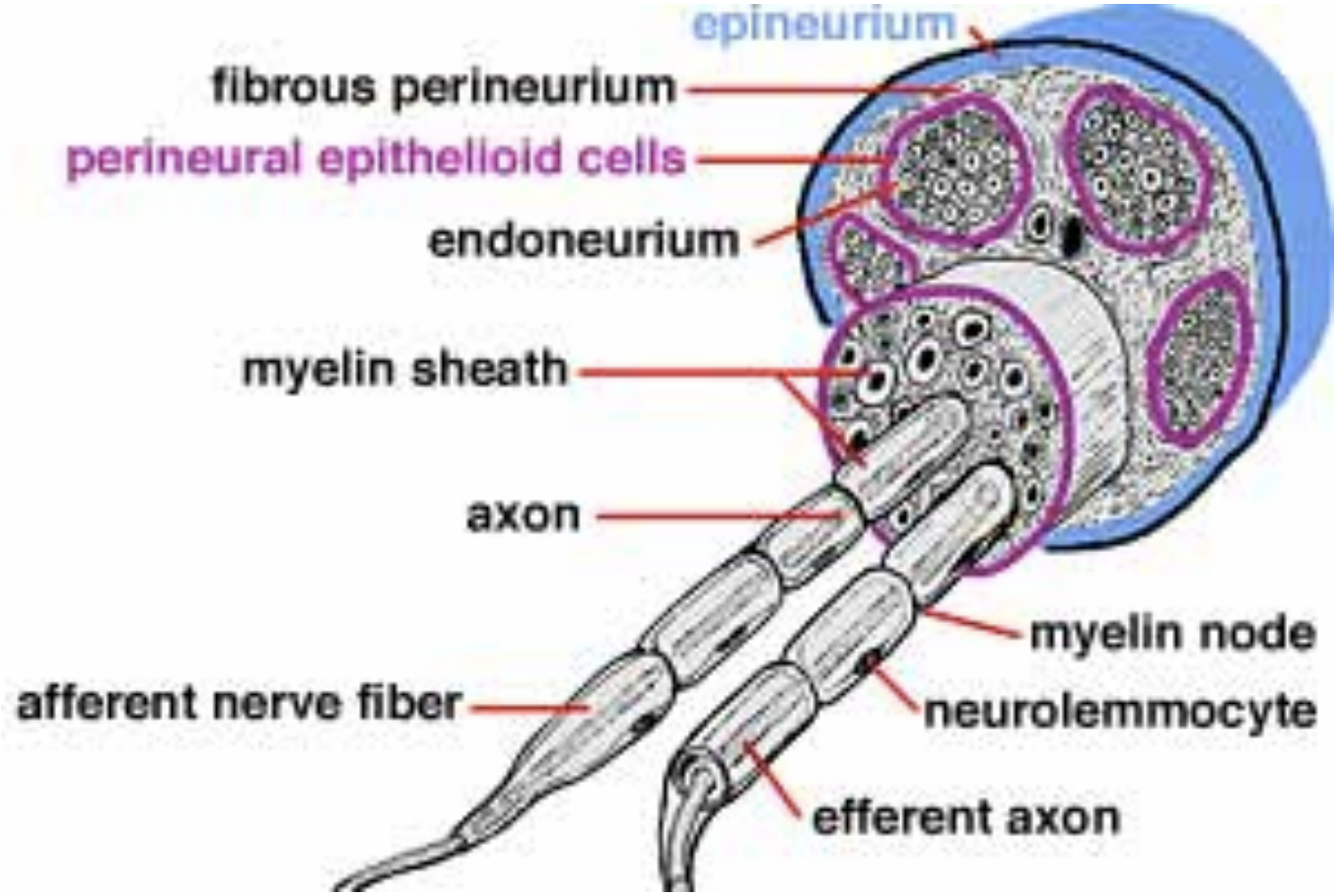
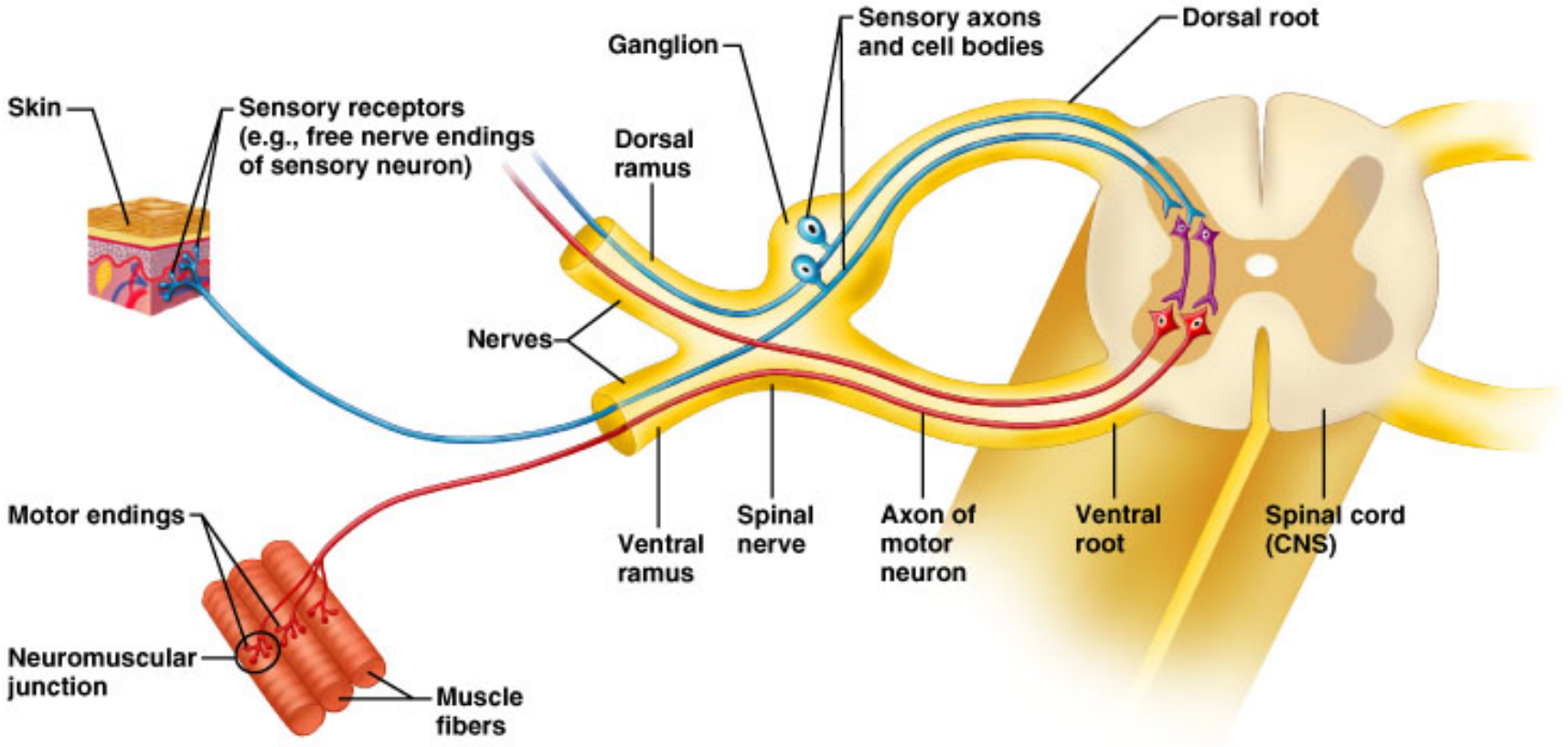
Peripheral nerve Injuries

