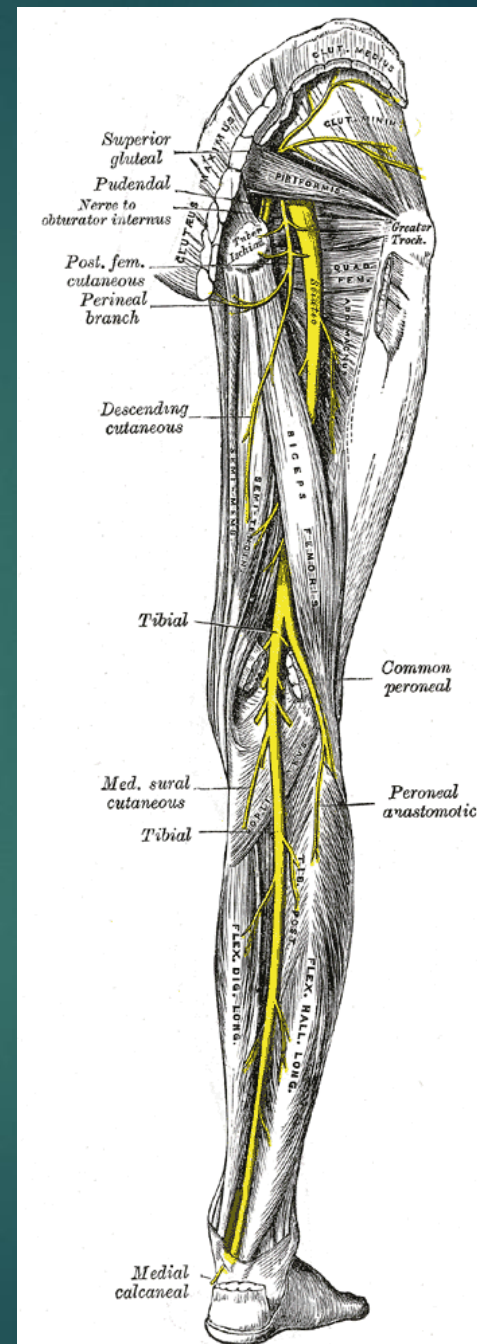
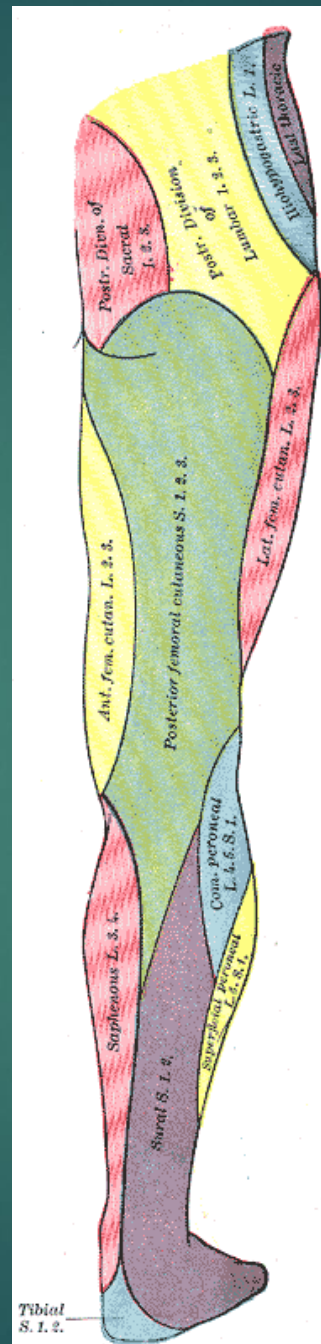
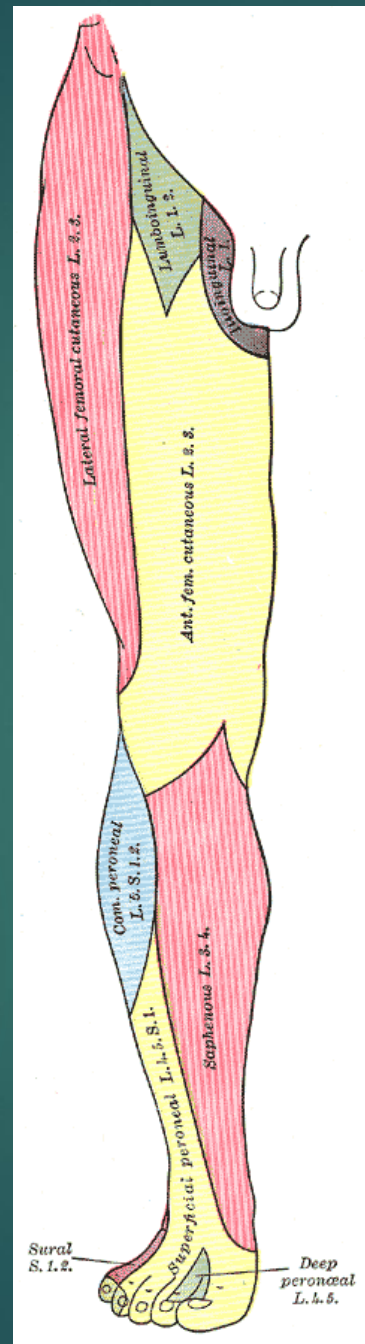
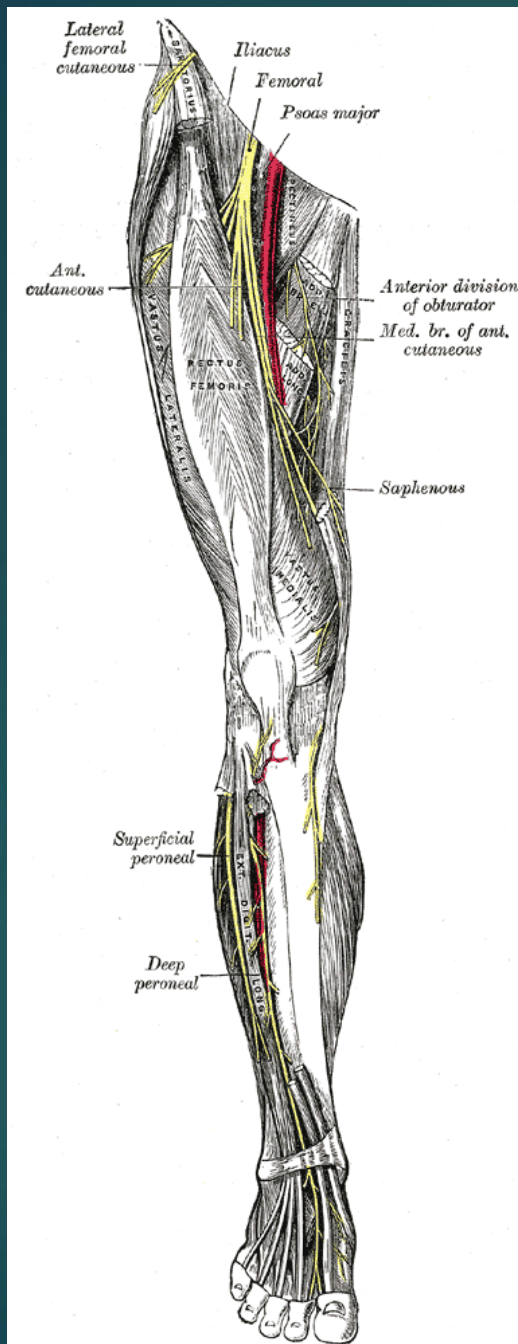
1. bone tenderness at C
- OR
2. bone tenderness at D
- OR
3. inability to bear weight both immediately and in ED



