# Bristle through Bone: An Osteological Model Approach to Teaching the Cranial Nerves and their Foramina

Noel T Boaz[1], David Kronen[2]. [1]Ross University School of Medicine, Dominica, [2]Bone Clones, Chatsworth, California, USA

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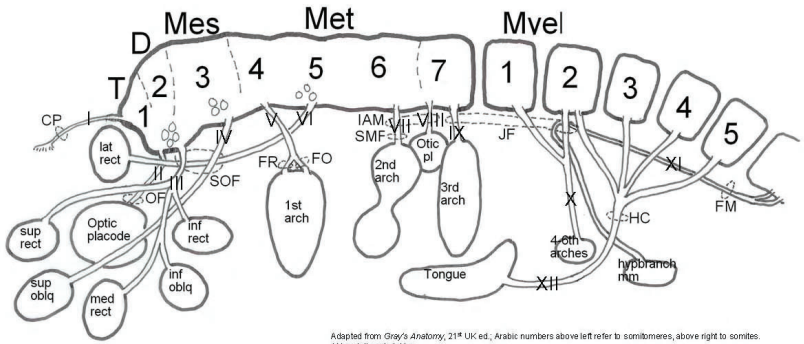
An evolutionary developmental approach to teaching gross anatomy offers the advantages of imparting process and pattern to a student's learning and tends to counteract rote memorization without understanding. Anatomical segmentation of the head and neck is a powerful paradigm for learning. We constructed a detailed model of articulated cranial bones with anatomically correct foramina for the 12 cranial nerves and their branches. A teaching module that uses this model with color-coded bristles for self-directed learning is presented. Cranial nerve branches are characterized by reference to the fibers that they carry, as lost or elaborated during embryogenesis from a primitive spinal-nerve-like pattern, and they are identified as somitomere-related cranial nerves, pharyngeal arch nerves, pretrematic branches, or autonomic nerves and ganglia. The bony foramina of the skull are related to the cranial nerve branches that they transmit via their embryological development and these are explored with the appropriate color-coded bristles. An understanding of the underlying osteology imparts an appreciation of the soft-part anatomical patterns of the head and neck that the student subsequently encounters in the gross anatomy laboratory.




Adapted from *Gray's Anatomy*, 21st UK ed.; Arabic numbers above left refer to somitomeres, above right to somites. Abbreviations in tables.

| VESICLE /ADULT DERIVATIVE | CRANIAL NERVE(S) | CRANIAL FORAMINA FOR MAIN BRANCHES |
|---|---|---|
| Telencephalon/ Olfactory bulbs | I – synapses with vesicle | Cribriform plate of ethmoid (CP) |
| Diencephalon/ Optic tracts | II – part of vesicle | Optic foramen (canal) of sphenoid (OF) |
| Mesencephalon/ Cerebral peduncles | III, IV – attach to vesicle | Superior orbital fissure (SOF) |
| Metencephalon/Pons | V,VI,VII,VIII – attach to vesicle | Foramen rotundum (FR; $V_2$), foramen ovale (FO; $V_3$), SOF (VI), internal auditory meatus (IAM; VII, VIII), stylomastoid foramen (SMF; VII) |
| Myelencephalon/ Medulla oblongata | IX,X,XI,XII – attach to vesicle | Jugular foramen (JF, IX, X, XI), foramen magnum (FM, XI), hypoglossal canal (HC, XII) |

## CN I

Bristle through cribriform plate

## CN II

Bristle through optic canal

## CN $V_2$

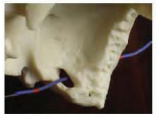
Bristle through foramen rotundum

Bristle through sphenopalatine foramen

Bristle through nasopalatine foramen

Bristle through zygomaticofacial foramen

## CN $V_3$



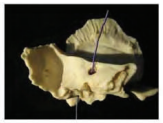
Bristle through foramen ovale

Bristle through mandibular canal

## CN VI

Bristle through superior orbital fissure

## CN VII

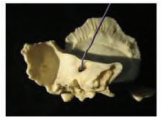


Bristle entering internal auditory meatus and exiting stylomastoid foramen

Bristle exiting hiatus of greater petrosal nerve

Bristle exiting pterygoid canal (nerve of pterygoid canal incorporates sympathetics from deep petrosal nerve as well)

## CN VIII



Bristle entering internal auditory meatus

## CN IX

Bristle entering jugular foramen

Bristle exiting hiatus of lesser petrosal nerve

## CN X

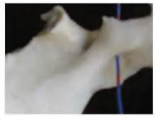
Bristle entering jugular foramen

## CN XI

Bristle passing through foramen magnum

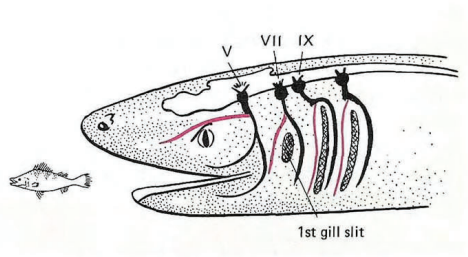
Bristle entering jugular foramen

## CN XII



Bristle passing through hypoglossal canal

## Pretrematic Nerves




From Langebartel, DA 1977 *The Anatomical Primer*. Baltimore: University Park Press.

| PARASYMPATHETIC NUCLEI FOR HEAD & NECK | CRANIAL NERVE OF ORIGIN AND EXITING FORAMINA | PARASYMPATHETIC GANGLIA | TERMINAL DISTRIBUTARY BRANCH OF TRIGEMINAL NERVE |
|---|---|---|---|
| Oculomotor (Edinger-Westphal) Nucleus | III/Superior orbital fissure | Ciliary | Short ciliary nerves ($V_2$) to constrictor pupilllae and ciliary muscle |
| Superior salivatory nucleus | VII/Internal auditory meatus+hiatus of greater petrosal nerve+pterygoid canal+inferior orbital fissure | Pterygopalatine | Zygomatic nerve ($V_2$) to lacrimal nerve ($V_1$) to lacrimal gland |
| Superior salivatory nucleus | VII/Internal auditory meatus+petrotympanic fissure (for chorda tympani) | Submandibular | Lingual nerve ($V_3$) to submandibular and sublingual glands |
| Inferior salivatory nucleus | IX/Jugular foramen+tympanic canaliculus+hiatus of lesser petrosal nerve+foramen ovale | Otic | Auriculotemporal nerve ($V_3$) to parotid gland |

## CN $V_1$

Bristle entering superior orbital fissure

Bristle passing through supraorbital notch

## Chorda Tympani (VII)

Bristle in petrotympanic fissure

## Tympanic Nerve (IX)

Bristle in tympanic canaliculus

## Auricular Nerve (X)

Bristle in mastoid canaliculus

Bristle exiting tympanomastoid fissure