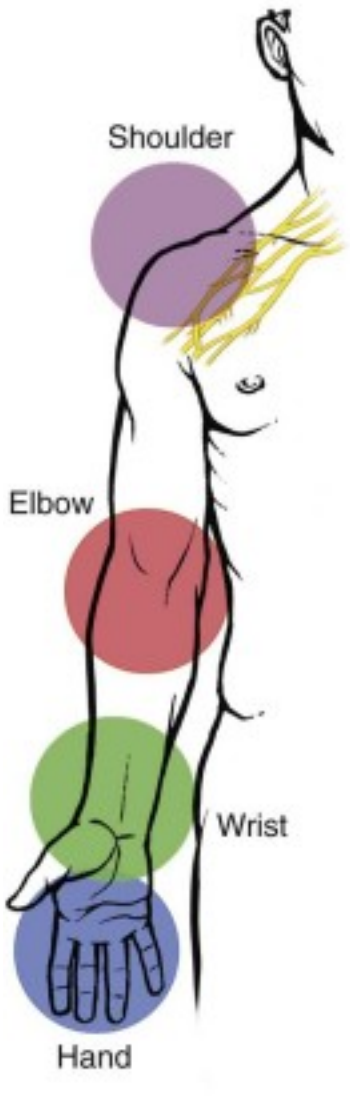
Nerve Structure



Peripheral Nervous system

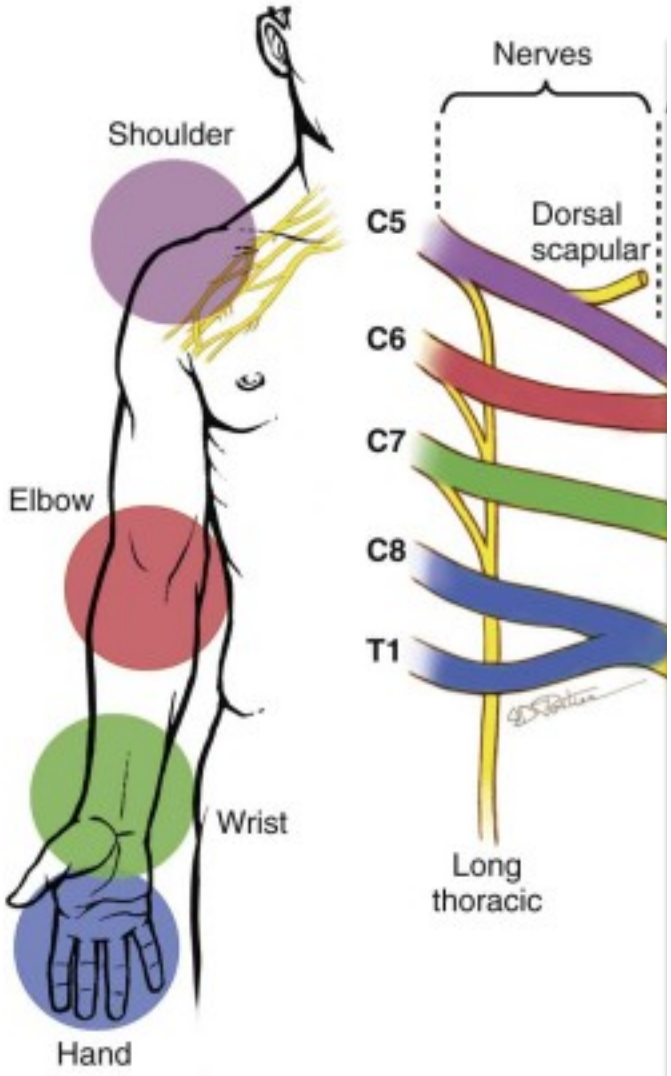
Dorsal roots – sensory fibers arising from cell bodies in dorsal root ganglia
Ventral roots – motor fibers arising from anterior gray column of spinal cord



