

Regional & Neuraxial Analgesia

College Document on Major Regional Analgesia	2
Neuraxial Anatomy	3
Vertebral Anatomy	4
Structures When Passing Needle	6
Surface Anatomy	6
Caudal Epidurals	6
Technique	6
Coagulation Disorders & Regional Techniques	6
Epidural Analgesia	7
Spinal Anaesthesia	9
Complications of Neuraxial Block	11
Plan B for a Regional technique	11
Nerve Stimulators	12

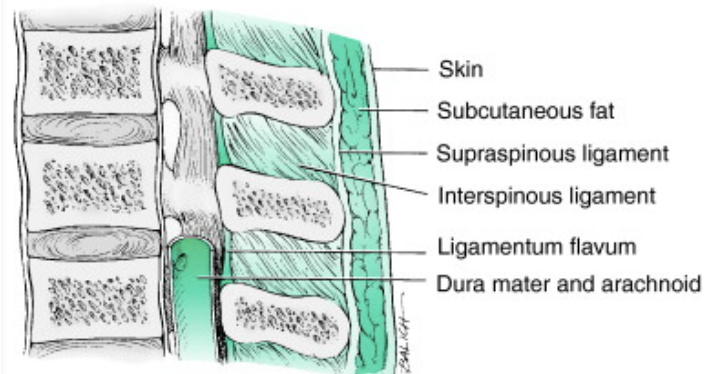
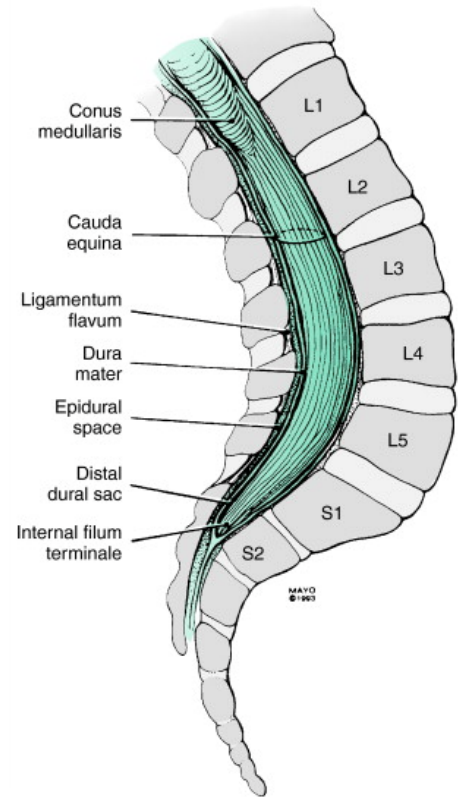
Regionals - 1

College Document on Major Regional Analgesia

- Informed consent should include discussion of risks including:
 - Nerve injury
 - Drug toxicity
 - Haemodynamic changes
 - Bleeding or bruising
 - Infection
 - Failure of technique
 - Post dural puncture headache
- Problems with informed consent in labour ward of PACU understood
- Should have qualified help when doing technique - tech or midwife
- preparation:
 - Need full infection control
 - Skin prep must be dried to avoid contaminating equipment or drugs
 - Coagulation status must be assessed before all blocks
 - IV access prior & maintained during duration of technique
- Monitoring:
 - During insertion:
 - ECG, SPO₂, RR, conscious state, frequent bp
 - Continue that level until 30mins after vitals stable
 - Person doing block must be around to assess satisfaction of block or until immediate complications have passed
 - May then delegate responsibility to other MDT members eg pain team
- Full record keeping incl prescription charting
- Equipment:
 - Catheters & giving sets must be well labelled and specifically a diff colour
 - Dedicated pumps with set protocols to avoid OD
- Post procedure r/v:
 - Local protocols to r/v for complications, effectiveness, side effects, timing of removal
 - Daily r/vs
 - MRI preferred to CT for nerve injury
 - Remove catheters if suspected infection and send for culture
- Late complications of neuraxial analgesia:
 - Postdural puncture headache
 - Epidural abscess
 - Epidural haematoma
 - Spinal cord or nerve root compression

