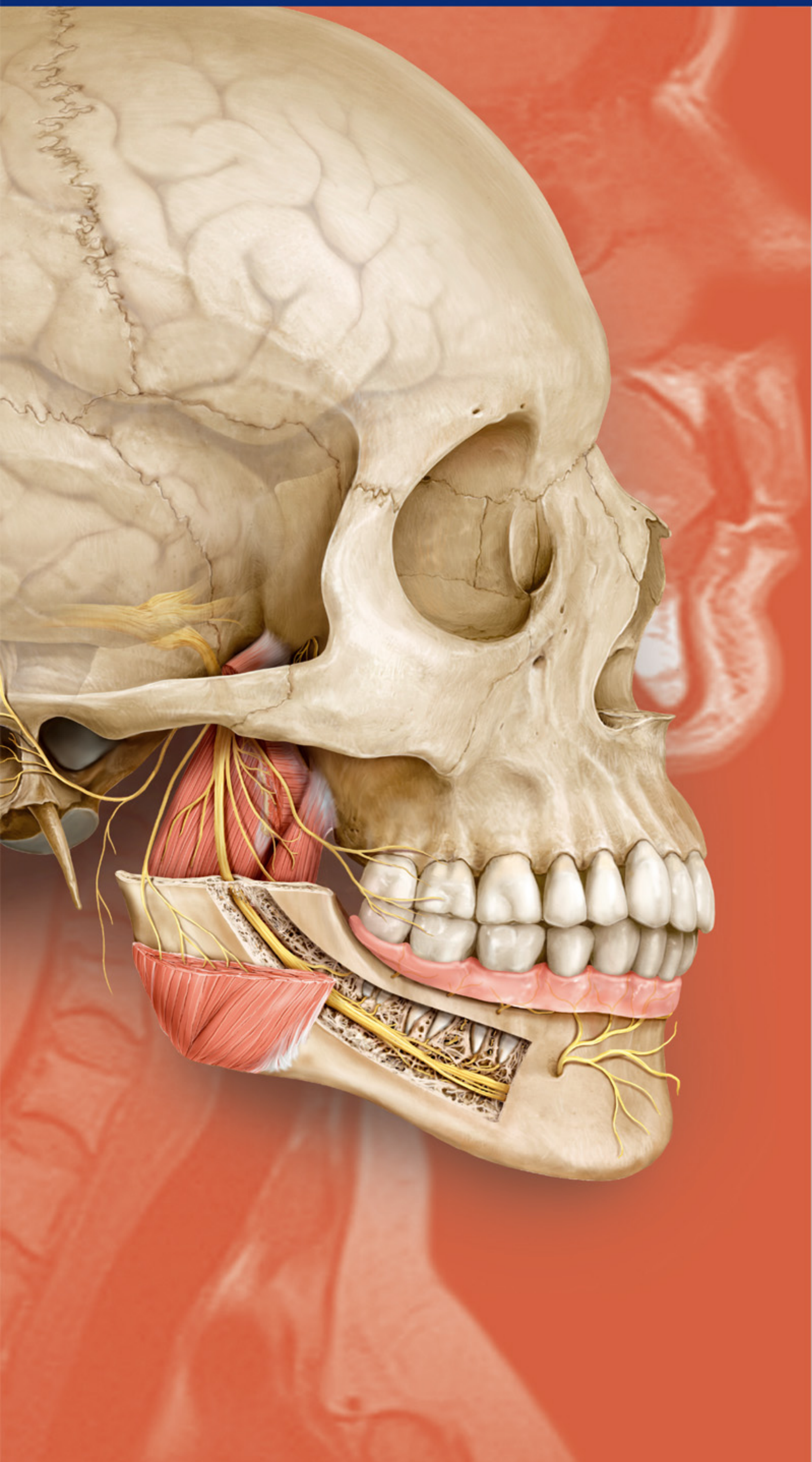
Anatomy for Dental Medicine

Latin Nomenclature



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Based on the work of
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Anatomy for Dental Medicine

Latin Nomenclature

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To my wonderful wife, Amy Curran Baker,
and my awe-inspiring daughters, Phoebe and Claire

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Preface to the Second English Edition

Before embarking on the second edition of *Anatomy for Dental Medicine*, we sought to find out how anatomy is currently being taught in North America. We consulted members of the American Dental Education Association (ADEA) and read their Basic Science Survey Series for Dentistry, a series of reports that clarify this very issue. What we found out is that teaching time is being squeezed and many institutions have combined courses that were once stand-alone (e.g., embryology, histology, and neuroanatomy) into the anatomy course. Armed with this knowledge, we set out to create a single-volume text atlas that would cover dental student's needs across all formats of anatomy education, a feat that we think we have achieved with this second edition.