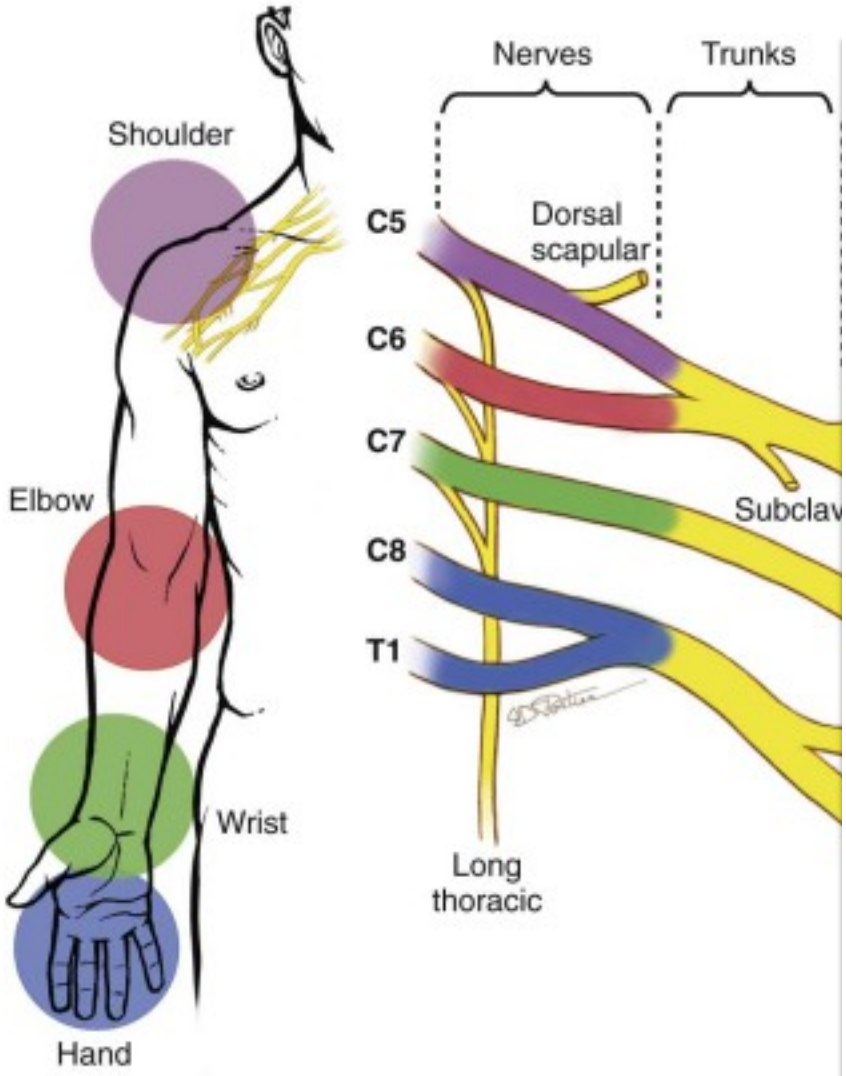


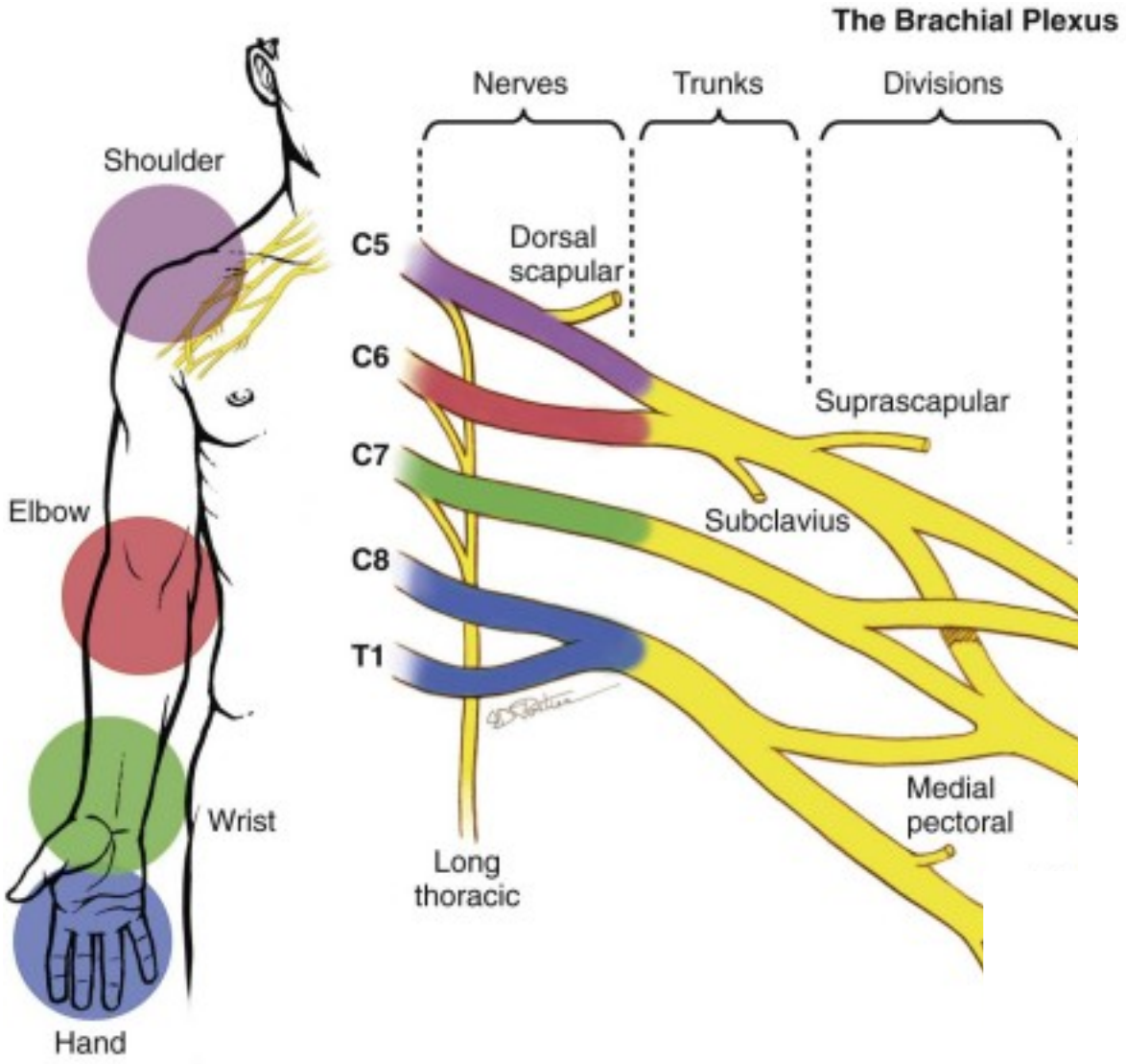
Rob **T**aylor **D**rinks **C**old **B**eer