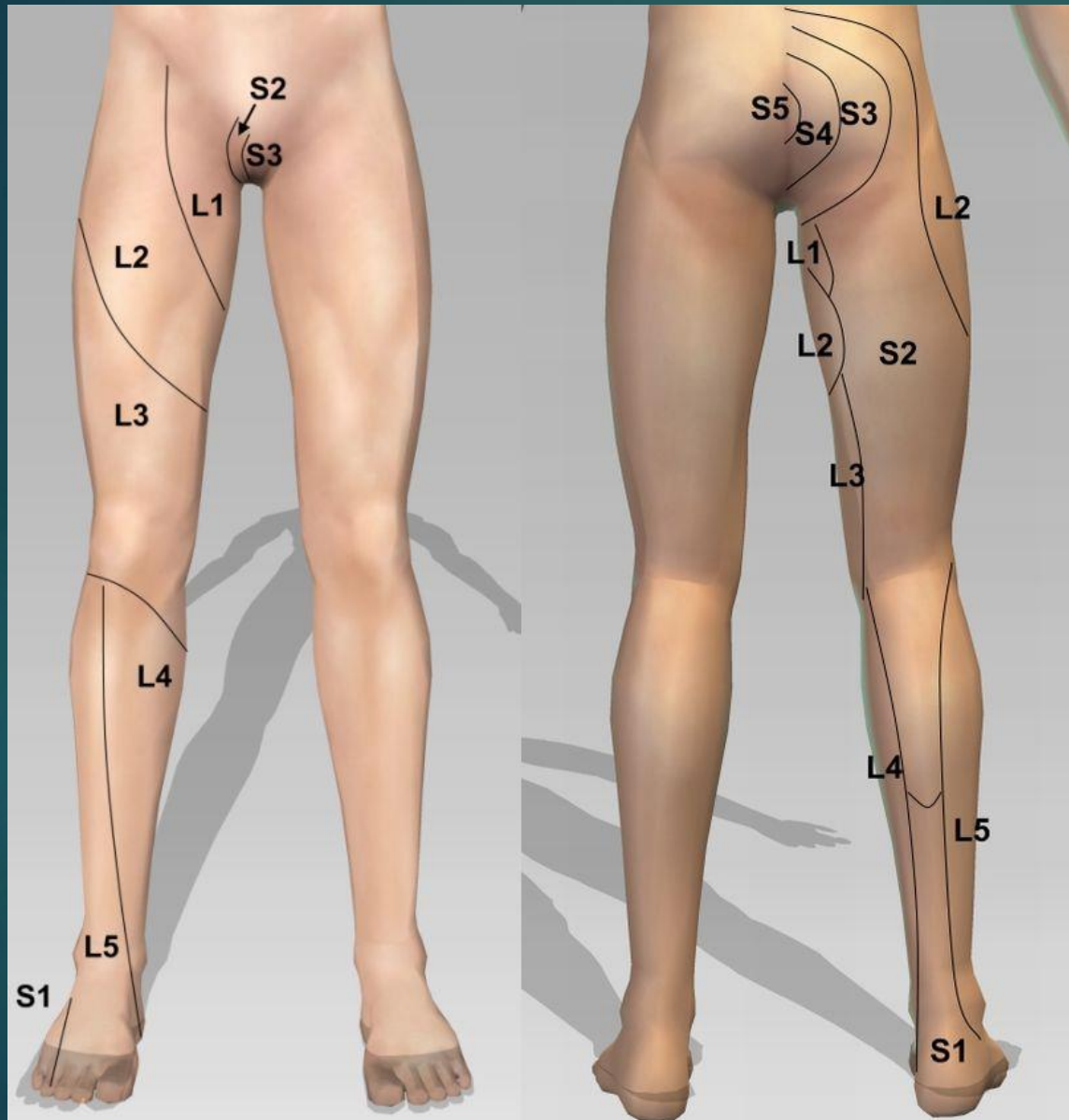








Muscle	Nerve Supply
Biceps Femoris (short head)	Common Peroneal Nerve
Extensor Digitorum Brevis	Deep Peroneal Nerve
Extensor Digitorum Longus	Deep Peroneal Nerve
Extensor Hallucis Brevis	Deep Peroneal Nerve
Extensor Hallucis Longus	Deep Peroneal Nerve
Peroneus Tertius	Deep Peroneal Nerve
Tibialis Anterior	Deep Peroneal Nerve
Peroneus Brevis	Superficial Peroneal Nerve
Peroneus Longus	Superficial Peroneal Nerve



Movement	Segment
Hip Flexion	L2/3
Knee Extension	L3/4
Ankle Dorsiflexion	L4/5
Great Toe Extension	L5
Ankle Eversion	L5/S1
Ankle Plantarflexion	S1/S2