Some key features retained from the first edition are:

- Organized in a user-friendly format in which each two-page spread is a self contained guide to a specific topic.
- Intuitively arranged to facilitate learning. Coverage of each region begins by discussing the bones and joints and then adds the muscles, the vasculature, and the nerves. This information is then integrated in the topographic neurovascular anatomy coverage that follows.
- Features large, full-color, highly detailed artwork with clear and thorough labeling and descriptive captions, plus numerous schematics to elucidate concepts and tables to summarize key information for review and reference.
- Includes a full chapter devoted to sectional anatomy with radiographic images to demonstrate anatomy as seen in the clinical setting.

The second edition has two new chapters: an embryology chapter that introduces dental students to all of the major concepts that they need to be familiar with and that puts anatomical concepts from later chapters in context, and a chapter that covers the anatomy of the rest of body, which includes coverage of the upper limb, thorax, abdomen, and pelvis (the back is covered in Chapter 11 with the neck). In addition, we increased our coverage of neuroanatomy such that it should be sufficient to meet dental student's needs.

In this second edition, we also rearranged material into a more regional approach, thus enhancing its usefulness as a companion to lecture-based material and to dissection courses. However, we also retained a systemic anatomy approach at the beginning of the atlas, which allows certain topics to be presented more clearly while providing a good entry point for the novice learner.

Other notable changes to the second edition include a new appendix on the anatomy of dental local anesthesia, which is one of the critical applications of head and neck anatomy. There are also appendices that include factual-type questions to test recall of information and clinical vignette-style questions that test comprehension and application. These appendices include full answer explanations. There is also more than 400 new illustrations, summary tables, dentally relevant clinical correlations, radiographs, and full-color photographs. The text, artwork, and labels have been thoroughly updated, and we welcome the continuing support of those members of the medical and dental community who alert us to any issues and keep us on our toes! All in all, we have taken our very well-received first edition and given it even more relevance and appeal such that it should serve dental students—and other students for whom the head and neck holds particular relevance—well for many effective years of studying to come.

A Note on the Use of Latin Terminology

To introduce the Latin nomenclature into an English textbook is a delicate task, not least because the English language is composed of a large number of loanwords from Latin that have passed into general use. Some loanwords are so common that fluency of the text would be disturbed if they were to be translated back to Latin. The Latin loanwords have typically undergone several adaptations to the English language. A term such as *sympathetic trunk* (lat. *truncus sympaticus*) has undergone morphological adaptation (through the loss of masculine suffix *-us*), orthographical adaptation (via the substitution of a Germanic *k* for a Latin *c*), and phonological adaptation (*th* and *e* instead of *t* and *i*); further, the word order has been reversed. The Latin term *sympaticus* is in fact borrowed from late Greek *sympathetikos* (from *sympathes*: "having a fellow feeling, affected by like feelings"), illustrating that terms move between languages when cultures meet. Other anatomical terms are so colloquial (e.g., *hand*), that a Latin term (e.g., *manus*) would be inappropriate to use at all occasions. Hence, the text would easily become unreadable if full stringency of the translation would be applied. Regarding figures and tables, Latin has been used whenever possible, and in the text body Latin has been used unless it would considerably disturb the fluency. In some cases, dual terminology has been used and the English term or the Latin term has been put in parenthesis. As much as possible, the terminology of *Terminologia Anatomica* (1998) has been followed.

Hugo Zeberg, MD, PhD
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Eric W. Baker

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Finally, I would like to dedicate my work with this edition to the autopsy technician Lars Winblad, who unexpectedly passed away at a too early age.