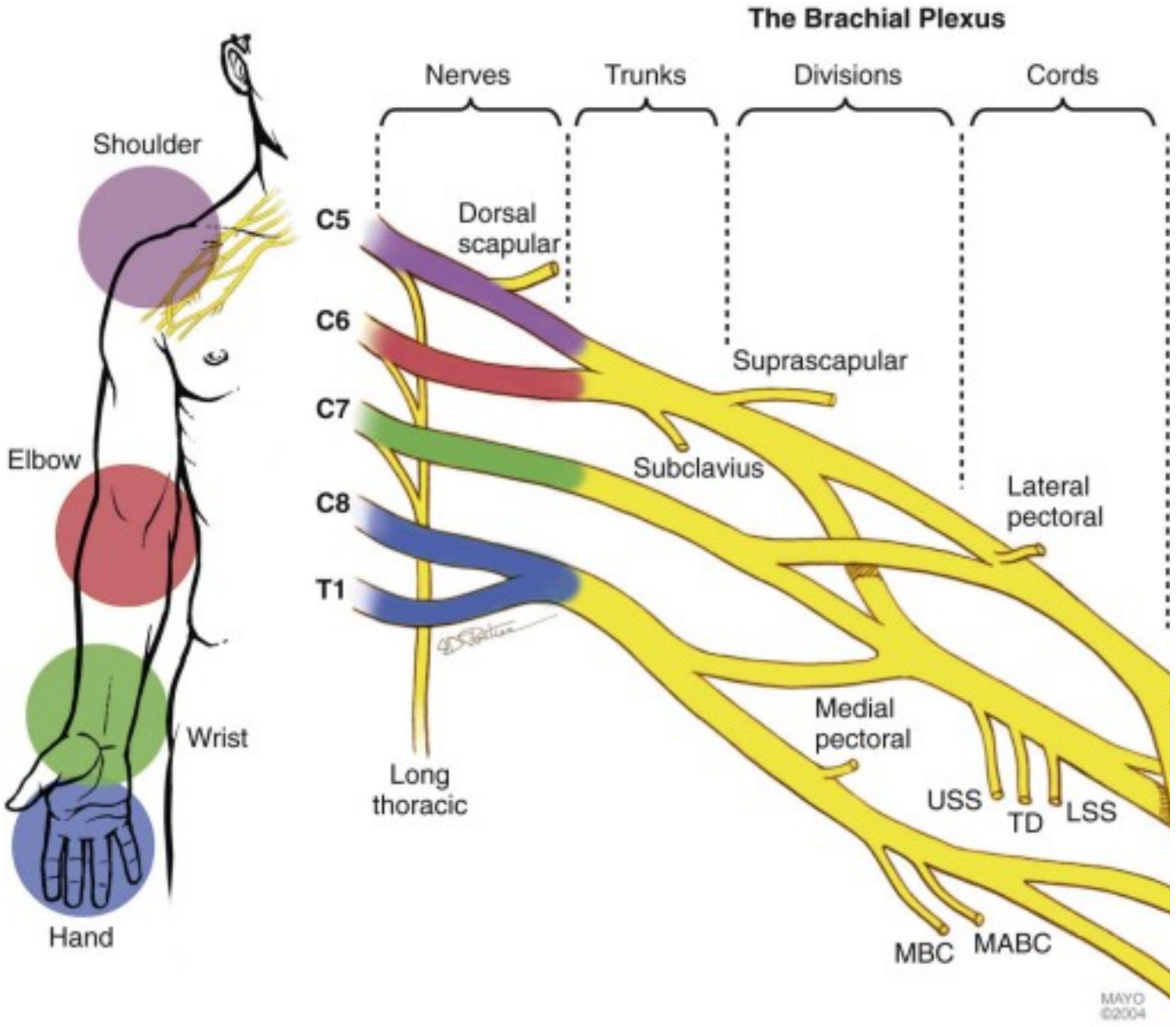
The Brachial Plexus

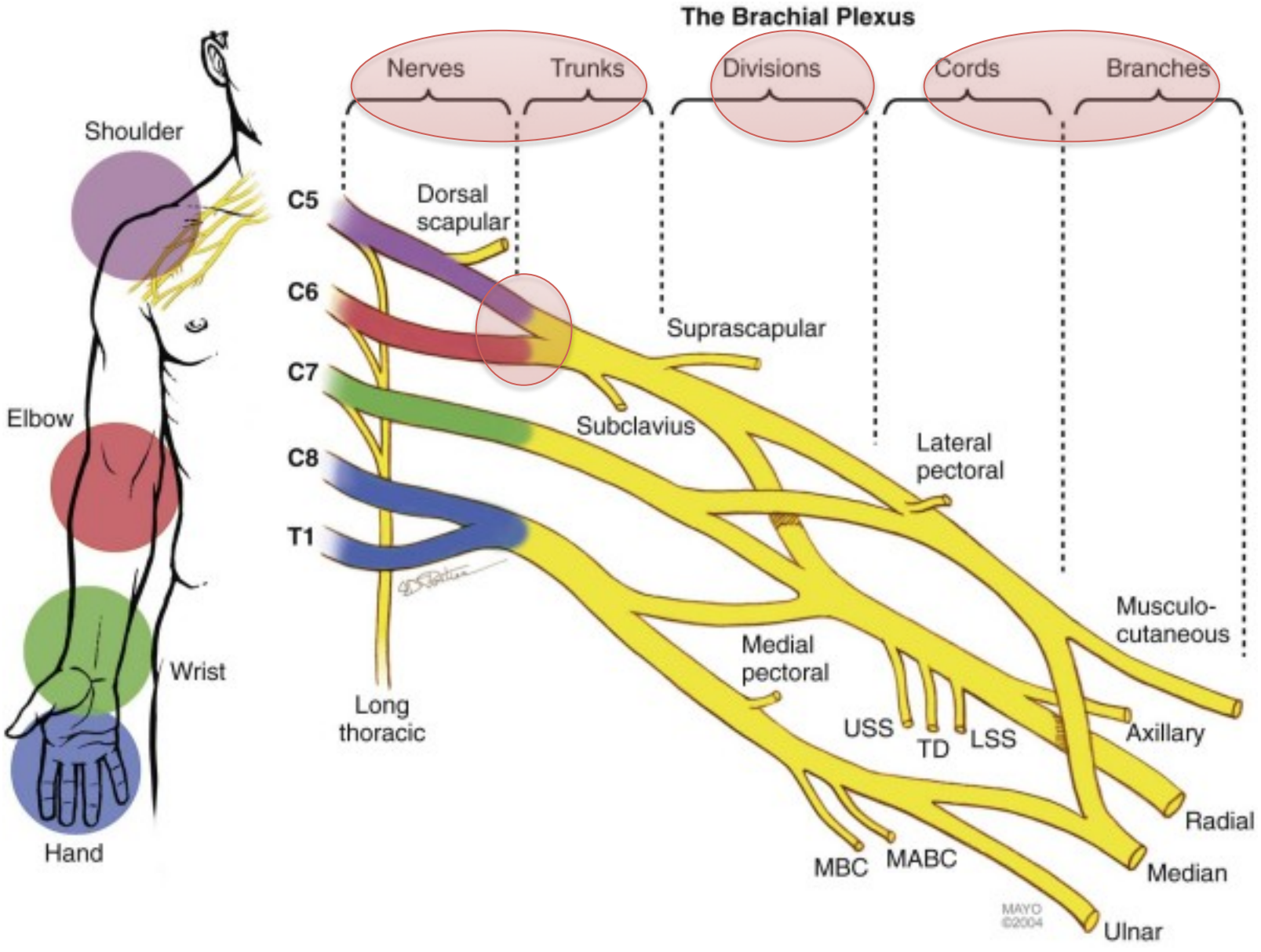


The Brachial Plexus




The Brachial Plexus
Nerves
Trunks
Divisions
Shoulder
Elbow
Wrist
Hand
C5
C6
C7
C8
T1
Dorsal scapular
Suprascapular
Subclavius
Medial pectoral
Long thoracic


The Brachial Plexus
Nerves
Trunks
Divisions
Cords
Shoulder
Elbow
Wrist
Hand
C5
C6
C7
C8
T1
Dorsal scapular
Suprascapular
Subclavius
Lateral pectoral
Medial pectoral
Long thoracic
USS
TD
LSS
MBC
MABC
MAYO ©2004


The Brachial Plexus
Nerves
Trunks
Divisions
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Branches
Shoulder
Elbow
Wrist
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C5
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C7
C8
T1
Dorsal scapular
Suprascapular
Subclavius
Lateral pectoral
Musculo-cutaneous
Medial pectoral
Long thoracic
USS
TD
LSS
Axillary
Radial
Median
Ulnar
MBC
MABC
MAYO ©2004

Nerve Injury Mechanism

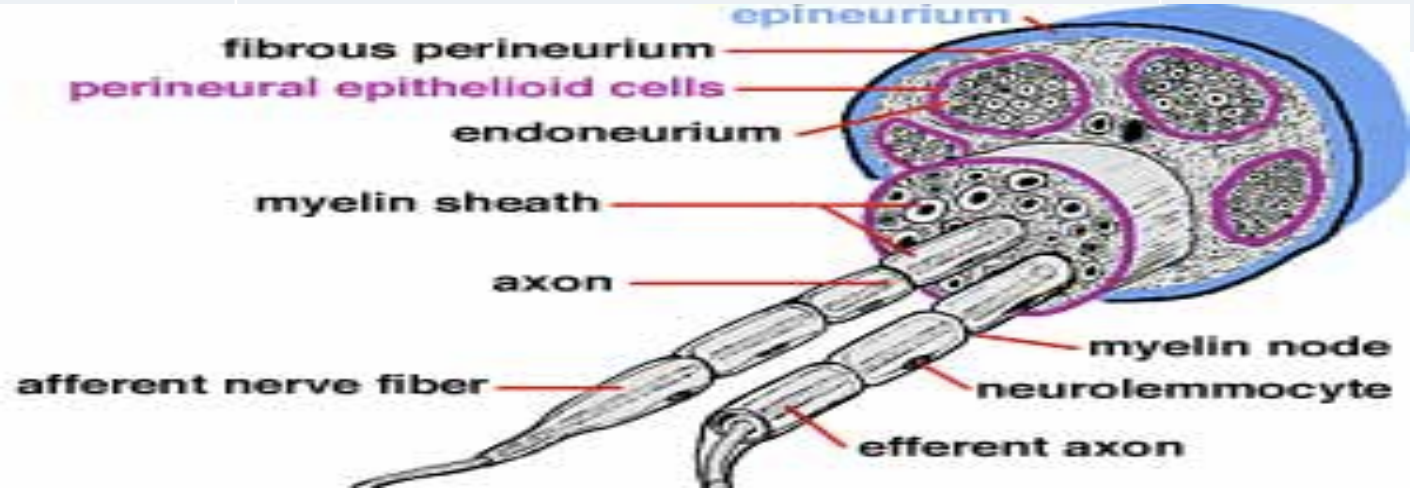
- Laceration
- Stretch/Traction
- Compression – acute & chronic
- Combination (blast)
- Ischaemia- acute & chronic (incl infection)
- Temperature
- Electrical shock
- Vibration
- Radiation
- Injection (lac & compartment)

Nerve Injury Response

- DISTALLY
  - Wallerian degeneration
  - Myelin sheath breakdown
  - End/target organ effects
- PROXIMAL
  - Axonal calibre reduction
  - Decreased conduction velocity
  - Cell body atrophy & loss