Reflex	Segment
Knee Jerk	L3/4
Ankle Jerk	S1/2

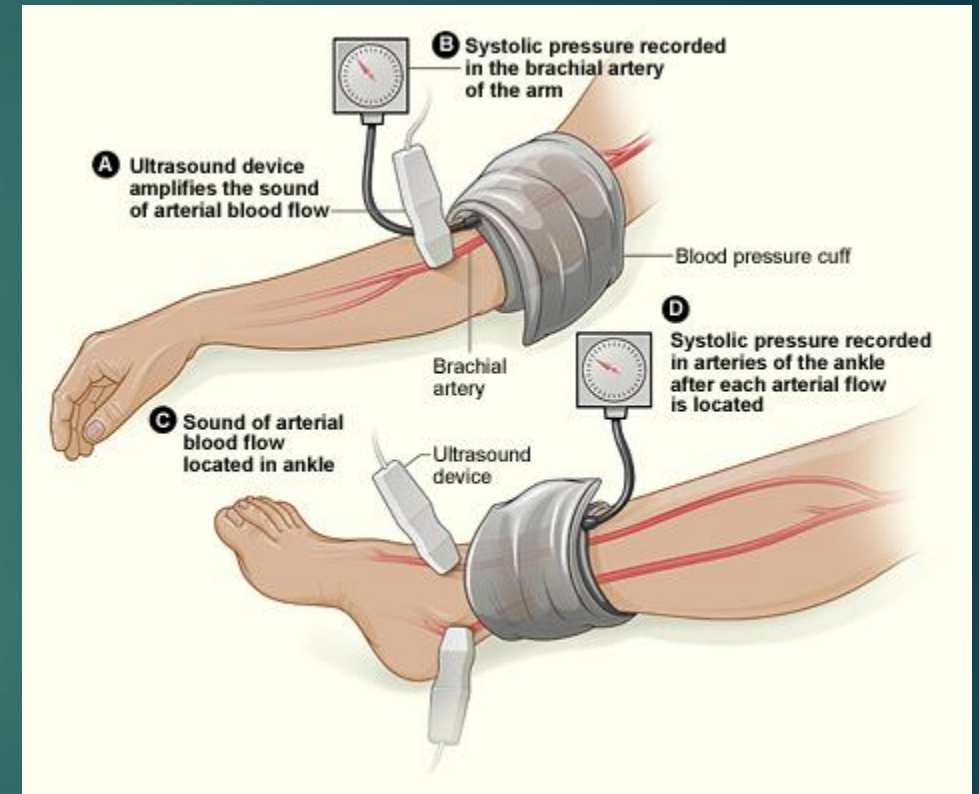


Ankle Brachial Index

$$ABI = \frac{P_{Leg}}{P_{Arm}}$$

- ▶ P_{Leg} = Highest of the dorsalis pedis and posterior tibial systolic pressure
- ▶ P_{Arm} = Highest of the left and right brachial systolic pressure

ABI	Interpretation
<0.90	Abnormal: Arterial Blockage
0.90-0.99	Borderline Abnormal
1.0 to 1.4	Normal
>1.40	Abnormal: Hardened Arteries