Hugo Zeberg

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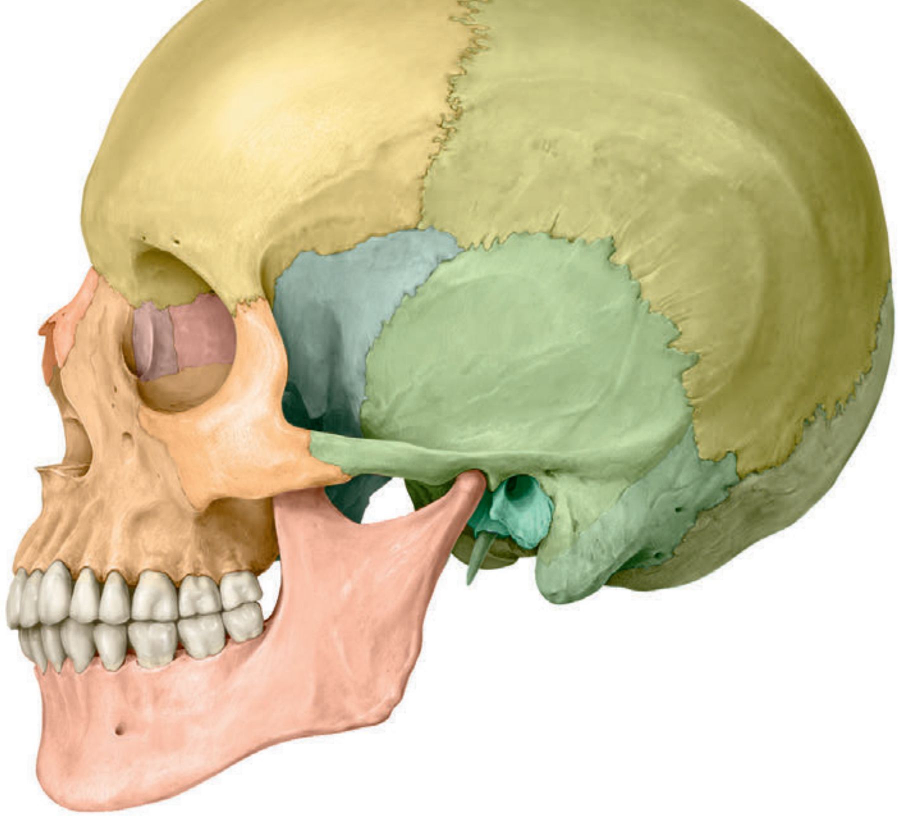
Eric W. Baker