Neuraxial Anatomy

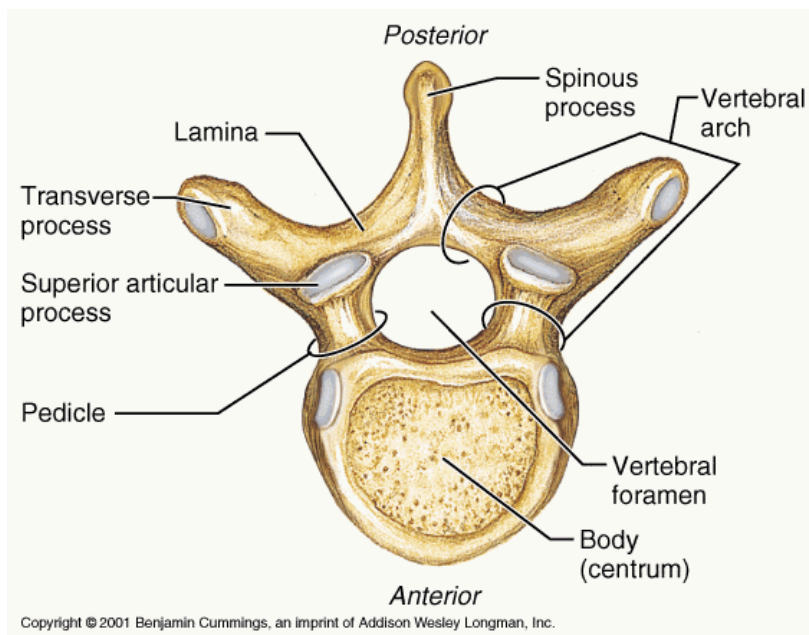
- Spinal cord terminates as conus medullaris
 - adults: L1 lower border of vertebral body adults
 - infants: L3
- conus medullaris attached to coccyx by filum terminale:
 - = neural fibrous band
 - surrounded by cauda equina:
 - = nerves of lower Lx & Sx roots
 - ∴ runs from L1 - S2
- meninges in bony vertebral column:
 - pia mater: (deep)
 - high vascular
 - closely envelops cord ⇒ creates filum terminale
 - arachnoid mater:
 - non vascular
 - delicate
 - effectively adhered to dura mater
 - dura mater (superficial):
 - longitudinally organised fibroelastic membrane
 - continuous from cranial dura mater ∴ runs foramen magnum ⇒ S2 (attaches to coccyx)
- spaces:
 - Subarachnoid space (between pia mater & arachnoid mater)
 - contains:
 - CSF
 - spinal nerves
 - trabecular network
 - blood vessels which supply spinal cord
 - dentate ligaments - lat extensions of pia mater - supply lat support from bone to spinal cord
 - space ends S2 in adults (lower in children)
 - ↳ despite spinal cord ending at L1-L2
 - Extends laterally along nerve roots to dorsal root ganglia
 - Subdural space =
 - potential space inbetween dura & arachnoid mater
 - not used intentionally by anaesthetists
 - symptoms of injection: (see later)
 - Epidural space =
 - from foramen magnum to sacral hiatus
 - outside boundaries:
 - ant: PLL
 - lat: pedicles & intervertebral foramina
 - post: ligamentum flavum
 - cephalad: foramen magnum
 - caudal: coccygeal ligament
 - internal boundaries = dura mater
 - = a low pressure area containing:
 - areolar tissues
 - loose fat



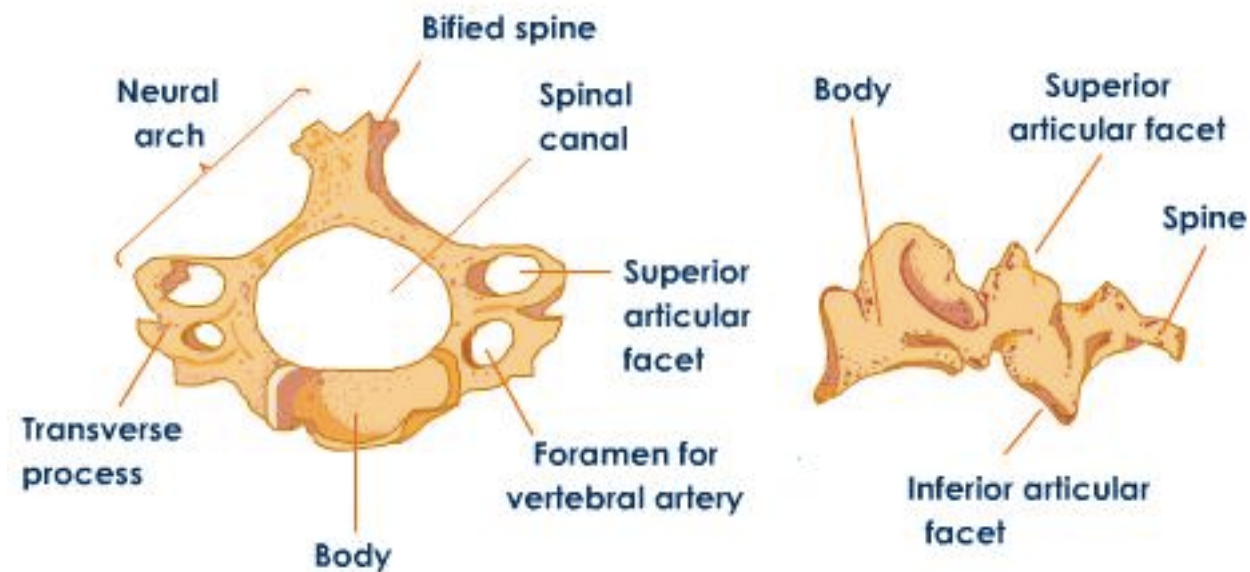
- blood vessels & lymphatics
- internal vertebral venous plexus
- is segmented & discontinuous with:
 - epidural space septa - explain unilateral block
 - dorsal median connective tissue
- Ligamentum flavum:
 - nonuniform ligament, different space to space
 - composed of 2 curvilinear ligaments which join in the middle
 - maximal thickness in Lx region 2-5mm

