Cranial Nerve VII: Facial

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18.1 Anatomy

Cranial nerve VII develop from the second pharyngeal arches. The facial nerves exit the pons inferior and ventrolaterally, immediately superior to the pontomedullary junction [1, 2], and course superiorly and laterally through the cerebellopontine angle (CPA) (Fig. 18.1) to enter the internal auditory canal (IAC), traveling superiorly and anteriorly (Figs. 18.2 and 18.3). The fibers then turn anteriorly (the labyrinthine segment) from the lateral IAC to the anterior genu, where the greater superficial petrosal nerve branches off, extending anteriorly and medially. The remaining fibers then course posteriorly and laterally (the tympanic segment) immediately inferior to the lateral semicircular canal [3, 4]. The nerve penetrates the mastoid bone, turns inferiorly at the posterior genu, and descends posterior to the external posterior auditory canal (EAC). Two branches originate from the descending mastoid segment, the stapes muscle nerve, and the chorda tympani. The main facial nerve remaining fibers then exit the skull base through the stylomastoid foramen (Fig. 18.4). The facial nerve then pierces the posterior fascia of the parotid gland and passes lateral to the retromandibular vein while ramifying into terminal branches extending out over the face to the voluntary and involuntary muscles of facial expression [5–7].

Intracranial course: Primary motor fibers descend mostly in the corticobulbar tract arising from the lower third of the precentral gyrus in the corona radiata, internal capsule, and cerebral peduncle. The upper part of the face receives bilateral innervation, whereas the lower third receives contralateral motor input.

18.1.1 Nuclei

- *Motor nucleus:* Ventrolateral pontine tegmentum, anterior and lateral to the sixth motor nucleus
- *Superior salivary nucleus:* Located posterior to the motor nucleus
- *Solitary nucleus:* Located posterior and lateral to the superior salivatory nucleus

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18.1.2 Facial Nerve Segments

- Cisternal
- Canalicular
- Labyrinthine
- Tympanic
- Mastoid
- Extracranial

18.1.3 Branches

- *Anterior genu:*
  - Greater superficial petrosal nerve (GVE)
- *Descending mastoid segment:*
  - Stapes muscle nerve (GVE)
  - Chorda tympani (GVE + SA)
- *Intraparotid branches (SVE):*
  - Temporal
  - Zygomatic
  - Buccal
  - Mandibular
  - Cervical
- *Extraparotid Branches:*
  - Posterior auricular nerve

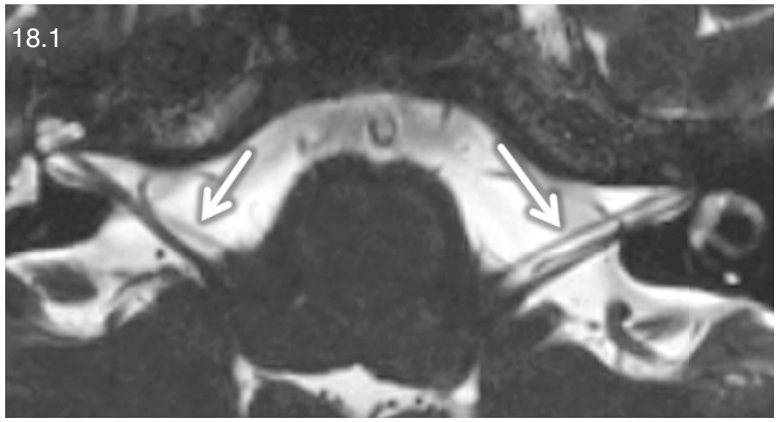

Fig. 18.1 Axial high-resolution CISS T2 MR image at the level of the cerebellopontine angle cistern and internal auditory canal. The facial nerve roots (*arrows*) exit anterior to the vestibulocochlear nerve from the inferior and anterior pons, above the pontomedullary junction bilaterally. The facial nerve remains anterior to the vestibulocochlear nerve as it crosses through the cerebellopontine angle cistern