Head

1 Embryology of the Head & Neck

2 Ossa Cranii

3 Vasculature & Lymphatics of the Head & Neck

4 Neuroanatomy & Innervation of the Head & Neck

Germ Layers & the Developing Embryo

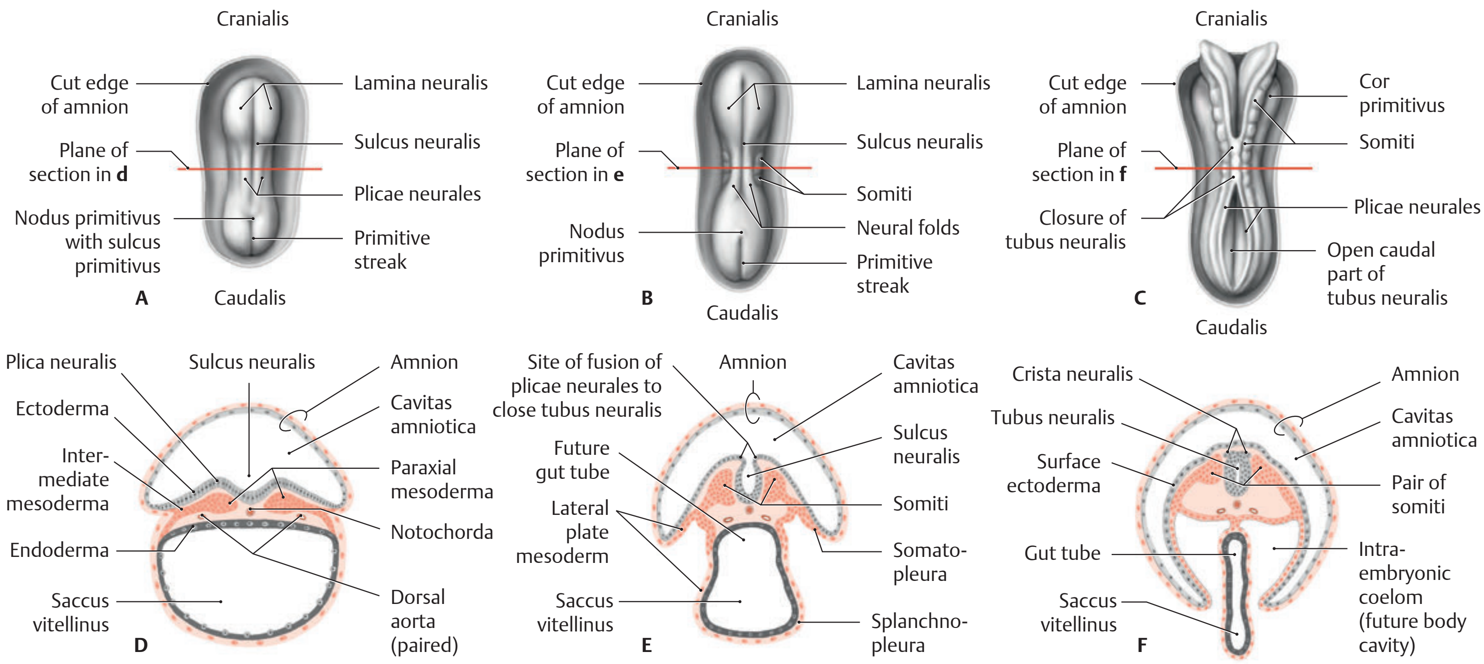


Fig. 1.1 **Embryonic development** (after Sadler)
Age in postovulatory days.
A-C Posterior (dorsal) view after removal of the amnion.
D-E Schematic cross-sections of the corresponding stages at the horizontal planes of section marked in **A** to **C**. Gastrulation occurs in week 3 of human embryonic development. It produces three germ layers in the discus embryonicus: ectoderma (light grey), mesoderma (red), and endoderma (dark grey).
A, D Day 19, the three layers are visible in the discus embryonicus. The amnion forms the cavitas amniotica dorsally and the endoderma encloses the saccus vitellinus. The tubus neuralis is developing in the area of the lamina neuralis.
B, E Day 20, the first somiti have formed, and the sulcus neuralis is beginning to close to form the tubus neuralis, with initial folding of the embryo.
C, F Day 22, eight pairs of somiti flank the partially closed tubus neuralis, which has sunk below the ectoderma. The saccus vitellinus elongates ventrally to form the gut tube and saccus vitellinus. At the sites where the plicae neurales fuse to close the tubus neuralis, cells form a bilateral crista neuralis that detaches from the surface and migrates into the mesoderma.

Table 1.1 **Differentiation of germ layers**

Germ layer	Embryonic structure		Adult derivative
Ectoderma	Tubus neuralis		Encephalon, retina, medulla spinalis
	Crista neuralis	Crista neuralis of the head	Sensory and parasympathetic ganglia, enteric nervous system, parafollicular cells, smooth muscle, pigment cells, globus caroticus, cartilage, connective tissue, dentinum and cementum of the dentes, dermis and tela subcutanea of the caput
		Crista neuralis of the trunk	Sensory and autonomic ganglia, peripheral glia, medulla glandulae suprarenalis, pigment cells, intramural plexuses
	Surface ectoderma	Placodae	Adenohypophysis, cranial sensory ganglia, olfactory epithelium, auris interna, lens
			Epithelium of the cavitas oris, glandulae salivariae, cavitates nasi, sinus paranasales, lacrimal passages, meatus acusticus externus, epidermis, hair, nails, cutaneous glands
Mesoderma	Paraxial	Somiti	Corium of skin (from dermatome), musculature (from myotome), columna vertebralis (from sclerotome)
	Axial	Notochorda	Musculi externi bulbi oculi
	Intermediate		Renes, gonads, renal and genital excretory ducts
	Lateral plates	Visceral	Cor, blood vessels, smooth muscle, bowel wall, blood, cortex glandulae suprarenalis, visceral serosa
		Parietal	Sternum, limbs without muscles, dermis and tela subcutanea of the anterolateral body wall, smooth muscle, connective tissue, parietal serosa
Endoderma	Intestinal tube		Epithelium of the bowel, respiratory tract, digestive glands, glandulae pharyngeae, tuba auditiva, cavitas tympani, vesica urinaria, glandulae parathyroideae, glandula thyroidea