Classification

SEDDON (1943)	SUNDERLAND (1978)	BIRCH
Neurapraxia	**1** (myelin only)	Non-degenerative
Axonotmesis	**2** (myelin & axon)	Degenerative
Neurotmesis	**3** (myelin, axon, endoneurium)	Degenerative
	4 (myelin, axon, endoneurium, perineurium)	Degenerative
	5 (myelin, axon, endoneurium, perineurium, epineurium)	Degenerative



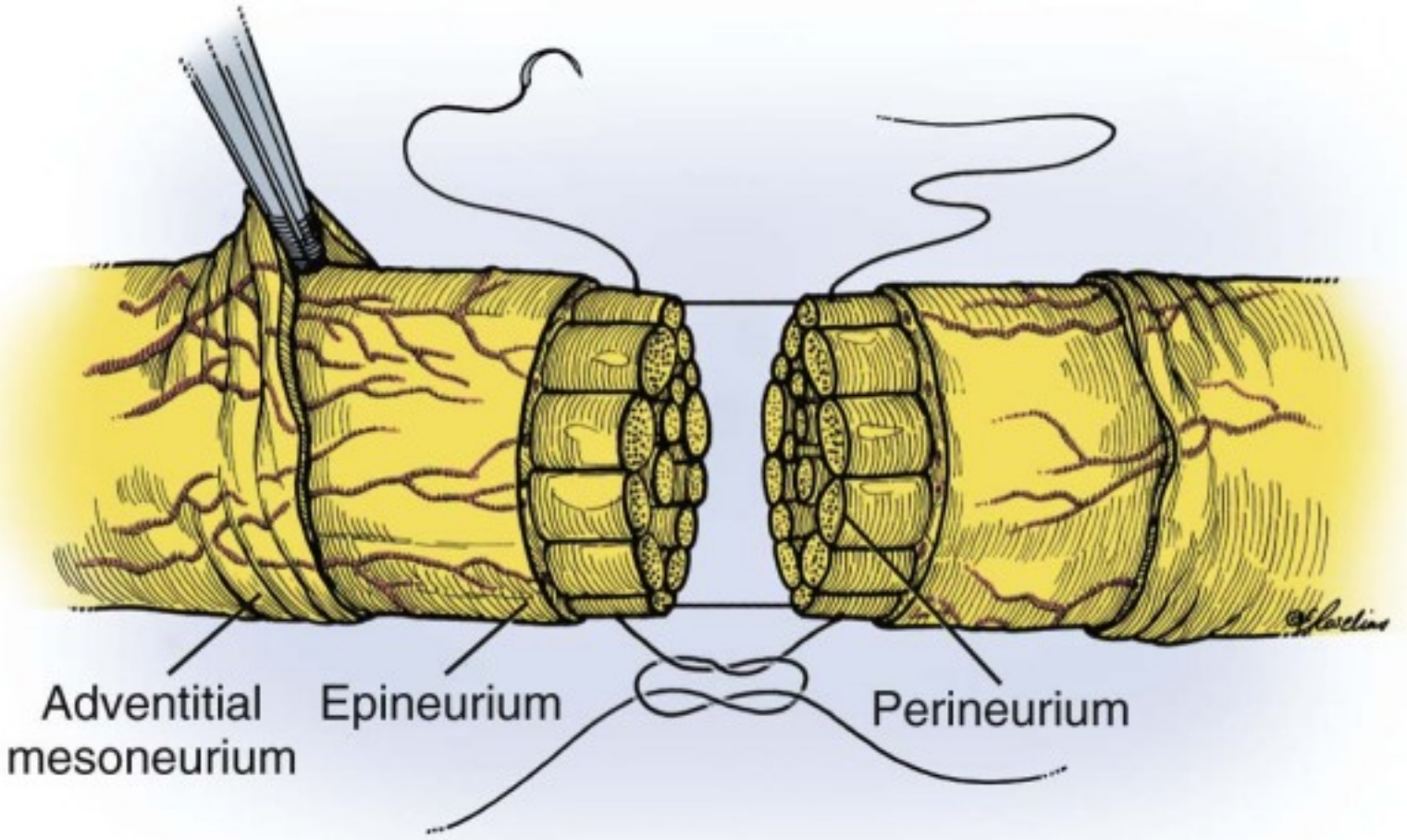
Nerve Healing

- Cell body response
- Schwann cell proliferation
- Axonal sprouting (~ neuroma)
- Growth cone
- Neurotrophic & neurotropic factors
- Axonal growth rates

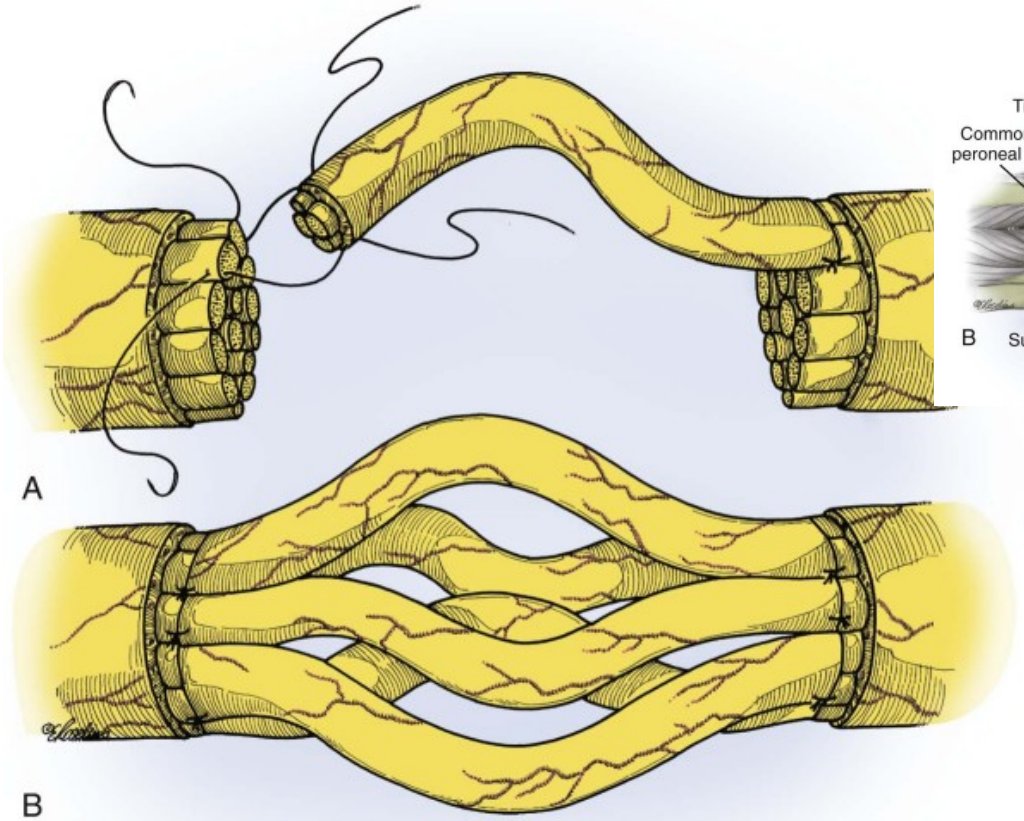
Nerve Repair

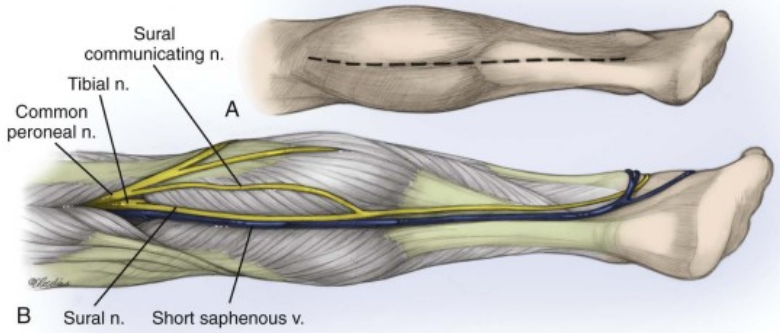
- Neurolysis
- Direct suture
  - Epineural repair
  - Fascicular repair
- Interposition graft
- Glue
- Conduits

