Cranial Nerves

overview
1) most cranial nerves are counterparts of spinal nerves - interfaces where PNS and CNS communicate with one another
2) most cranial nerves are associated with the brain stem
3) exceptions

for cranial nerves - forebrain
forebrain and brain stem
brain stem
high cervical spinal cord

for spinal nerves - spinal cord

points of entry / exit
for spinal nerves - intervertebral foramina
for cranial nerves - cranial foramina

cribriform plate
optic canal
superior orbital fissure
foramen rotundum
foramen ovale
internal auditory meatus
jugular foramen
hypoglossal canal

multiple components
for spinal nerves - four
for cranial nerves -
Cranial Nerves in the context spinal nerves

sensory and motor components of spinal nerves

transformation of posterior neural tube into embryonic spinal cord

afferents

1) from skin, muscles, tendons

2) from internal organs: GI tract, blood vessels, etc

afferents

to skeletal muscle

to autonomic postganglionic neurons (and chromaffin cells in adrenal medulla)

efferents

sensory

motor

alar plate

sulcus limitans

basal plate

DRG: dorsal root ganglion

DR: dorsal root

VR: ventral root

SN: spinal nerve
Cranial Nerves components

embryonic brain stem

alar plate
sulcus limitans
basal plate

developing brain stem
opens laterally

sulcus limitans

fourth ventricle
alar plate
basal plate

somatic sensory
SpS

visceral sensory
VS

special sensory
SpS

carry commands to striated muscles that originate in

somatic motor
SM
branchial motor
BrM
visceral motor
VM
Cranial Nerves

two (hopefully helpful) views of CN components

1) anatomy of cranial nerve components in brain stem and upper cervical spinal cord

looking down on folded-out brain stem

upper edge (folded outward)

midline

sulcus limitans

notes - columns discontinuous entire brain stem

from figure 12-2
## Cranial Nerves

Two (hopefully helpful) view of CN components

2) Functional grouping of cranial nerves

<table>
<thead>
<tr>
<th>CN</th>
<th>special sensory</th>
<th>somatic sensory</th>
<th>visceral sensory</th>
<th>visceral motor</th>
<th>branchial motor</th>
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<td>✓</td>
<td>✓</td>
<td></td>
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<tr>
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<tr>
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?
Cranial Nerves
III, IV, VI and XII
innervate skeletal muscles derived from head somites

somites: blocks of mesoderm in early vertebrate head; give rise to muscles (and other tissue)

somites 1, 2 and 3:
somites 4 and 5:
somites 6 and higher:

classified as somatic motor
motor neurons grouped as nuclei in midbrain pons medulla

in addition, an autonomic component

location of motor neurons

cranial nerves exit brain stem
Hypoglossal Nerve (XII)

**clinical test**
protrusion of tongue

**normal response**

**XII injury**
following hypoglossal damage
tongue points ________________
side of XII damage

caudal medulla

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caudal medulla
Abducens Nerve (VI)

contraction following abducens damage turns eye ...

affected eye deviates

mid pons

muscle
Trochlear Nerve (IV)

troclear notes:
1) exits brain stem
2) crosses
3) length
4) to reduce diplopia after trochlear nerve damage, tilt head

contraction turns eye ...

muscle

caudal midbrain

following trochlear damage

from figure 21-7B
Oculomotor (III)

contraction of superior rectus (SR) major eye movement

contraction of inferior rectus (IR) major eye movement

contraction of medial rectus (MR) major eye movement

contraction of inferior oblique (IO) major eye movement

contraction of levator palpebrae superioris (LPS) eye lid

EW: Edinger-Westphal nucleus

Superior Rectus

Inferior Rectus

Medial Rectus

Inferior Oblique

Levator Palpebrae Superioris
Oculomotor (III)

EW: Edinger-Westphal nucleus

sphincter muscles of iris
pupil

ciliary muscle

preganglionic parasympathetic

ciliary ganglion

postganglionic parasympathetic

pupillary sphincter
ciliary muscle
Oculomotor (III)
following damage to oculomotor nerve on one side
ipsilateral effects
strabismus
eyelid
pupil
accommodation
oculomotor

Edinger Westphal nucleus = EW
oculomotor nucleus = III
trochlear nucleus = IV
abducens nucleus = VI
hypoglossal nucleus = XII
conjugate gaze (horizontal)

There’s damage to abducens nerve on one side:
- “medial strabimus”
  - Ipsilateral eye, lateral gaze:
  - Contralateral eye, medial gaze:

There’s damage to abducens nucleus on one side:
- “lateral gaze paralysis”
  - Ipsilateral eye, lateral gaze:
  - Contralateral eye, medial gaze:

There’s damage to MLF:
- “Internuclear Ophthalmoplegia” (INO or INOP)
  - Eye movements during convergence
  - Eye movements during gaze
internuclear ophthalmoplegia (INO or INOP)

This problem is noted with some eye movements. A person is able to converge the eyes when looking at an object at a modest distance from the face. See diagram below.

```
  object

  left eye  right eye

(left eye abducts, right eye looks straight ahead)
```

However, abnormal eye movement is evident. On looking to the left, the left eye abducts, but the right eye looks straight ahead. The problem moves to the opposite eye when the person looks to the right - only the right eye abducts; the left eye looks straight ahead.

(The abducted eye can exhibit nystagmus - fast movement nasally, slow movement temporally.)

```
  object

  left eye  right eye

(left eye abducts, right eye looks straight ahead)
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