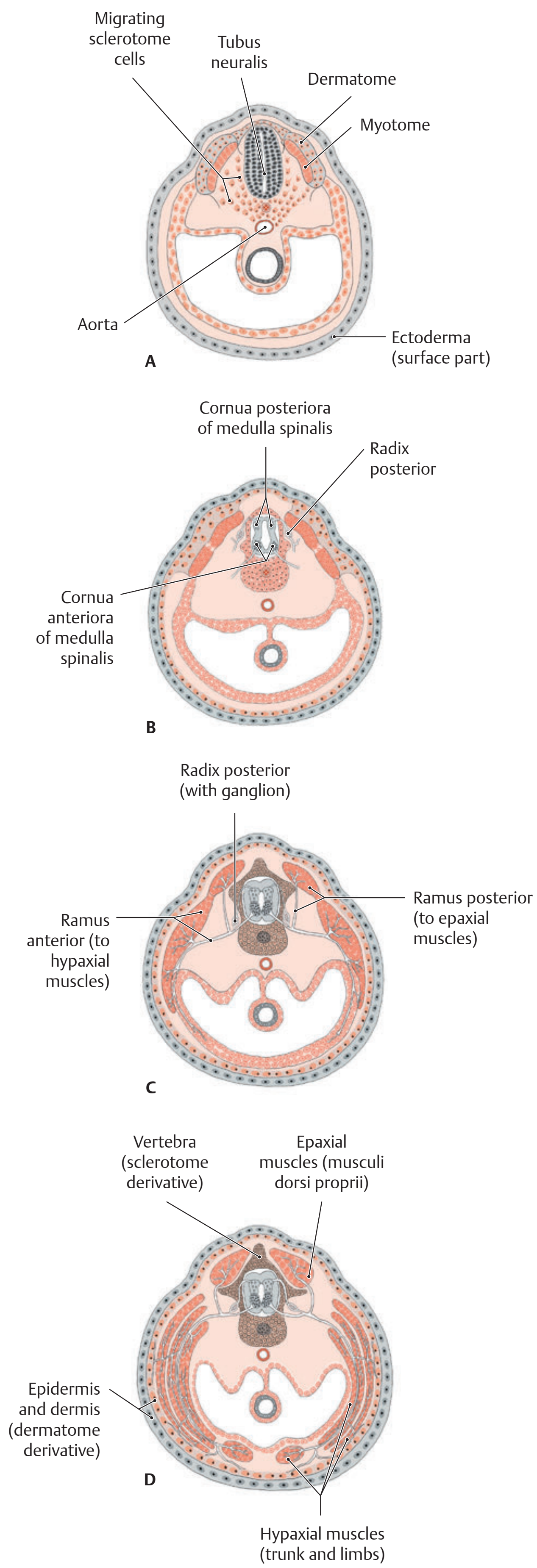


Fig. 1.2 **Somatic muscle development**
Age in postovulatory days. Each somitus divides into a dermatome (cutaneous), myotome (muscular), and sclerotome (vertebral) at around day 22 (see Fig 1.1).
A Day 28, sclerotomes migrate to form the columna vertebralis around the notochorda (primitive medulla spinalis).
B Day 30, all 34 or 35 somitus pairs have formed. The tubus neuralis differentiates into a primitive medulla spinalis. Motor and sensory neurons differentiate in the cornua anterius and posterius of the medulla spinalis, respectively.
C By day 40, the radices posterior and anterior form the mixed nervus spinalis. The ramus posterior supplies the epiaxial muscles (future musculi dorsi proprii); the ramus anterior supplies the hypaxial muscles (anterior muscles, including all muscles except the musculi dorsi proprii).
D Week 8, the epiaxial and hypaxial muscles have differentiated into the skeletal muscles of the trunk. Cells from the sclerotomes also migrate into the limbs. During this migration, the nervi spinales form the plexus (cervicalis, brachialis, and lumbosacralis), which innervate the muscles of the neck, upper limb, and lower limb, respectively.