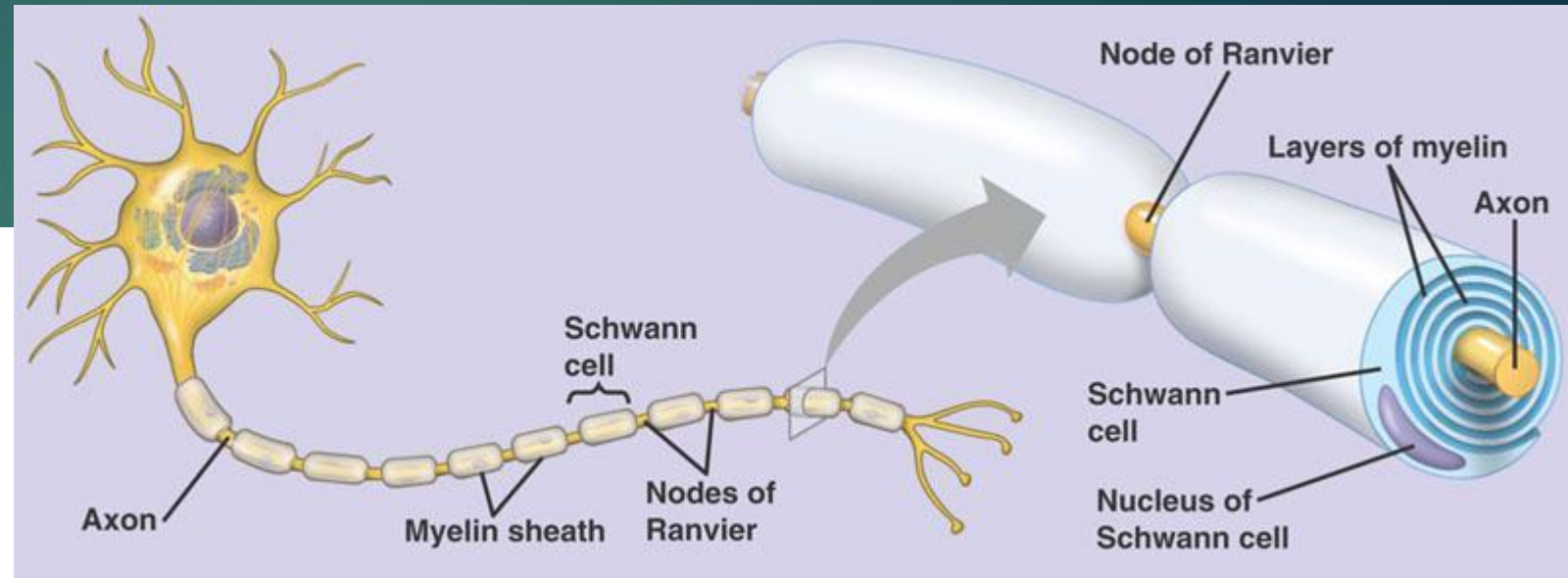
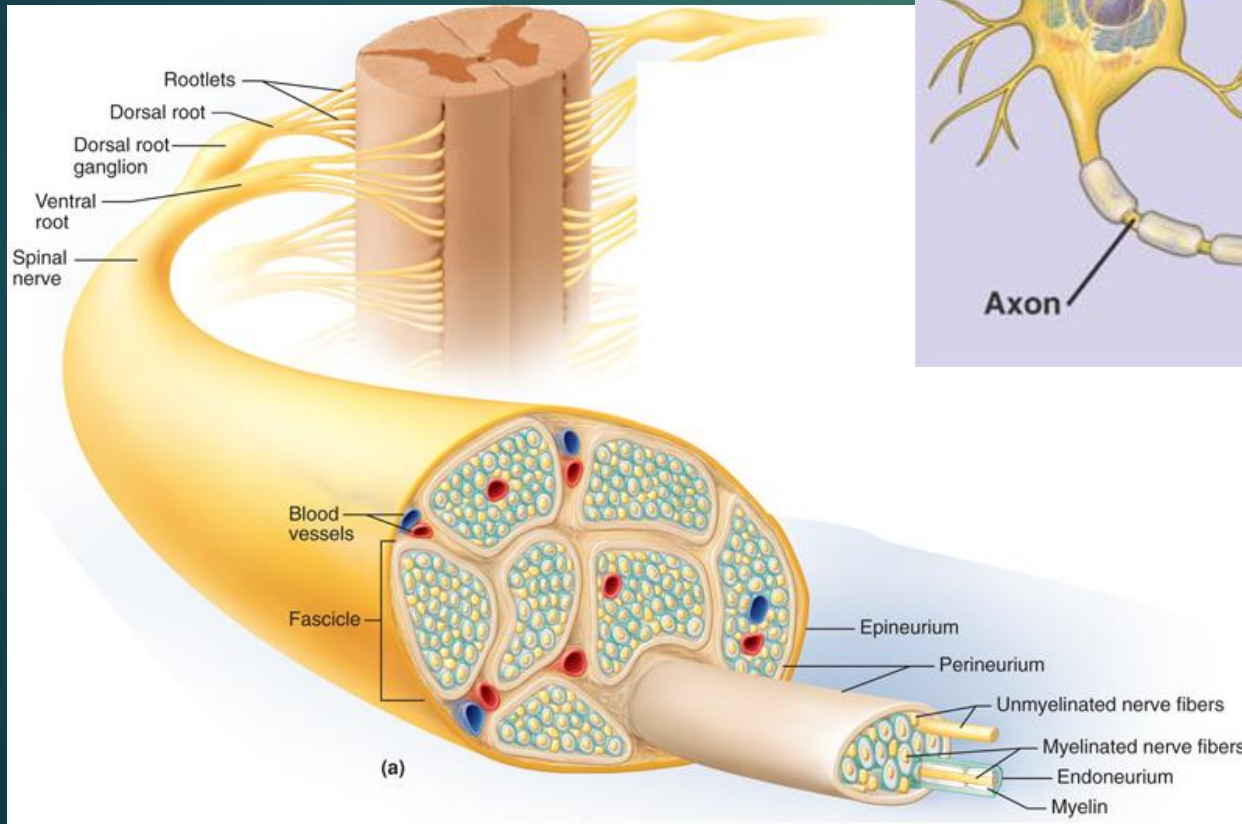
- ▶ MRI
 - ▶ ACL Rupture
 - ▶ LCL Rupture
 - ▶ MCL – Grade I-II
 - ▶ High Grade Posterolateral Corner Injury
 - ▶ Lateral Capsule Disruption
 - ▶ Common Peroneal Nerve Avulsion
- ▶ Discharged



Clinic Followup and Progress

- ▶ 10/7 post injury
 - ▶ Still no active dorsiflexion
 - ▶ Not for surgery straight away
- ▶ 3/52 post injury
 - ▶ Still no active dorsiflexion
- ▶ 7/52 post injury
 - ▶ Still no active dorsiflexion
- ▶ 3/12 post injury
 - ▶ Out of knee brace, continuing with physio
 - ▶ Still no active dorsiflexion
 - ▶ For review in another 3/12

Neuroanatomy



Peripheral Nerve Injury

Seddon Classification For Nerve Injury

1. Neuropraxia

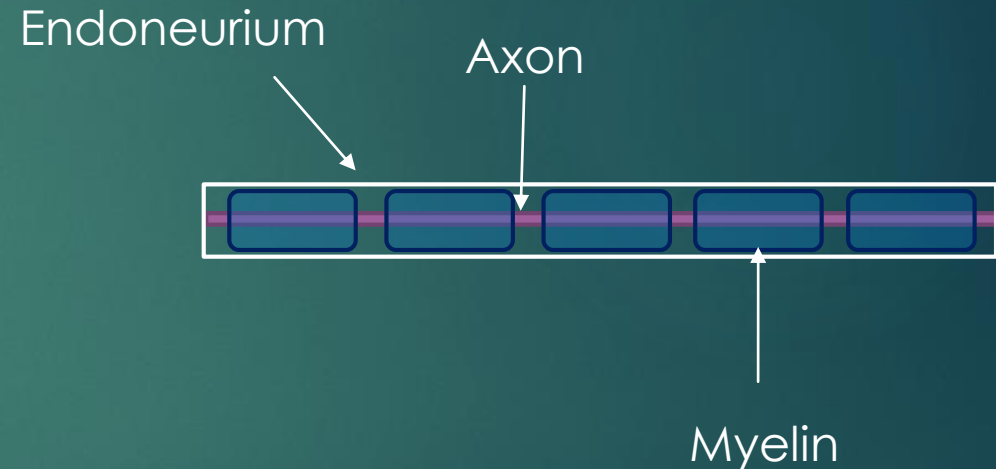
- ▶ Mild stretch or contusion – no significant damage

