The Facial Nerve

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• The facial nerve has a complex course through temporal bone and parotid gland

• Components:
  – Motor
  – Sensory (N. Intermedius)
  – Secretomotor (parasympathetic)

• Facial nerve nucleus situated in pons

• Nerve fibres turn around the nucleus of the 6th nerve in the brainstem
Anatomy

- Fibres from contralateral hemisphere supply the nucleus in the pons
- Motor fibres run from the ipsilateral hemisphere and supplies the portion of nucleus that supplies the forehead
  - Upper motor neuron innervation of the forehead is bilateral
Anatomy (continued)

- Emerge from brainstem at lower border of pons between olive and inferior cerebellar penduncle
- Crosses cerebellopontine angle and enters temporal bone through the internal auditory canal
• Structures found in internal auditory canal:
  – Facial nerve
  – Vestibulo cochlear nerve
  – Nervus intermedius
  – Internal auditory artery and vein

• Runs through fallopian canal in a lateral direction, between cochlea and vestibule
• Separated from middle cranial fossa by thin layer of bone

• Reaches medial wall of epitympanic recess, turns sharply backwards at the first genu: geniculate ganglion

• Branch: greater superficial petrosal nerve

• Course through temporal bone: Labyrinthine portion
• From geniculate ganglion the nerve tuns posteriorly and slightly inferiorly
• Bony fallopian canal forms a cylindrical ridge, inferior to the lateral semi-circular canal and superior to the oval window (with stapes) and promontory: Tympanic portion
• Anterior limit of nerve: processus cochleariformis with tensor tympani tendon
• In bony floor of additus the nerve makes a gradual turn (second genu) and turns inferiorly to commence the vertical segment: **Mastoid postion**

• Branches in middle ear: chorda tympani; stapedius

• Runs inferiorly to stylomastoid foramen surrounded by mastoid air cells
Anatomy (continued)

- Emerges from stylomastoid foramen
- Runs forward between deep and superficial lobe of parotid salivary gland
- Devides into five branches:
  - Temporal
  - Zygomatic
  - Buccal
  - Mandibular
  - Cervical
• Damage to facial nerve results in facial weakness and cosmetic deformity
• Level of damage determines clinical picture
• Upper motor neuron vs lower motor neuron
• Forehead often spared in upper motor neuron lesions
• Degree of recovery dependent on extent of nerve damage
• International system for degree of facial nerve weakness
• House-brackmann grading system:
  – Six grades: I – VI
  – Grade I: normal function
  – Grade VI: no movement
Relax: Note slightly wider palpebral fissure on right eye.

Raise eyebrows: Note reduced furrowing of forehead on the right.
Testing of facial nerve function

- To determine site of facial nerve injury
- Relies on knowledge of facial nerve branches
Testing of facial nerve function (continued)

Branches:

• **Greater superficial petrosal nerve:**
  – Lachrymation
    Test: Schirmer test

• **Nerve to stapedius:**
  – Stapedius reflex
    Test: Audiometrical evaluation

• **Chorda tympani nerve:**
  – Taste
    Test: Testing taste
Electrodiagnosis

- To decide if lesion will recover is paramount
- Electrical testing helpful to determine status of nerve and to predict potential for recovery
- Tests of nerve conductivity and can show degeneration as early as three days after injury
- Nerve stimulated through skin with an electrode
Electrodiagnosis (continued)

- Minimal excitability test
- Maximal stimulation test (MST)
- Electroneuronography (ENoG)
- Strength-duration curves (SD curves)
- Electromyography
- Compound action potential after stimulation
Electrodiagnosis

- Stimulating electrode over stylomastoid foramen; recording electrode in region of nasolabial fold
- Normal side compared to abnormal
- Difference in amplitude is directly proportional to degree of degeneration eg. 25 reduction = 75% degeneration
- Not useful for 72 hours after injury
Electrodiagnosis (continued)

Electromyography:

• Measurement of electrical activity in muscle useful to demonstrate survival of motor units
• Implies preservation of some intact fibres
• Shows presence of fibrillation potentials, indicating denervation: indication of recovery before it is clinically apparent
• Not helpful for recent onset
• Thus: all electrical testing limited by fact that it cannot provide an indication of status of facial nerve in immediate post injury state
Diagnosis of facial paralysis

• Most causes idiopathic
• Potentially treatable causes must be excluded
• Goal of diagnosis to arrive at prognosis and treatment
Management

- Time of onset:
  - Recent onset after trauma:
    - Surgically explore and repair within 3 - 6 weeks
  - Late onset after trauma:
    - Conservative - steroids
Causes of facial nerve