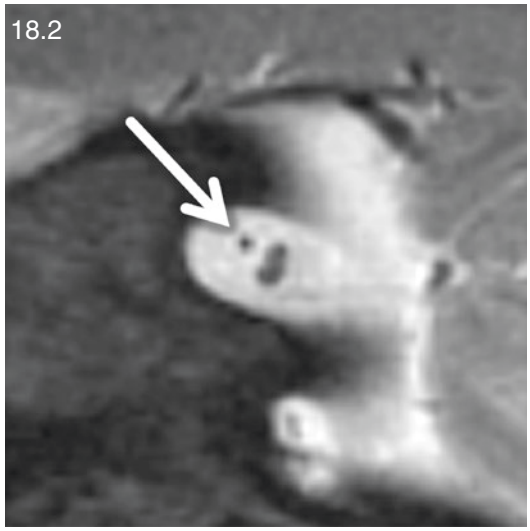

Fig. 18.2 Oblique sagittal T2 MR image through the porus acusticus reveals the characteristic "ball in catcher's mitt" appearance of the facial nerve (*arrow*) and the vestibulocochlear nerve. The facial nerve is the "ball," and the vestibulocochlear nerve is the "catcher's mitt", inferior and posterior to the facial nerve within the opening of the IAC

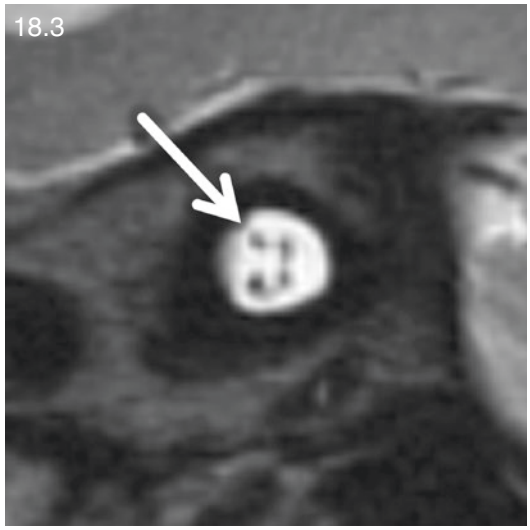

Fig. 18.3 Oblique sagittal T2 MR images through the mid-internal auditory canal (IAC). The four nerves which travel in the IAC are clearly identified. The common mnemonic used to remember the nerves in the IAC is 7-up (anterosuperior, facial nerve (*arrow*)) and coke-down (cochlear nerve anteroinferior, inferior to the facial nerve). The posterior nerves are the superior (posterior to the facial nerve) and inferior (posterior and inferior to the facial nerve) vestibular nerves

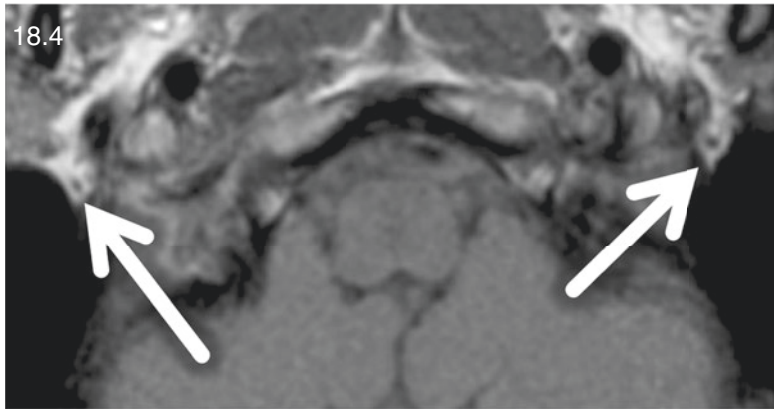

Fig. 18.4 Axial T1 noncontrasted MR image at the level of the stylomastoid foramen shows the exiting low-signal facial nerve (*arrows*) surrounded by high-signal fat in the "bell" of the stylomastoid foramen. The fat surrounding the facial nerve may be obscured if perineural tumor spread is present

