Muscles of facial expression, mastication, sensory to face, CN V, VII, TMJ

Muscles of facial expression (Notes)
The main thing to note here is that muscles of facial expression lie underneath the skin, joined to bones. By contraction they produce movements in the skin to convey mood.

Structure of Scalp (Moore pp 872)
The name: **scalp** serves as an acronym for the layers it contains. **Skin** is the most superficial layer, following by **dense connective tissue**. The skin contains hair and sebaceous glands, and the connective tissue is highly vascularised and innervated (cutaneous). The epicranial **aponeurosis** is part of the epicranius muscle and provides a tough tendinous sheath. Beneath this is the **loose connective tissue** layer, which has many spaces in it which allow fluid build up due to infection, and the deepest layer is the **pericranium** (outermost layer of bone → **periosteum**).

Muscles around mouth (Moore 852 Fig 7.6)
Muscles of the face include several sphincters which are responsible in the opening and closing of the orifices. The orifices include: mouth, nose, and eyes. The main sphincter (first of the GIT) of the mouth is the **orbicularis oris** – which is important in **opening**, **closing** and **narrowing** the mouth. It allows **speech**, **chewing**, **whistling**, **singing** etc. The **buccinator** is a rectangular muscle helping in holding the cheek taut during chewing etc.

Muscles around eye (Moore 855 Fig 7.6 Netter Plate 20)
The **orbicularis oculi** is another sphincter, this time of the eye. It consists of two parts: **palpebral part** (eyelid) and **orbital part**. The palpebral part closes the eye slowly, allowing **spreading** of **lacrimal fluid** thereby preventing the cornea from drying. The orbital part **shuts** the **eye strongly**, in response to bright light and/or dust etc.

Muscles around ear and nose (Moore pp 856 Fig 7.6B)
The **nasalis** is probably of some significance because it compresses and flares the nostrils. High **diagnostic value** due to snoring as one of the pathological conditions.

Innervation of muscles of facial expression (Moore 862 Fig 7.11)
The branches of the facial nerve (CN VII) arise from the parotid plexus anteriorly. The five branches and their supply are:

- Temporal: superior orbicularis oculi
- Zygomatic: orbicularis oculi
- Buccal: nasalis, upper orbicularis oris
- Mandibular:
- Cervical: platysma

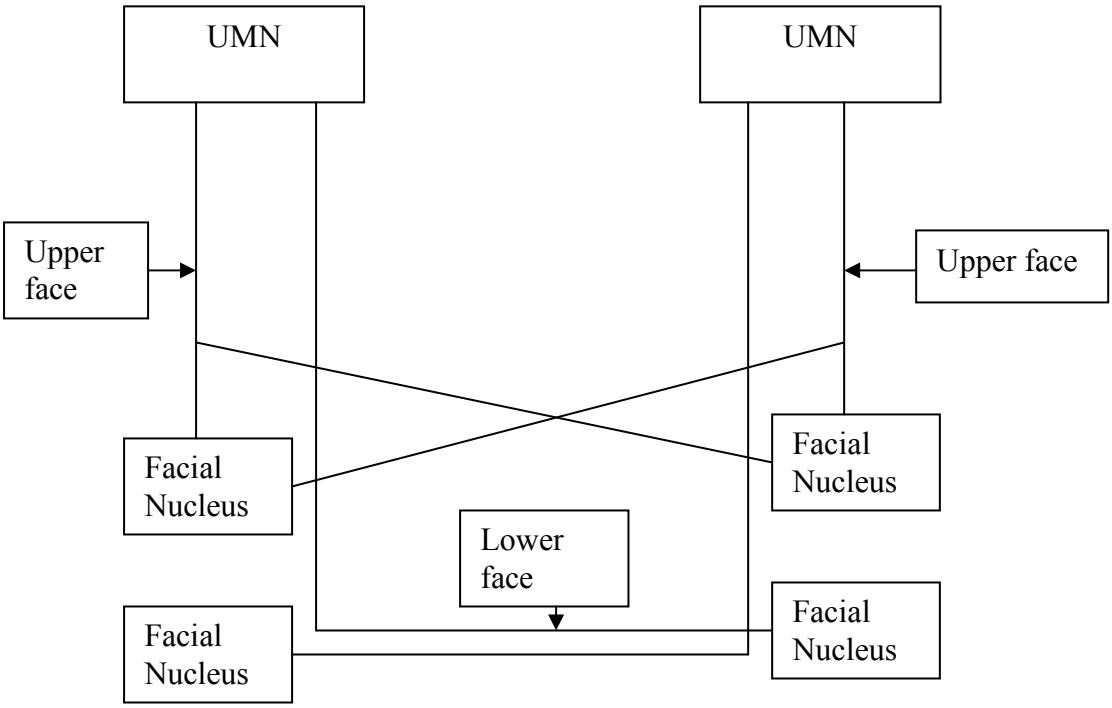
Lower motor neurons of facial nerve (Nolte 298, Fig 12.7, 12.6)
The **LMN** of the **facial nerve innervate** the **muscles of facial expression**. The **sensory component** of the facial nerve is very little, mostly from the **anterior 2/3 of the tongue (taste)** and around the areas of the **external acoustic meatus** etc. How does LMN project from the **facial nucleus**, located **ventrolateral** in the **pontine tegmentum**. Fibres project **dorsomedially** and then **wrap around the abducens nucleus** and turn ventrally again to **exit the brainstem**. The place where the fibres wrap around the abducens nucleus is called the **internal genu of the facial nerve**.