Vertebral Anatomy

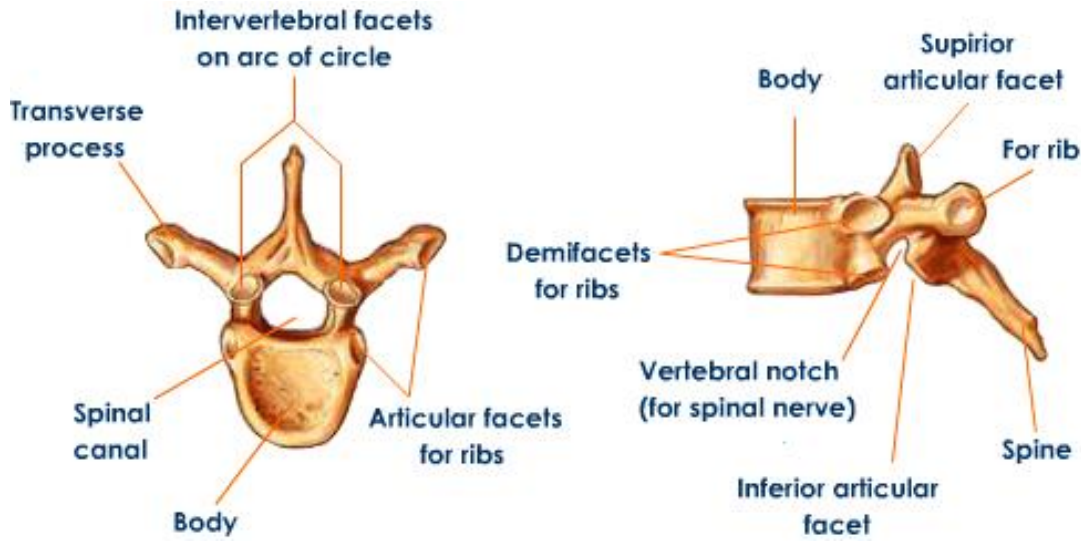
Overview



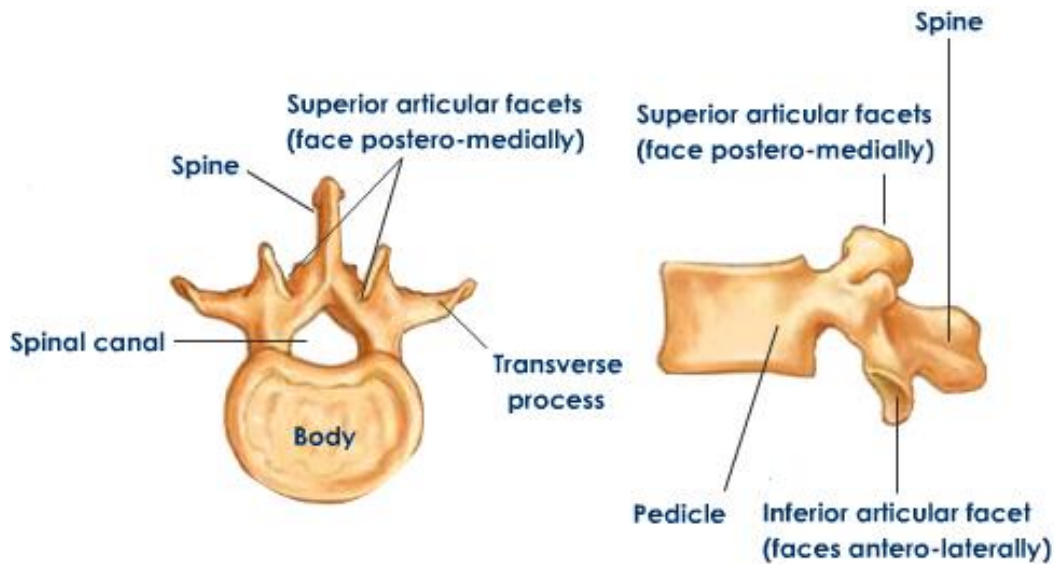
Cervical Vertebrae



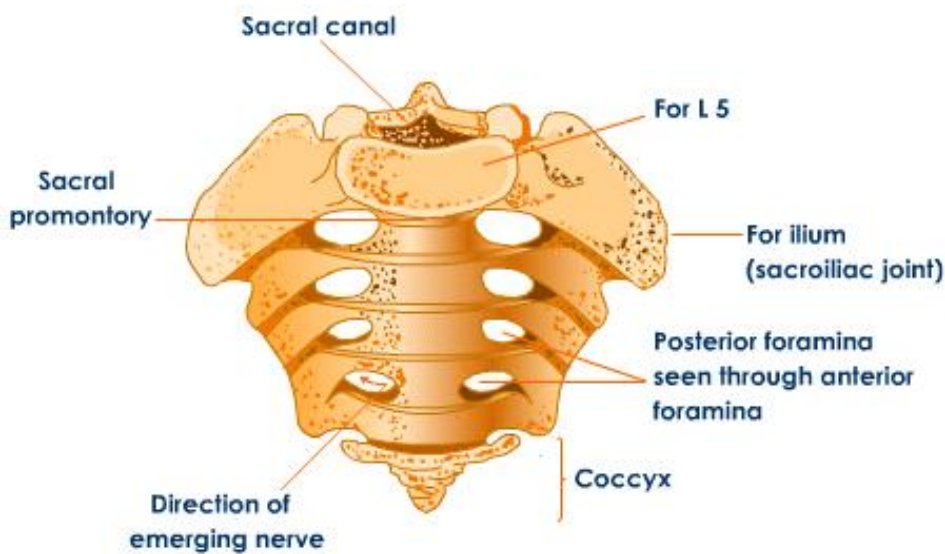
Thoracic Vertebrae



Lumbar Vertebrae



Sacral Vertebrae



Structures When Passing Needle

- Skin to sub arachnoid space:
 - skin
 - sub cut fat
 - supraspinous ligament
 - interspinous ligament
 - ligamentum flavum ⇒ give of resistance
 - ↳ = 1st pop
 - dura & arachnoid mater (hopefully together)
 - ↳ = 2nd pop

Surface Anatomy

- Iliac crests = Tuffiers line = L4/L5 interbody space

Caudal Epidurals

- very varied sacral anatomy
- aim is to identify sacral hiatus
- sacral hiatus:
 - covered by posteriorly by sacrococcygeal ligament (functional counterpart of ligamentum flavum)
 - shape varies from slit to wide inverted 'V'
 - absent altogether in approx 5% adults ⇒ seems to ossify with age ∴ ↑ed likely in young
- internal of sacrum contains sacral canal
 - ↳ contains terminal portion of dural sac

Technique

- Midline
- Paramedian:
 - 1-cm lateral to upper border of spinous process
 - Insert needle perpendicular to contact lamina of vertebra
 - Withdraw slightly reinserting 15 deg medial, 30deg cephalad to pass over lamina through interlamina space until pop through dura

Coagulation Disorders & Regional

Techniques

- Haemorrhage can be brisk ⇒ haematoma ⇒ nerve compression
 - ↳ in/around spinal cord ⇒ permanent paralysis
- Coagulopathy relative contraindication depending considerably on context
- Numbers:
 - Platelets >80
 - INR <1.5

Epidural Analgesia

- Can provide complete analgesia for 3-5days

Benefits

- Efficacious
- ↓ed atelectasis & pulmon infection, better cough
- ↓post op ACS:
 - ↓sympathetic stress thus ↓myocardial oxygen requirement
- ↓hypercoagulable states & fibronlytic function is improved
 - ↳ proven benefit in graft survival in vascular surgery
- Quicker post op mobility ⇒ ↓post op DVT
- ↑gut action by ↓pain & ↓opiate need
- Intraop epidural ↓s post op blood transfusions
 - ↳ BUT no ↑survival benefit in high risk patients