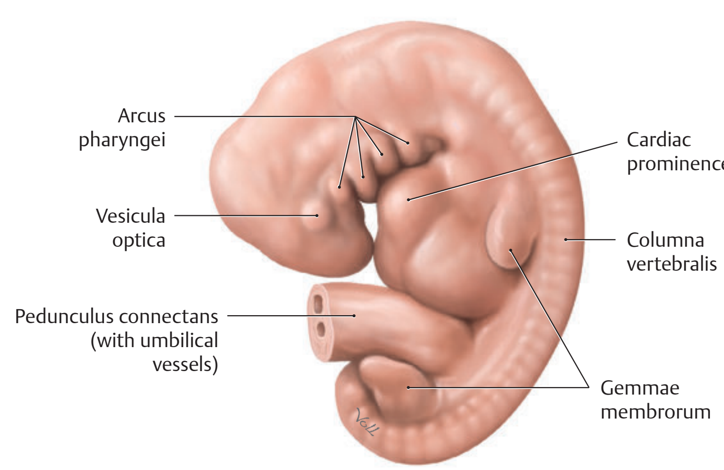


Fig. 1.3 **5-week-old embryo**
The human embryo at 5 weeks has a crown-rump length of approximately 5 to 7 mm. The funiculus umbilicus, which attaches the embryo to the mother, is seen. The future hemispheria cerebri form along with the oculus, auris, arcus pharyngei (which form a large portion of the structures of the caput and collum), cor (which will start beating at around week 6), tubus neuralis, and gemmae membrorum.

Development of the Encephalon & Medulla Spinalis

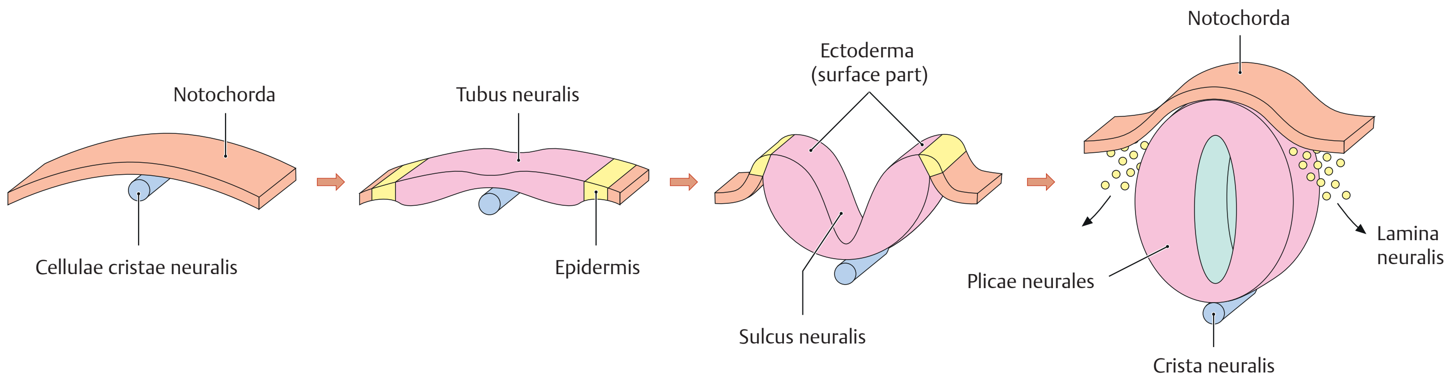


Fig. 1.4 **Development of the tubus neuralis and crista neuralis** (after Wolpert)

The tissues of the nervous system orginate embryonically from the posterior surface ectoderma. The notochorda in the midline of the body induces the formation of the lamina neuralis, which lies above the notochorda, and of the cristae neurales, which are lateral to the notochorda. With further development, the lamina neuralis deepens at the center to form the sulcus neuralis, which is flanked on each side by the plicae neurales. Later the sulcus deepens and closes to form the tubus neuralis, which sinks below the ectoderma. The tubus neuralis is the structure from which the systema nervosum centrale (CNS) – the brain and medulla spinalis–develops (further development of the medulla spinalis is shown in **Fig. 1.5**, further encephalon development in **Fig. 1.7**). Failure of the sulcus neuralis to close completely will leave an anomalous cleft in the columna vertebralis, known as spina bifida. The administration of folic acid to potential mothers around the time of conception can reduce the incidence of spina bifida by 70%. Cells that migrate from the crista neuralis develop into various structures, including cells of the systema nervosum periphericum (PNS), such as Schwann cells, and the pseudounipolar cells of the ganglion sensorium nervi spinalis (see **Fig. 1.6**).