2. Axonotmesis

- ▶ Axon disruption with an intact endoneurium

3. Neurotmesis

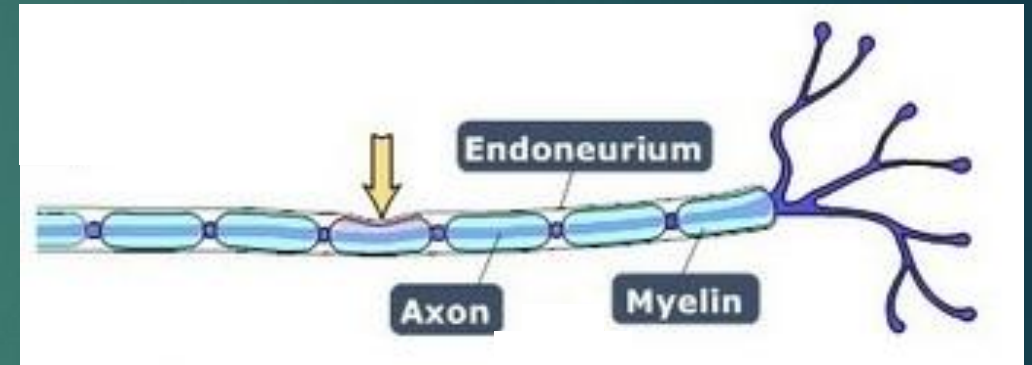
- ▶ Complete peripheral nerve rupture



Peripheral Nerve Injury

1. Neuropraxia

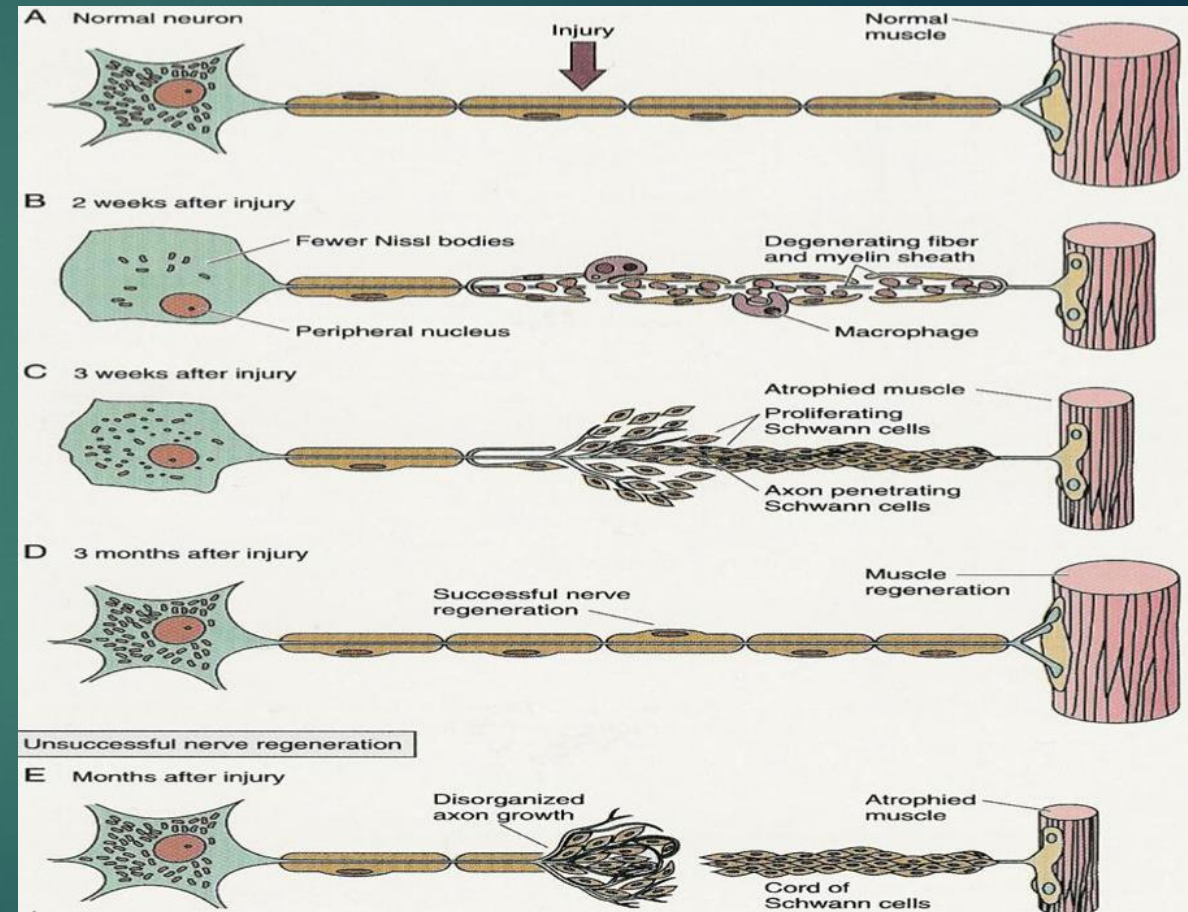
- ▶ Mild stretch or secondary contusion resulting in transient nerve dysfunction secondary to local ischaemia and demyelination
- ▶ Usually caused by blunt injury
- ▶ No significant damage to axon or endoneurium
- ▶ No Wallerian degeneration
- ▶ Conduction occurs proximal and distal to the injury, but not at the site of injury
- ▶ Profound motor loss +/- mild sensory changes
- ▶ Recovery in days to weeks



Peripheral Nerve Injury

Wallerian Degeneration

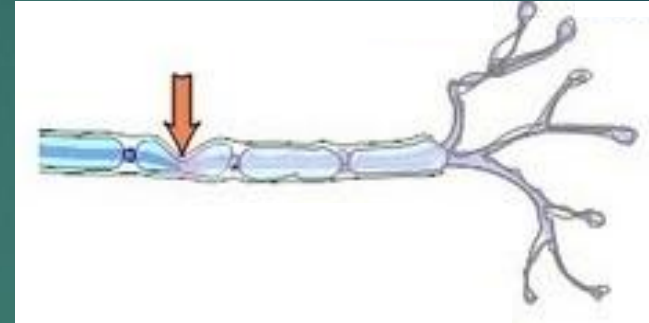
- ▶ Where there has been significant disruption to a nerve, there will be degeneration distal to the lesion
- ▶ Begins within 24-36 hours of a lesion
- ▶ Prior to this, distal axon stump remains electrically excitable
- ▶ The axon degenerates, followed by the degradation of the myelin sheath
- ▶ The nerve fibre's neurilemma (outer lining of myelin sheath) does not degenerate and remains as a hollow tube.
- ▶ Within 4 days of the injury, the distal end of the portion of the nerve fibre proximal to the lesion sends out sprouts towards those tubes. If a sprout reaches the tube, it grows into it and advances about 1 mm per day, eventually reaching and reinnervating the target tissue.
- ▶ If the sprouts cannot reach the tube, for instance because the gap is too wide or scar tissue has formed, surgery can help to guide the sprouts into the tubes.