Course of the facial nerve in the cranial cavity (Notes, Netter Plate 117)
Exiting the brain stem at the **cerbellopontine angle** – it enters the skull at the **internal acoustic meatus** along with **CN VIII** (Vestibulocochlear). An **acoustic neuroma** is a **benign tumor** of the **vestibular part** (mostly) arising ue to **Schwann cell** proliferation.

Course of facial nerve in the skull (Moore pp 862 Netter Plate 117)
After entering the internal acoustic meatus, it travels in the **facial canal** formed by the walls of the **tympanic cavity** to become the **facial nerve** proper. It travels into the **geniculate ganglion**, projecting inferiorly to exit the skull at the **stylomastoid foramen**. Immediately, it gives off the auricular branch called **posterior auricular nerve**. The main branch then runs

into the **parotid gland**, forming the **parotid plexus** – then giving off the five main branches talking about before.

UMN control over facial nucleus LMNs: Corticobulbar tract (Lecture 4)



Basically, the above diagram describes the fact that in the **upper face (1/3-1/2)**: the UMNs supply LMNs bilaterally. In the **lower face (½ - 2/3)**: the UMNs supply LMNs contralaterally.

Damage to UMNs, LMNs, or facial nerve (Moore pp 857)
Basically the deal here is, if there is **unilateral UMN damage**, then only the **lower face** of the **opposite side** is **affected**. If the damage is to **LMN** (still unilaterally) then the **whole face** is **paralysed** on the **same side**, because axons of the facial nerve are affected.

Muscles of mastication (chewing) (Moore pp 920 Fig 7.4.1, Netter Plate 48/49)
The muscles of mastication are: **temporalis** and **masseter**, **lateral** and **medial pterygoids**. The **temporalis** muscle is attached to the temporal fossa proximally, and to the coronoid process distally. It elevates the **mandible**, and **retracts** it from a **protracted position**. The **masseter** is a rectangular muscle attached distally around the lateral aspect of the ramus of the mandible. Its main action is to help in **chewing and biting** (occlude the teeth) and **elevating the mandible**.

The **lateral pterygoid muscle** has two heads of origin. The upper head joins directly to the TMJ; the lower head joins to the condylar fovea. This muscle **protrudes** the **mandible** and **depresses it (while protruded)**. The **medial pterygoid muscle** also has two heads. It attaches to the medial aspect of the ramus, close to the angle of the mandible – and is responsible for **elevation of the mandible**.