- Upper motor vs lower motor

Rules:
- Congenital vs acquired
- Immediate vs delayed
<table>
<thead>
<tr>
<th>Site</th>
<th>Aetiology</th>
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<tbody>
<tr>
<td>Intracranial</td>
<td>Acoustic neuroma</td>
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<tr>
<td></td>
<td>CVA*</td>
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<tr>
<td></td>
<td>Brain stem tumour*</td>
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<tr>
<td>Intratemporal</td>
<td>Bell’s palsy</td>
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<td></td>
<td>Herpes zoster oticus</td>
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<td></td>
<td>Middle ear infection</td>
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<td></td>
<td>Trauma</td>
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<td></td>
<td>– surgical</td>
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<tr>
<td></td>
<td>– temporal bone fracture</td>
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<tr>
<td>Extratemporal</td>
<td>Parotid tumours</td>
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<tr>
<td>Miscellaneous</td>
<td>Sarcoidosis, polyneuritis</td>
</tr>
</tbody>
</table>
Brain stem

Facial nerve nucleus

CPA

Internal auditory canal

GSPN

GG

CT

Stylomastoid foramen

SN (stapedius reflex)

Parotid gland

Lacrimation

Taste (anterior ⅔ tongue)

Salivation (sublingual and submandibular glands)

Facial expression (facial muscles)

CPA: Cerebellopontine angle
GSPN: Greater superficial petrosal nerve
GG: Geniculate ganglion
SN: Stapedius nerve
CT: Chorda tympani
Congenital

- May be traumatic or inherited/developmental

**Traumatic:**
- Difficult delivery
- Forceps
- Large infant

**Treatment:**
- Usually resolves
- EMG will differentiate between traumatic and inherited/developmental
Inherited

- **Myotonic dystrophy:**
  - Autosomal dominant
  - Progressive muscle wasting
  - Mental impairment
  - Facial nerve paralysis early sign

- **Albers-Schoenberg: disease**
  - Autosomal recessive pattern
  - Disorder of bone metabolism
    - Bone density increases
    - Primary bone resorption decreases
  - Osteopetrosis of bony canals with cranial nerve compression
Developmental

- Moebius syndrome: cranial nerve abnormalities
- Charge syndrome: facial nerve dysfunction
- Oculo-auricuolo-vertebral syndrome (OAV)
- Congenital unilateral lower lip palsy (CULLP)
  - Hypoplasia of depressor anguli oris muscle
Acquired

- Infections causes:
  - Bell’s palsy
  - Ramsay hunt syndrome

- Bell’s palsy:
  - Idiopathic
  - Lower motor neuron
  - Spontaneous resolution within 3 months: ?Herpes virus

- Treatment:
  - Anti-virus
  - Steroids
  - Artificial tears
Ramsay Hunt syndrome

- Herpes zoster
- Pain, vesicles, facial nerve paralysis
- Can involve CN VII

Treatment:
- Anti-viral
- Steroid
- Artificial tears
Ramsay Hunt syndrome (continued)

Suppurative otitis media

• With or without cholesteatoma
• Compression of nerve
• Sign of complication

Treatment:
  – Medical: anti-biotics
  – Surgical: Mastoidectomy
Neoplasms

• Tumours of facial nerve: Schwannoma

• Acoustic neuroma:
  – CN VIII
  – Excision puts facial nerve at risk

  **Diagnosis:**
  – Unilateral hearing loss
  – MRI

  **Treatment:**
  – Watchful waiting
  – Surgery
  – Radiotherapy
Parotid gland tumours

• Adenoid cystic carcinoma: perineural spread

Treatment:
  – Surgery
  – Radiotherapy: neutrous
Traumatic

- Surgery: Iatrogenic
- Skull base fractures
- Sharp injuries
Iatrogenic

- Surgery for removal of tumours
- Complication of middle ear surgery

Sharp injuries:

- Any form of sharp injury to facial region
  
  **Treatment:** primary anastomosis
Skull base fracture

- Signs of BOS fracture:
  - Battleship sign
  - Raccoon eyes
  - Glasgow coma scale reduced
- Two types: Transvers and longitudinal
- Check for:
  - Facial palsy
  - Hearing loss
  - CSF leak

**Treatment:** Surgery vs conservative
Fig. 4 Pathologies causing facial paralysis.

- Cerebrum
cerebrovascular accident
- Cerebellopontine angle
  - meningioma
  - acoustic neuromas
- Internal auditory canal
  - acoustic and facial neuromas
  - Bell’s palsy
- Temporal bone
  - fracture and surgery
- Middle ear
  - surgery for cholesteatoma
  - carcinoma
- Skull base
  - glomus jugulare
- Parotid cancer