Peripheral Nerve Injury

Axonotmesis

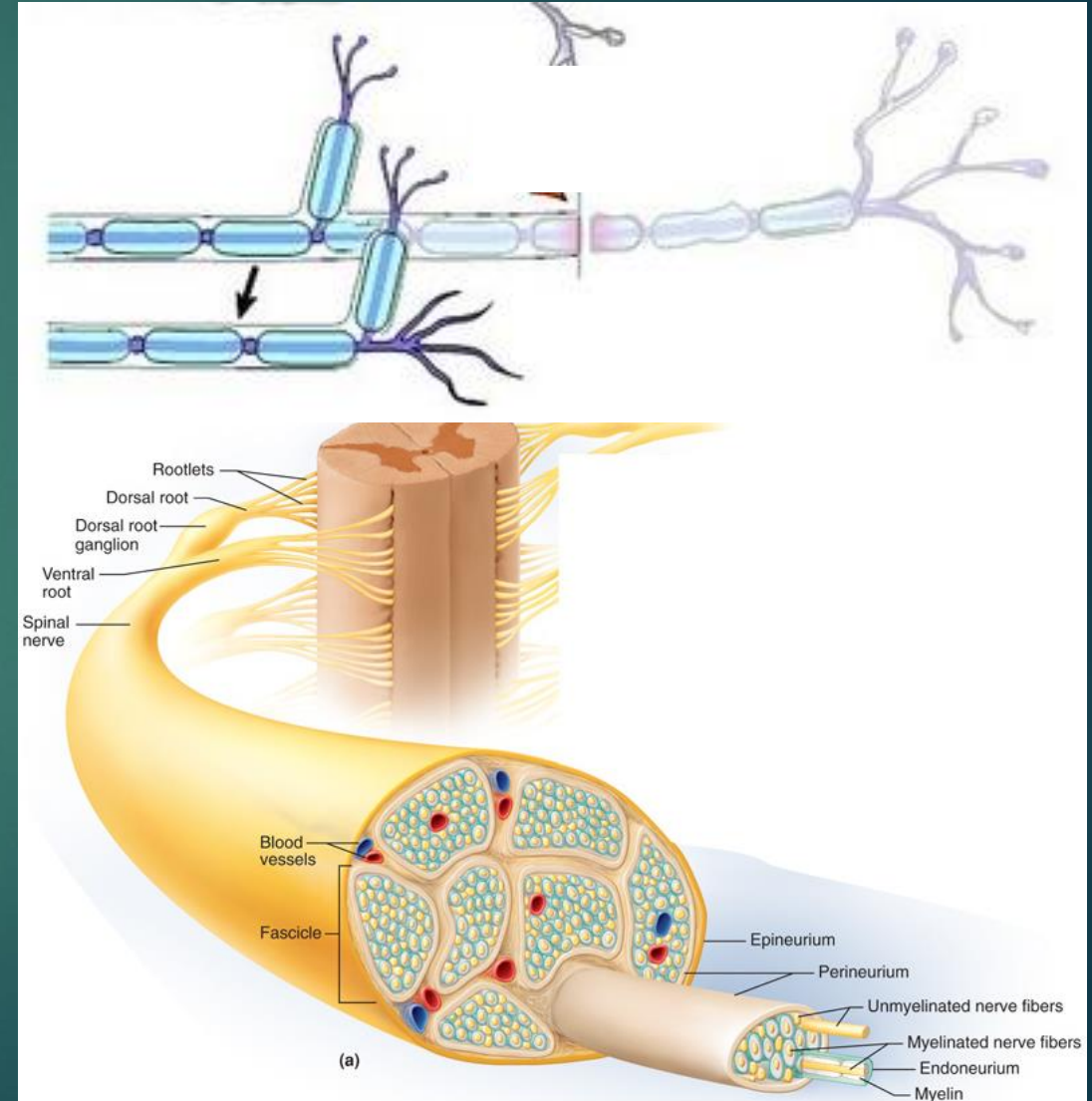
- ▶ Axon disruption with an intact endoneurium
- ▶ Complete motor loss +/- sensory changes
- ▶ Wallerian Degeneration
- ▶ Regeneration 0.5-1 mm per day after a 1 month delay
- ▶ Recovery



Peripheral Nerve Injury

3. Neurotomesis

- ▶ Complete peripheral nerve rupture
- ▶ Involves both axonal disruption and:
 - ▶ 3a – Involves ENDONEURIUM – fair regrowth
 - ▶ 3b – Involves PERINEURIUM – poor regrowth
 - ▶ 3c – Involves EPINEURIUM – no regrowth
- ▶ Complete motor and sensory loss
- ▶ Wallerian Degeneration
- ▶ No nerve conduction distal to the injury after 3-4 days