Direct suture

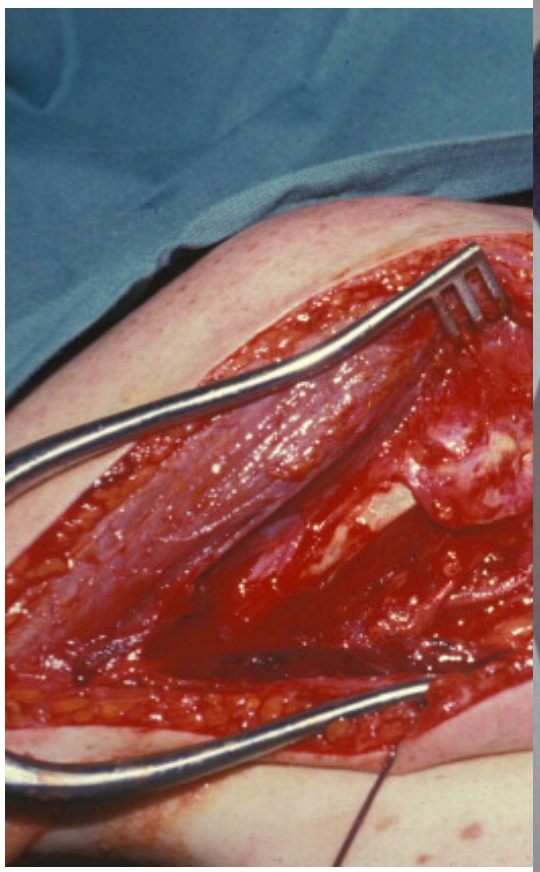


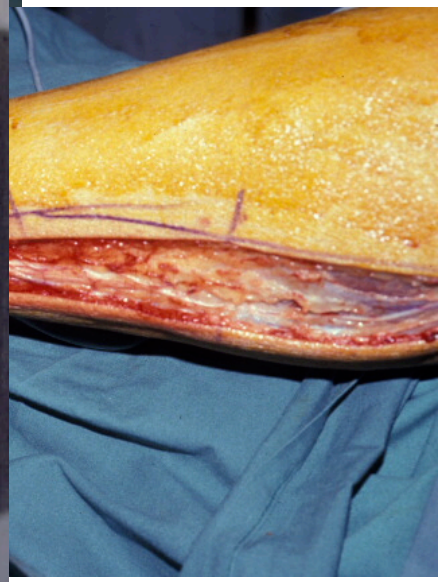
Nerve graft


A
B

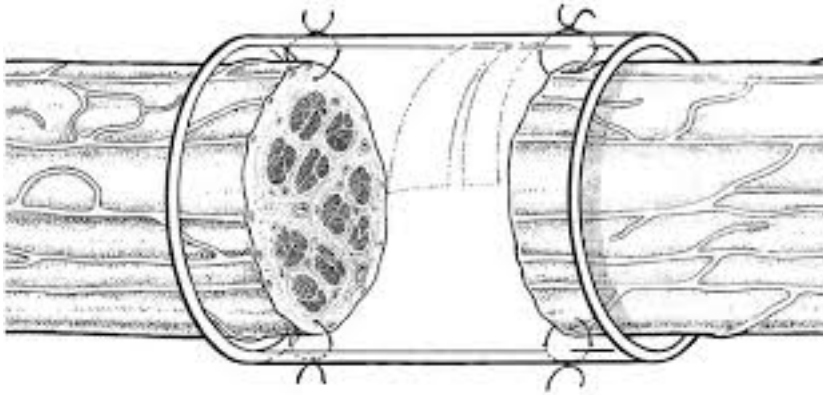

Sural communicating n.
Tibial n.
Common peroneal n.
A
B
Sural n.
Short saphenous v.

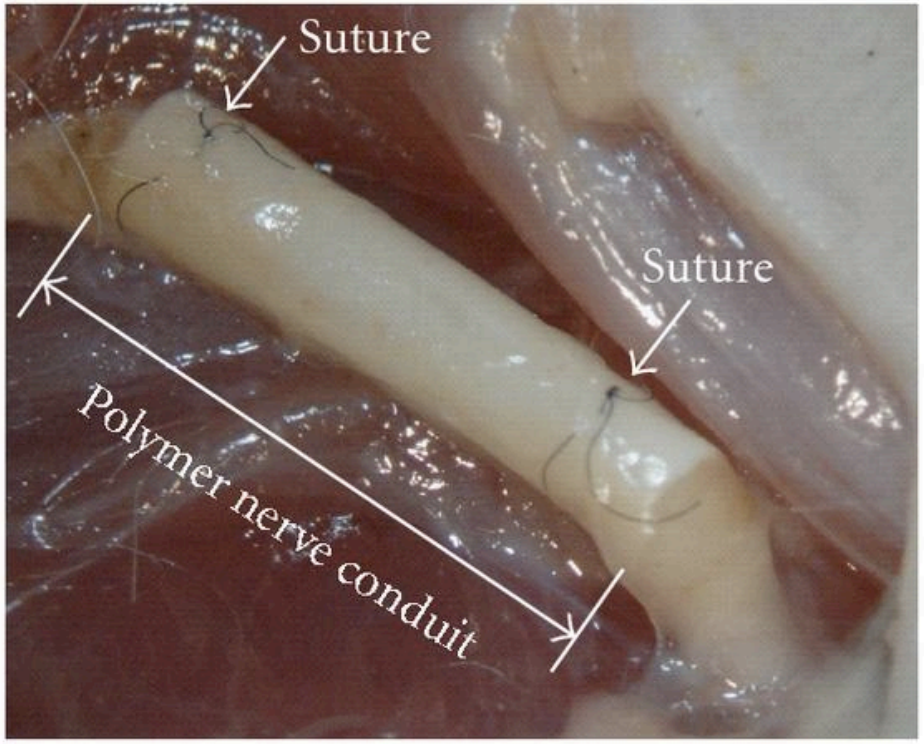
Nerve Cable Grafting





Nerve Conduits





Reconstructive Surgical Options

- Orthopaedic surgery
  - Tendon transfer
  - Arthrodesis
- Neurosurgery
  - Nerve transfer
- Free tissue surgery
  - Muscle transfer
  - Vascularized nerve

Tendon Transfers

- Mr Broome

- Examples
  - Radial nerve
  - Median nerve
  - Upper limb rehabilitation in Tetraplegia