These muscles lie in the infratemporal fossa just **inferior** to the **zygomatic arch**. This is bordered by the ramus of mandible, lateral pterygoid plate, stylomastoid foramen, inferior surface of the greater wing of sphenoid.

Other muscles involved in chewing are: **geniohyoid, digastric, buccinator, orbicularis oris, tongue**.

Temporomandibular joint (Moore pp 923 Netter Plate 11)

The temporomandibular joint is really important in **mastication**. Its articulations involve the **condylar process** of the **mandible**, the **mandibular fossa**. It is covered by an **articular capsule** – which is loose, and a thick fibrous capsule. The **articular disc** separates this joint into a superior and inferior compartment. The **protraction/retraction** movements occur in the **superior** compartment. The **elevation/depression** occur in the **inferior** compartment. The two main ligaments here are the **stylomandibular**, and **sphenomandibular**. The former runs from the styloid process of the temporal bone to the angle of the mandible. The latter runs from the spine of the sphenoid bone to the lingula of the mandible. The joint also accounts for **side-to-side** movements of the jaw, helpful in grinding and chewing of tough food.

Actions at TMJ (Moore pp 923 + Notes)
Open: **gravity** (prime mover), **lateral pterygoid**, **digastric** and **geniohyoid**
Close: **masseter**, **temporalis** (anterior fibres), **medial pterygoid**
Protrusion: **lateral pterygoids**
Retraction: **temporalis** (posterior)
Side-to-side: **pterygoids**

Innervation of muscles of mastication (Moore pp 861)
The trigeminal nerve (CN V) is the **prime sensory nerve** for the **face**, but also contains **motor fibres** that **innervate** the **muscles of mastication**. The nerve that emerges from the foramen ovale (skull) contains both sensory and motor fibres, and this is the most inferior and largest division of the trigeminal nerve → called the mandibular division of the trigeminal nerve or CN V_3. What are the muscles of mastication? Revise.

LMNs of trigeminal nerve (Moore pp 857 Netter Plate 116)
The **lower motor neurons** of the trigeminal nerve are all **located** in the **trigeminal motor nucleus** at the level of the **mid pons**. Fibres from here **project laterally** and form the **main motor root**. Remember we are now only talking about the mandibular division of CN V (because we are referring to LMN). It travels in the **cranial cavity**, **exiting** it **through** the **foramen ovale**. It descends into the **infratemporal fossa** then giving off **various branches** to the **muscles of mastication**.

UMN control over trigeminal nucleus LMNs: Corticobulbar tract (Refer to Lecture 4)
The **main thing to note here** is that the UMNs synapse at the trigeminal nucleus to give rise to the LMN (still talking about motor neurons here, not sensory remember!). When they synapse – some fibres cross over to supply the other side. So the **UMNs control the LMNs bilaterally.**

Cutaneous innervation of face and scalp (Moore pp 857 Netter Plate 116)
The cutaneous nerves of the neck overlap those of the face. Thus the cutaneous innervation of the face receives supply from the **Trigeminal nerve** and its three main branches, as well as branches from nerves contributing to the **cervical plexus**, and the **greater occipital nerve**.

<u>Ophthalmic Division (Moore pp 857 Netter Plate 116)</u>
The **ophthalmic division** of the trigeminal nerve (**CN V_1**) is the smallest and most superior division. It is **wholly** a **sensory nerve**, and arises from the **trigeminal ganglion**. It **enters** the **orbit** via the **superior orbital fissure**, giving off **branches** to the **eyeball** and the superior part of the **nasal cavity**. It then continues on to **exit** the **orbit** to supply **parts of the face**. The main branches of the ophthalmic nerve are (superior to inferior): **frontal nerve**, **lacrimal nerve**, and **nasociliary nerve**.

The **nasociliary nerve** gives off other cutaneous nerves such as: **posterior ethmoidal nerve**, **anterior ethmoidal nerve**, and **infratrochlear nerve**. The **frontal nerve** continues and divides into the **supraorbital** and **supratrochlear nerve**. Lastly, the **lacrimal nerve supplies** the **skin** around the **lacrimal gland**, borrowing some fibres from the maxillary nerve (CN V_2).