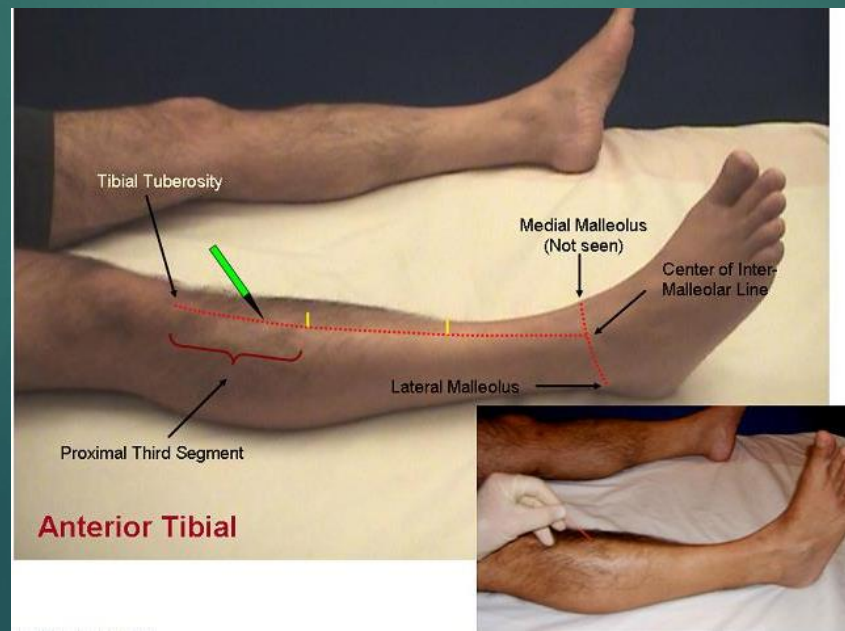


Nerve Conduction Studies

- ▶ Needle Electromyography

- ▶ Changes of axonal degeneration may not appear in muscle for 2-3 weeks after injury, EMG not indicated within this time (typically suggested at 4-6 weeks if no signs of improvement)

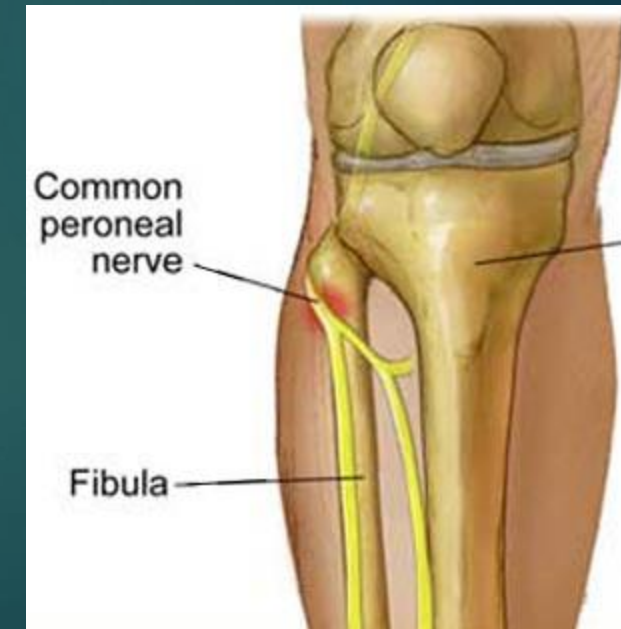
(Goitz & Tomaino, 2003)



Common Peroneal Nerve Injury Associated with Knee Injury

- ▶ Associated with ankle inversion injuries and also commonly associated with knee dislocations
 - ▶ 10-42% incidence of common peroneal nerve injury with knee dislocation / bicruciate ligament injury
(Goitz & Tomaino, 2003)
- ▶ Higher correlation with knee dislocation and associated
 - ▶ Posterolateral corner injuries (26/27 in a study by Krych et al, 2014)
 - ▶ Fibular head fracture (39% vs 21%)
 - ▶ Vascular injury (15% vs 5%)
 - ▶ Higher BMI
 - ▶ Male
(all from Peskun et al 2011)
- ▶ Multiple anatomical factors
 - ▶ Has limited excursion (only about 0.5cm) at the fibular head during knee motion, where it is tethered by its branches
 - ▶ Relative thickness of epineural to axonal tissue is low compared to other similarly sized nerves
 - ▶ Less protection from stretch injuries

(Goitz & Tomaino, 2003)



Common Peroneal Nerve Injury Associated with Knee Injury

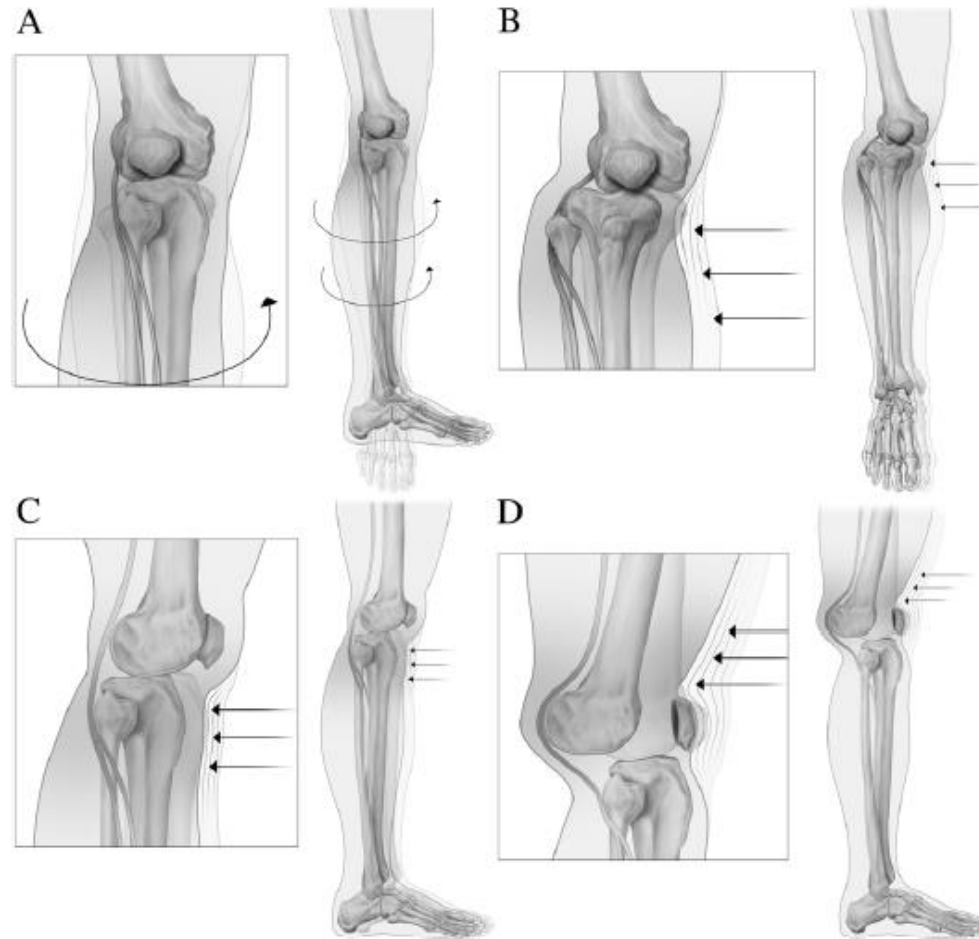
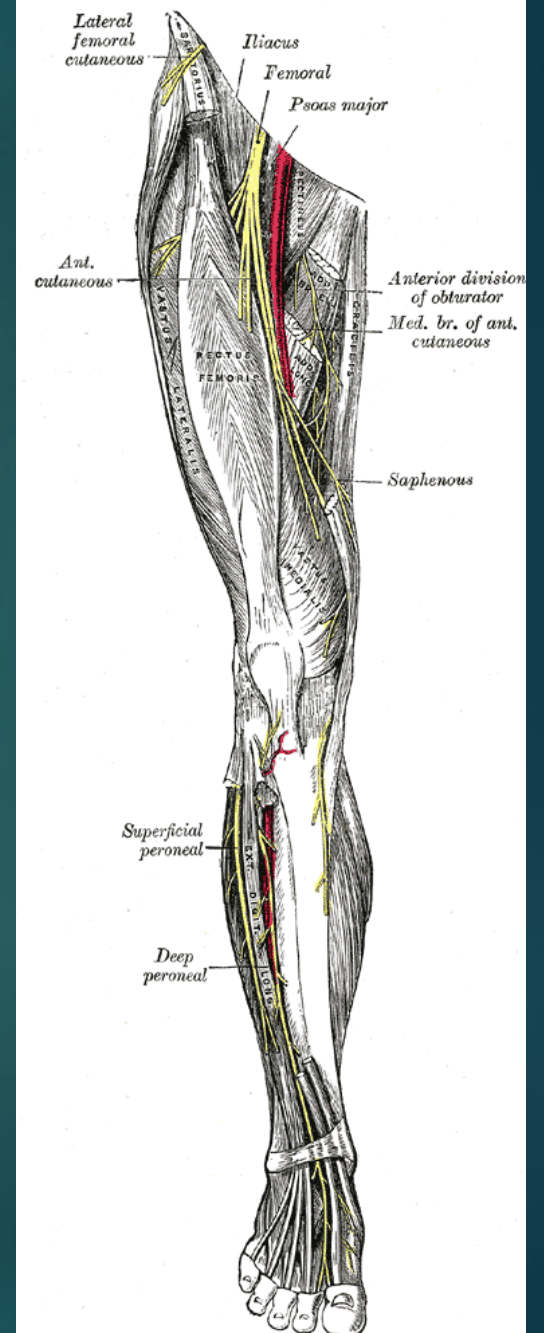