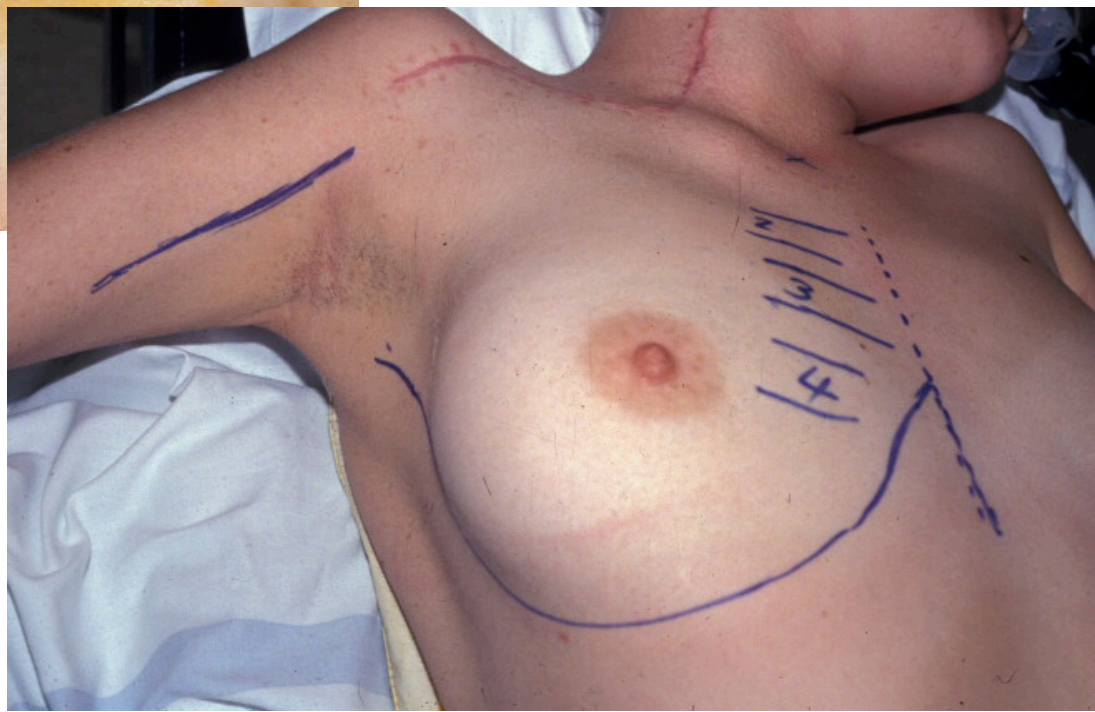
Arthrodesis

Arthrodesis

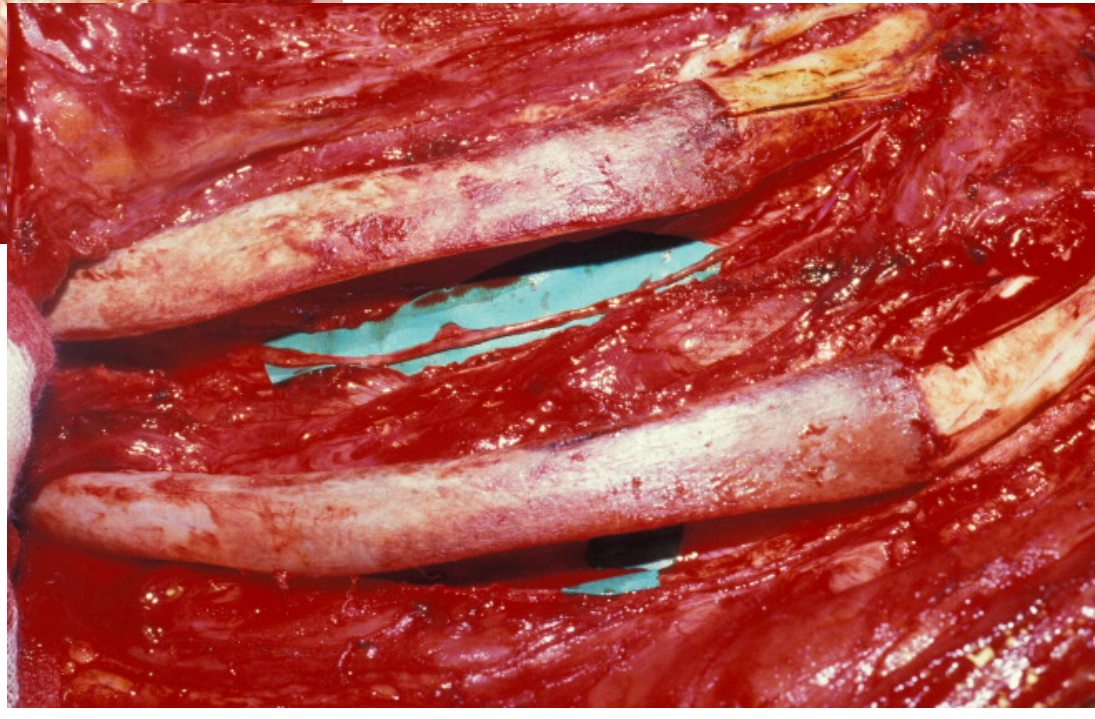
Nerve Transfer

- Accesory to Suprascapular
- Phrenic to Musculocutaneous/Axillary
- Intercostals to Musculocutaneous
- Ulna (2 fascicles) to Musculocutaneous
- Radial (long hd) to axillary
- etc

Intercostal nn. to MC n.



Intercostal nn. to MC n.

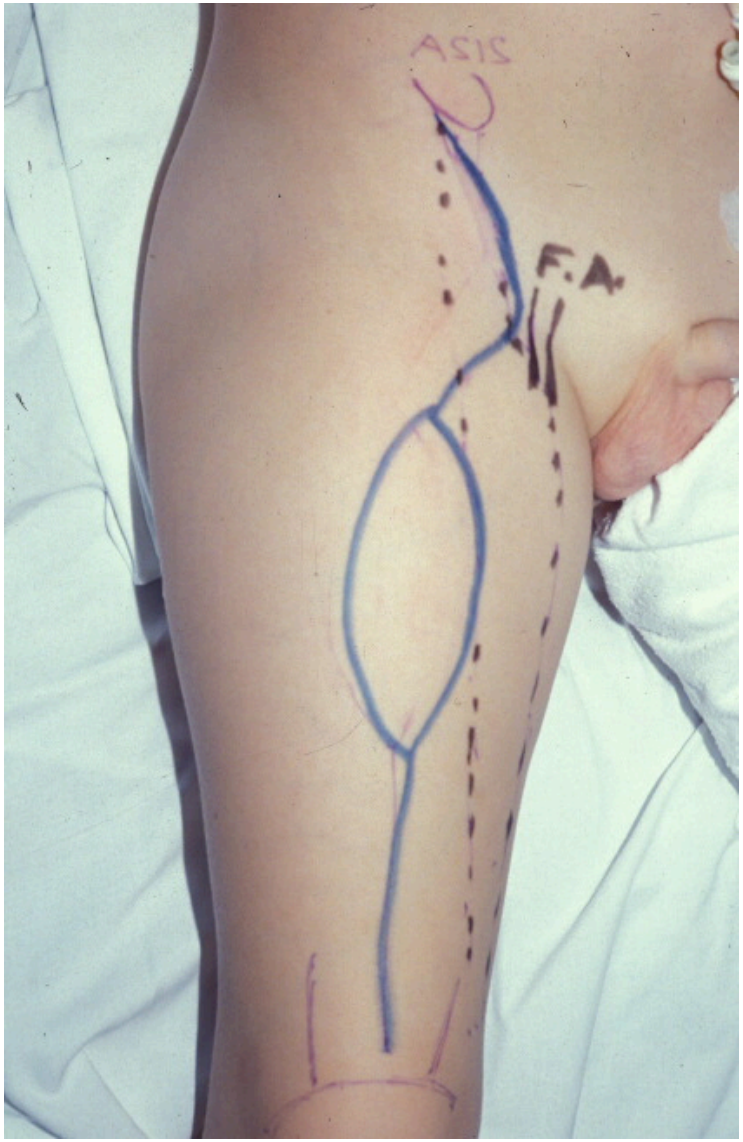


Intercostal nn. to MC n.