18.2 Function

- Branchial motor function (SVE): Motor fibers extend through the temporal bone through the stylomastoid foramen to supply the voluntary and involuntary muscles of facial expression.
- Visceral motor function (GVE): Parasympathetic fibers travel along the greater superficial petrosal nerve to the pterygopalatine ganglion to supply innervation to the lacrimal gland and nasal mucosa. There are also parasympathetic fibers that travel with the chorda tympani to supply innervation to the submandibular and sublingual glands.
- Special sensory function (SA): Sensory fibers extend through the middle ear along the chorda tympani to join the posterior division of V3 to form the lingual nerve. The chorda tympani component of the facial nerve carries taste information from the anterior two thirds of the tongue.

18.3 Pathology

Individual symptoms: Damage to the facial nerve results in the following symptoms depending on location:

- *Supranuclear lesions:* Contralateral paresis/palsy of lower portion of the face (central paresis) with flattening of the nasolabial fold (unopposed contraction of the contralateral side of the orbicularis oris), possible drooling of saliva, and general sparing of the upper half of the face (corrugation of the forehead and voluntary eyelid closure possible).
- *Pontine lesions:* Isolated lesions of the pons can result in a facial nerve neuropathy. Etiologies such as ischemia, neoplasm, and vascular malformations such as a cavernous malformation or demyelinating pathologies are possible.
- *Cisternal lesions:* Masses within the cerebellopontine cistern can present with facial nerve neuropathy, such as a facial nerve schwannoma, meningioma, or metastatic disease. Neurovascular compression can result in a facial hemispasm. Lesions in the tympanic segment will cause a "peripheral" paralysis characterized by ipsilateral muscular weakness of the upper and lower face (flattening of the nasolabial fold and lagophthalmos).
- *Intratemporal lesions:* Lesions such as facial nerve schwannomas have varied appearances when found within the temporal bone based on the surrounding anatomic landscape of the involved segments [8]. Herpetic infection of the facial nerve (Bell's palsy) is demonstrated on imaging with normal CT osseous borders, but avid enhancement throughout the intratemporal bone and a tuft of enhancement within the lateral IAC. Traumatic fractures may injure the facial nerve within the temporal bone.
- *Extracranial lesions:* Consider neoplasms as major causes of extracranial CN VII dysfunction. Perineural tumor spread can be seen with minor salivary gland carcinomas, such as adenoid cystic carcinoma, or with squamous cell carcinoma.

18.3.1 Syndromes

Millard-Gubler syndrome: Lesion in ventral pons involves CN VI, VII, and corticospinal tract. The patient will present with contralateral hemiplegia, ipsilateral facial, and abducens palsy [9].

Foville's syndrome: Inferior medial pontine syndrome characterized by ipsilateral facial nerve paralysis, ipsilateral conjugate gaze paralysis, and contralateral hemiplegia [9].

Herpes Zoster Oticus (Ramsey-Hunt Syndrome): Characterized by ipsilateral facial nerve palsy and erythematous vesicular rash over the ipsilateral ear and the mouth. The varicella zoster virus (HSZ) lies in the geniculate ganglion. Patients may also complain of vertigo, tinnitus, and hearing loss since the geniculate ganglion is close to the inner ear structures [10].

Möbius syndrome: See Chap. 17.

Herpetic palsy (Bell's Palsy): Most frequent cause of sudden ipsilateral peripheral facial nerve paresis or paralysis of unknown etiology. It is generally self-limited and may be linked to the Herpes simplex virus (HSV) [11].

Geniculate neuralgia (aka tic douloureux of the nervus intermedius of Wrisberg): Patients present with paroxysmal otalgia. It may be caused by compression of the nervus intermedius and the geniculate ganglion, requiring microsurgical decompression or classic antiepileptic drugs [12].

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