Contraindications

- Patient refusal
- Untrained staff
- Contraindications to needle placement:
 - Local or general sepsis
 - Hypovolaemia
 - Coag disorders:
 - Platelets <80
 - INR >1.5
 - Concurrent anticoag drugs
 - Central neurological diseases

Tips

- Breakthrough pain:
 - Add oral paracetamol or NSAID
 - Bolus dose 3-5ml then ↑infusion rate
 - Check all connections and infusion site
 - Check block - if patchy withdraw catheter to 2cm in space
 - Bolus fentanyl 50-100mcg only
- Pruritis:
 - Give naloxone 50-100mcg & consider adding 300mcg to infusion fluids
 - Remove opioid from infusion
 - Try antihistamines or ondansetron
- Hypotension:
 - Check fluid status
 - Check block height ⇒ ↓infusion rate
 - Ephedrine/metaraminol
- Motor block -
 - ↓infusion rate
 - ↓LA concentration
- Shivering: try fentanyl, pethidine, tramadol, ondansetron

Complications

Complications of epidural anaesthesia⁴ (see also pp746–51)

Complication	Incidence (%)	Management
Dural puncture	0.16–1.3	Bed rest, analgesia, hydration, blood patch (see p748)
Headache	16–86	Bed rest, analgesia, hydration, suspect dural puncture
Nerve or spinal cord injury	0.016–0.56	Immediate neurological assessment (see p32 and p1178)
Catheter migration	0.15–0.18	Remove catheter and resite if appropriate
Epidural haematoma Epidural abscess	0.0004–0.03 0.01–0.05	MRI or CT scan. Immediate neurosurgical assessment. Antibiotics (see also p1105 and p1171)
Respiratory depression	0.13–0.4	Decrease in opioid concentration may be required
Hypotension	3–30	IV fluids ± vasopressors. Temporarily reduce or stop infusion
Pruritus	10	Naloxone IV (50–100µg) ± antihistamine
Urinary retention	10–30 (in males)	Catheterisation
Motor block	3	Check for catheter migration. Temporarily cease infusion. Consider epidural haematoma (p1171 and p1174)
Other		Possible increased risk of anastomotic leakage after bowel surgery. No evidence to support this

- Spinal infection:
 - Classic triad of epidural abscess (Only seen together in 13%):
 - Fever (66% on own)
 - Backache (75% on own)
 - Neurological signs (very late sign)
 - Normal bloods mean nothing
 - If suspect should remove immediately and send line tip to lab
 - 90% infections are bacterial (mostly staph aureus)
 - MRI early before neurology develops
 - Once muscle weakness develops:
 - only 20% will regain full function even after surgery
 - Better prognosis: <36hrs, extent compression, younger
 - Mortality 10%
 - Needs percutaneous aspiration & Abx

Drugs in Epidural

- Standard protocols used in different institutions:
 - Light mix - bupivacaine 0.125% & fentanyl 5mcg/ml

- Infusion rates:
 - 8-15ml/hr adult
 - 4-8ml/hr >70yr olds

Spinal Anaesthesia

Dosing

- Older & pregnant need less
- 2.5 - 3mls of hyperbaric will reach T6-T10 in most non pregnant young if placed in lying shortly after injection
- If isobaric LA given dose needs to be higher
- Lignocaine not used
- Ropivocaine not licensed for intrathecal use
- Hyperbaric solutions:
 - Used to get higher block
 - More hypotension
- Isobaric:
 - Produce lower block height
 - Less hypotension

Contraindications

- Absolute:
 - Local sepsis
 - Refusal
 - Anticoagulation (see epidural)
- Relative:
 - Aortic or mitral stenosis
 - Hypovolaemia/hypotension
 - Prev back surgery - possibly technically difficult
 - Neurological disease
 - Systemic sepsis - ↑ed risk of meningitis/epidural abscess

Complications

- Hypotension
- Bradycardia -
 - block into mid thoracic region
 - Can progress to cardiac arrest
- High block ⇒ compromised breathing ⇒ total spinal
 - Urinary retention
 - Nerve damage -
 - permanent injury 1:25,000 to 1:50,000
 - Paraplegia or death 1:50,000 to 1:140,000
- Post dural puncture headache
- Infection
- Bleeding