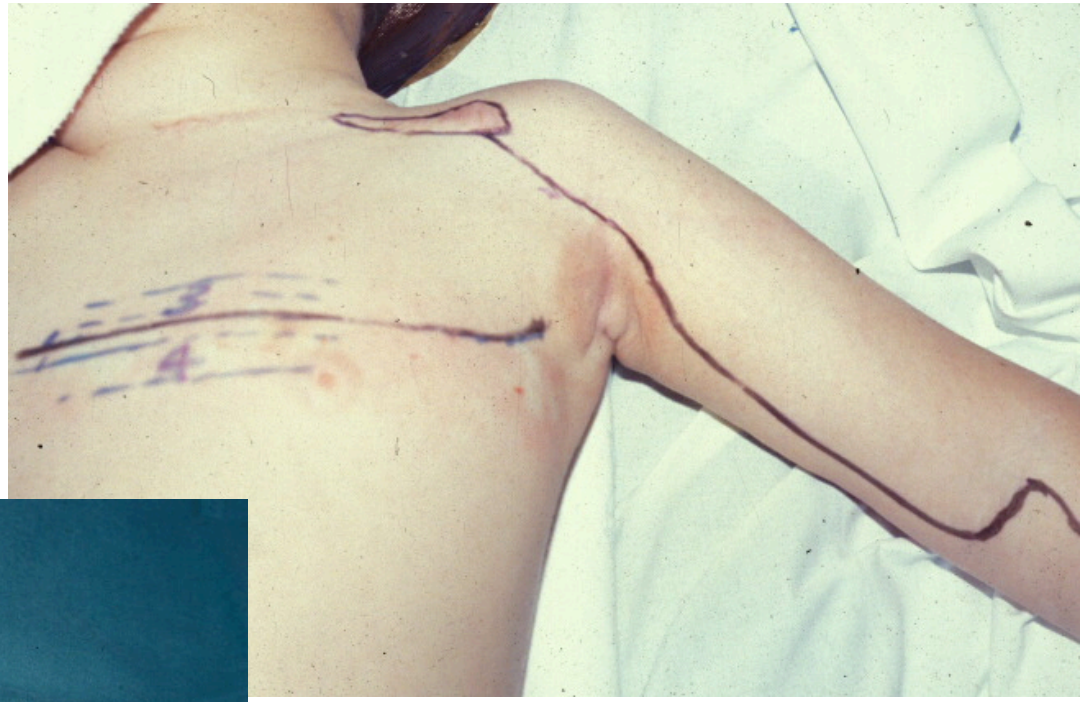
Free Muscle Transfer

- Gracilis
- Rectus femoris

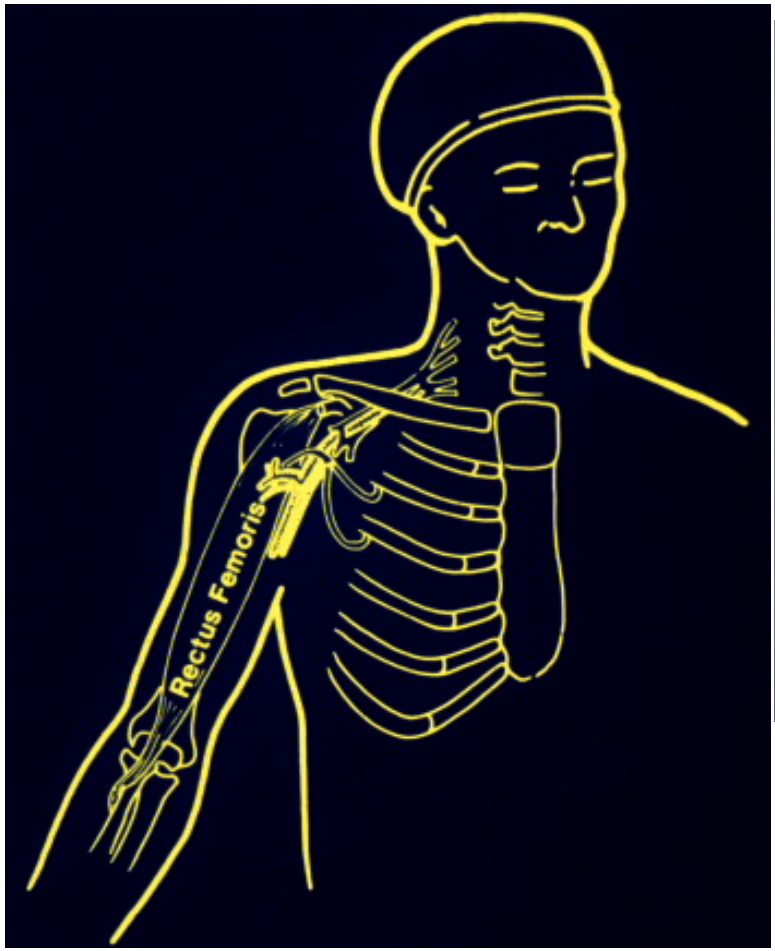
Rectus Femoris Transfer



Rectus Femoris Transfer



Rectus Femoris Transfer



Amputation

- Indications
  - Irreparable vascular or limb injury
  - Sepsis
  - Non-union with no chance
- Level
- Prosthesis
- UNCOMMON

Therapy

- Early & pre-operative stage
  - Maintain range of movement & prevent contractures
    - Mobilization & appropriate splintage
  - Oedema management
    - Massage (patient & relatives involved)
    - Pressure garments
    - Flowtron device
    - Mobilization
    - Elevation.
  - Stimulation
    - Sensory
    - Electrical stimulation of denervated muscles
  - Above all education & empowerment of patient

Therapy

- Post-operative stage
  - Initially restricted mobilization
    - » *eg: Intercostal nerve to musculocutaneous transfer*
  - After 4 weeks
    - Mobilize within specified range
    - Re-education
      - » *cf tendontransfers*
    - Biofeedback - visual and tactile
    - Electrical stimulation
      - May take months (12 - 24 months)
  - When voluntary movement noted
    - Strengthening against resistance

Prognosis

- Mechanism of injury
- Age
- Level of lesion
- Co-morbidities
- Delay to repair/reconstruct
- Quality of repair

Grading of Recovery

Motor Recovery

M0 No contraction

M1 Return of perceptible contraction in the proximal muscles

M2 Return of perceptible contraction in both the proximal and distal muscles

M3 Return of perceptible contraction in both the proximal and distal muscles of such a degree that all *important* muscles are sufficiently powerful to act against resistance

M4 Return of function as in stage 3 with the addition that all *synergic* and independent movements are possible

M5 Complete recovery

Sensory Recovery

S0 Absence of sensibility in the autonomous area

S1 Recovery of deep cutaneous pain sensibility within the autonomous area of the nerve

S2 Return of some degree of cutaneous pain and tactile sensibility within the autonomous area

S3 Return of some degree of superficial cutaneous pain and tactile sensibility within the autonomous area with disappearance of any previous overreaction

S3+ Return of sensibility as in stage 3 with the addition that there is some recovery of two-point discrimination within the autonomous area

S4 Complete recovery

Conclusion

- Early referral
- Meticulous assessment
- Many reconstructive options available
- ?