<u>Maxillary division (Moore pp 858 Netter Plate 116)</u>

The **maxillary branch** of the trigeminal nerve (CN V_2) **arises** from the **trigeminal ganglion** and **exits** the **skull** through the **foramen rotundum** to enter the **pterygopalatine fossa**. Here it gives off branches to the **pterygopalatine ganglion**, and then continues to give off the **zygomatic nerve**. This nerve enters the infraorbital foramen and terminates as the **zygomaticofacial** and **zygomaticotemporal nerves**. Eventually **CN V_2 terminates as** the **infraorbital nerve**. This nerve serves skin: **upper cheek**, **canine** and **premolar teeth**, **mucosa** of **maxillary sinus**, **skin + conjunctiva** of **upper eyelid**, **part of nose**, **upper lip**. The zygomaticotemporal nerve serves: **temple**. The zygomaticofacial nerve serves: **skin** over **zygomatic prominence** of **zygomatic bone**.

Mandibular division (Moore pp 861 Netter Plate 116)
The **mandibular division** of CN V is the **largest** and **most inferior** division. It is formed at the **foramen ovale** by the **merging** of the **sensory** and **motor fibres** (*already discussed above*). It **exits** the **skull** via the **foramen ovale** and then splits up into **three main branches**, supply the skin derived embryologically from the mandibular prominence. It is the only part of the trigeminal divisions that contains **motor fibres innervating** the **muscles of mastication** (described earlier). The major cutaneous branches are: **auricotemporal nerve**, **buccal nerve**, and **mental nerve**.

The **auricotemporal nerve** is one of the **first major branches**, passing through the parotid gland (giving off parotid branches) and then **ascending anterior** to the **auricle** of the **ear**. It supplies parts of the **auricle**, **external acoustic meatus**, **tympanic membrane**. The **buccal nerve** emerges from the ramus of the mandible and supplies the **mucosa of the cheek**, and a small area of **skin of the cheek**. The **mental nerve** emerges from the **mental foramen** and is the major branch of the **inferior alveolar nerve**. This in turn is a major branch of the **mandibular nerve** (CN V_3).

Arteries of face and scalp (Moore pp 865 Netter Plate 17)
The face is richly supplied by blood, highly vascularised area. Most of the **vasculature** is **derived** from the **external carotid artery**. The **facial artery** arises from the **external carotid**, **winds** its way **up the mandible** and **towards** the **nose** and courses where the **upper** and **lower eye** lids **meet**. The **terminal** of the **facial artery** is called **angular artery**. The **superficial temporal artery** is another supply, it begins between the ear and TMJ ascending upwards (**terminal branch of external carotid – Netter Plate 29)** and eventually terminating into **two branches**: **frontal** and **parietal**. The **posterior auricular artery** arises deep to the parotid gland, and **ascends** on the **medial aspect** of **SCM muscle** – travelling between the **ear** and the **mastoid process**. The **occipital artery** accompanies the occipital nerve posteriorly.

The **supraorbital** and **supratrochlear arteries** also contribute to the facial circulation, but these **arise** from the **ophthalmic artery** which in turn is a branch of the **internal carotid artery**.

Maxillary artery (Moore pp 920 Netter Plate 35)
The **maxillary artery** is one of the larger terminal branches of the **external carotid artery**. The other one being the superficial temporal artery. It is **divided** into **three parts**. It **arises posterior** to the **neck** of the **mandible** and travels **anteriorly posterior** to the **mandibular condyle**, representing the **first part** of the maxillary artery. It then travels either **superficial or deep** to the **lateral pterygoid muscle** (**2nd part**). The **third part** occurs when the **maxillary artery** travels to the **infratemporal fossa** via the pterygomaxillary fissure. Each of the parts gives rise to different branches, explained below:

- 1st part: auricular artery → external acoustic meatus, tympanic artery → tympanic membrane, **middle meningeal artery → dura of calvaria** (rupture gives rise to **epidural haematoma**), accessory meningeal artery → cranial cavity, inferior alveolar artery → mandible, teeth and gums
- 2nd part: deep temporal arteries, pterygoid arteries → pterygoid muscles, masseteric artery → masseter muscle, buccal artery → buccinator muscle.
- 3rd part: this gives off a number of branches, refer to Moore pp 922 for more information.