FIG. 4. Peroneal nerve injury as a result of various fractures and dislocations of the knee joint. A: Rotational dislocation. B: Lateral dislocation. C and D: Anterior-posterior dislocation.



Common Peroneal Nerve Injury Associated with Knee Injury

- ▶ Management
 - ▶ Incomplete nerve palsies generally have excellent recovery without intervention
 - ▶ With complete nerve palsies, there is little consensus regarding treatment:
 - ▶ Conservative Treatment
 - ▶ 0-50% have at chance of functional return without surgery

Common Peroneal Nerve Injury Associated with Knee Injury

- ▶ Operative repair
 - ▶ Surgical repair usually necessitates immobilisation in excessive flexion (in contradiction to the management of the ligamentous injuries sustained / repaired)
 - ▶ Primary Repair (rarely done – nerve frayed)
 - ▶ Neurolysis alone (releasing the nerve from its neuroma and surrounding scar tissue; epineurium still intact)
 - ▶ Neuroma excision and grafting
 - ▶ Graft length affects prognosis
 - ▶ <6cm = 75% at least grade 3 strength
 - ▶ 6-12cm = 35% at least grade 3 strength
 - ▶ >12cm = 14% at least grade 3 strength

Common Peroneal Nerve Injury Associated with Knee Injury

- ▶ Timing important (especially with increased length of graft)
 - ▶ 20cm = 200mm = > 200 days for regeneration!
- ▶ In closed injuries, operative treatment advised if there is no spontaneous regeneration at 3-4 months post injury (Garozzo et al, 2004)
 - ▶ Irreversible muscle atrophy, fibrosis and disappearance of functional neural endplates occurs by 9-12 months after denervation
 - ▶ Birch et al (1998) reported 48% good recovery if nerve repaired at 6/12, but only 9% at 12/12

Common Peroneal Nerve Injury Associated with Knee Injury

- ▶ Operative CPN repair has a poorer prognosis compared to other peripheral nerves
 - ▶ Excessive length of nerve
 - ▶ Abundance of connective tissue
 - ▶ Force imbalance between intact plantarflexors and the passively stretched denervated foot extensors.
 - ▶ Early AFO to avoid contracture
 - ▶ Tibialis posterior tendon transfer

Common Peroneal Nerve Injury Associated with Knee Injury

- ▶ Always look up!
- ▶ If has had knee dislocation, be wary of damage to the popliteal artery
 - ▶ Ankle Brachial Index
- ▶ CPN commonly injured in knee dislocations / bicruciate ligament injuries
 - ▶ Need AFO early to prevent contracture
 - ▶ Nerve Conduction Studies if no improvement at 4-6/52
 - ▶ If no improvement by 3-4/12, consider operative Mx as poor prognosis for operative Mx > 12/12



Bibliography

- ▶ Birch R, Pascher A, Schwarzl F, Pierer G, Fellingner M, Passler JM (1998). Surgical disorders of the peripheral nerves. London: Churchill Livingstone; 1998 p235-43
- ▶ Garozzo D, Ferraresi P & Buffatti P (2004). Surgical treatment of common peroneal nerve injuries: indications and results. *Journal of Neurosurgical Sciences* 43,3:105-112
- ▶ Krych AJ, Giuseffi SA, Kuzma SA, Stuart MJ, Levy BA (2014). Is peroneal nerve injury associated with worse function after knee dislocation? *Clinical Orthopaedics and Related Research* 472:2360-2636
- ▶ Peskun CJ, Chahal J, Steinfeld ZY & Whelan DB (2012). Risk factors for peroneal nerve injury and recovery in knee dislocation. *Clinical Orthopaedics and Related Research* 470:774-778

CLASSIFICATION OF NERVE INJURY