Baricity of Injected Medications

- overall plays little role in spread of drug:
 - most imp variable is mass delivered
 - ↳ ie 10mg bupiv gives same result if given in 14mls (0.07%) or 2mls (0.5%)
 - volume is only imp if isobaric solution is given

- hyperbaric bupivacaine solution:
 - contains 8% glucose
 - can make hyperbaric by adding other drugs eg opiates
 - ↳ although appears to make block last longer **not** higher
 - 2.5-3ml 0.5% will reach T6-T10 in most non pregnant young adults placed in supine shortly after injection
- isobaric solution -
 - needs higher volume (but same mass) to achieve same result
 - less side effects
- variables that effect baricity:
 - CSF density - (although clinically little impt)
 - lower in women (ie men are dense)
 - lower in pregnant
 - lower in premenopausal
 - specific gravity ∴ temperature:
 - ↳ (ratio of density to a standard at a specific temperature)
 - isobaric bupiv can be made hyperbaric if cool to 5degC
 - additive drugs - opioids

Complications of Neuraxial Block

Hypotension

- Avoid aortocaval occlusion (pregnancy) ⇒ move to full lateral position
 - ↳ measure bp on dependant arm
- IV fluid bolus
- Vasopressor/inotrope - ephedrine vs metaraminol

Subdural block

- When epidural catheter placed between dura mater & arachnoid mater
- Less than 1:1000 BUT may be indistinguishable from epidural placement
- Definitive diagnosis is radiological
- Characteristics of subdural block:
 - Slow onset 20-30min which is much more extensive than volume should dictate
 - ↳ may extend to Cx dermatomes with Horner's syndrome
 - Patchy & asymmetrical block with sparing of motor fibres to LLs
 - Total spinal with top up dose
 - ↳ due to ↑volume ⇒ rupture of arachnoid mater
- Rx by stopping infusion and re-siting catheter

Total Spinal

- If initial plan is epidural incidence = 1:5,000 - 1:50,000
- Features:
 - Rapid onset BUT can be delay upto 30mins
 - ↳ change maternal position or migration of catheter
 - Rapid rising block
 - Impaired coughing
 - Loss hand/arm strength
 - Difficulty talking, breathing & swallowing
 - Cardiovascular depression ⇒ resp paralysis ⇒ unconsciousness ⇒ fixed dilated pupils
- Rx:
 - Maintain airway & ventilation
 - ↳ may need intubation if not fully unconscious in order to protect airway
 - Avoid aortocaval compression (pregnant)
 - Ventilation for 1-2hours may be required

IV injection of LA

- IV or partial IV catheter poisoning occurs in at least 5% epidurals
- Every dose is a test dose
- Strategies to reduce risk:
 - Always check for blood in catheter
 - Always think of LA poisoning with every dose even if prev had no issues
 - Divide all large LA doses into smaller aliquots
 - Use low toxicity LAs
- LA toxicity algorithm

Plan B for a Regional technique

- Steps:
 - Consider technique - US vs periph nerve stim
 - Reattempt if dosing allows

- Get help, another operator
- If partial:
 - Co-sedation an option - midaz/propofol/remi
- GA
- Postpone surgery
- Consider placing indwelling catheter - epidural/periph nerve catheter/indwelling intrathecal catheter

Nerve Stimulators

Principle

- electrical current applied externally to nerve will induce membrane potential to reach threshold for depolarisation
- depolarisation \Rightarrow generation of action potential
- type of fibre effected determines response:
 - sensory \Rightarrow tingling/pain
 - motor \Rightarrow contraction of effector mm
- duration of stimulus required to cause depolarisation depends on type of nerve fibre allowing specificity:
 - $A\alpha$ = motor = 0.05-0.1ms
 - $A\delta$ = pain & temp = 0.15ms

Technique

- at a given current the current required to trigger mm contraction is proportional to the distance between needle tip and nerve fibre
- to create motor response:
 - use duration of 0.05-1ms
 - pulse frequency 1-2Hz
 - amplitude range 0-1mA
- can start with large amplitude to gain general area of nerve
- then need to \downarrow amplitude to pinpoint:
 - target for ideal position is contraction with amplitude of 0.2-0.3mA
 - \hookrightarrow lower amplitude risks nerve damage

Needles

- general type of needle = monopolar
- needle insulated apart from small section on tip
- place neutral electrode to complete circuit
- needle tips:
 - short bevelled needle 45deg may \downarrow chance of nerve lesions