Primary sensory neurons in trigeminal ganglion (Nolte 5th Ed pp 303, Fig 12-15, Lecture 4)
The **peripheral afferent fibres** of the trigeminal nerve are **associated** with the **three main branches** of the trigeminal nerve: **ophthalmic**, **maxillary** and **mandibular nerves**. There are **three sensory nuclei** that are associated with these trigeminal afferents and these are: **main sensory nucleus** (**midpons**), **spinal nucleus** (**extends caudally from midpons**), **mesencephalic nucleus** (**extends rostrally from midpons**). **Spinal** and **main sensory nuclei** are to do with **somatosensory information**. The mesencephalic nucleus is essentially a bit of the trigeminal ganglion in the CNS (note the trigeminal ganglion is actually located in the peripherally: Netter Plate 116). The axons of the psuedounipolar neurons collect in a bundle called the mesencephalic trigeminal tract, whose peripheral processes are distributed along the trigeminal nerve → muscle spindles and other proprioceptive areas.

The **primary sensory cell bodies** are located in the **trigeminal ganglion**. Fibres from here travel via the **descending tract**. One **exception** is **proprioception**. These **primary sensory cell bodies** are **located** in the **mesencephalic nucleus of V**, which is located in the mid pons (described above). These are the only known primary sensory cell bodies in the CNS.

Secondary sensory neurons: main and spinal nuclei of V (Nolte 5th Ed pp 303, Lecture 4)
Pain and temperature sensation is **directed** via the **descending tracts** to the **spinal nucleus**, whereas as **discriminative tactile** and **proprioceptive sensations** are **sent** to the **main sensory nucleus**. **2nd order neurons** here **cross** the **midline** and **ascend** as the **trigeminothalamic tract**.

Tertiary sensory neurons: VPM of thalamus (Nolte 5th Ed pp 303, Lecture 4)
Eventually the **trigeminothalamic tract terminates** at the Ventroposteromedial nucleus of the thalamus (**VPM**).

Fourth order neurons: primary somatosensory cortex (Lecture 4)
From the VPM, **3rd order neurons project** to **4th order neurons** which are located in the **post-central gyrus** of the parietal lobe (fibres travel via the **genu** of the **internal capsule**).

A good summary is offered in my Lecture 4 notes, and also in the Lecture notes: Facial expression…..

Veins of face and scalp (Moore pp 865)
Generally the veins **parallel the arteries**. The **superficial temporal vein** descends and is **joined** by the **maxillary vein** to form the **retromandibular vein**. The retromandibular vein travels **posterior** to the **ramus** if the **mandible** and through the **parotid gland**. It then splits into an **anterior branch**, joining the **facial vein** to form the **common facial vein** which in turn drains into the **internal jugular vein**. The **posterior branch** units with the **posterior auricular vein**, together **draining** into the **external jugular vein**. The maxillary vein has connections to the pterygoid plexus (Fig 7.6 Moore pp 867) and cavernous sinus → therefore forming a potential route of spread of infection.

Lymphatics of face and scalp (Moore pp 869 Fig 7.12 pp 870)
The lymphatics of the face and scalp are arranged into **superficial** and **deep areas**. The **superficial lymphatics** drains along the **veins**, whilst the **deep lymphatics** drains along the **arteries**. Eventually all the lymph drains into the **deep cervical lymph nodes**, and then into the **jugular lymphatic trunk**. This joins the **thoracic duct** on the **right side**, or the **brachiocephalic vein** on the **right side**.

The nodes involved are, superficial: **submandibular**, **submental**, **retroauricular**, **occipital**, **parotid**, deep: .