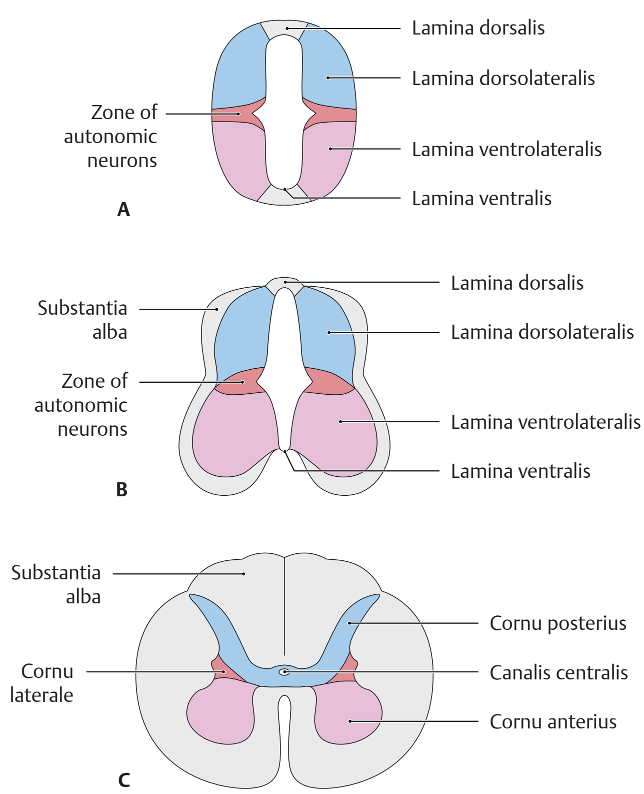


Fig. 1.5 **Differentiation of the tubus neuralis in the medulla spinalis during development**

Cross-section, superior view.

A Early tubus neuralis. **B** Intermediate stage. **C** Adult medulla spinalis. The neurons that form the lamina ventrolateralis are efferent (motor neurons), while the neurons that form the lamina dorsolateralis are afferent (sensory neurons). In the future thoracic, lumbar, and sacral medulla spinalis, there is another zone between them that gives rise to sympathetic (autonomic) efferent neurons. The lamina dorsalis and the lamina ventralis do not form neurons.

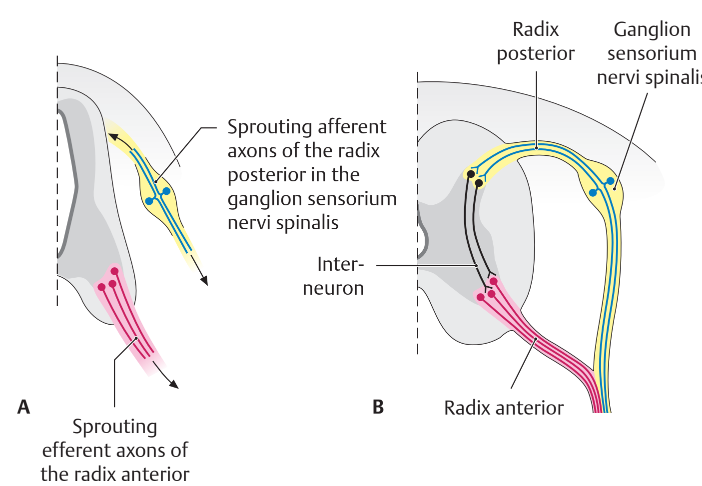


Fig. 1.6 **Development of a peripheral nerve**

Afferent (sensory) axons (blue) and efferent (motor) axons (red) sprout from the neuronal cell bodies during early embryonic development.

A Primary afferent neurons develop in the ganglion sensorium nervi spinalis, and alpha motor neurons develop from the lamina ventrolateralis of the medulla spinalis.

B The interneurons (black), which functionally interconnect the afferent and efferent neurons, develop at a later stage.

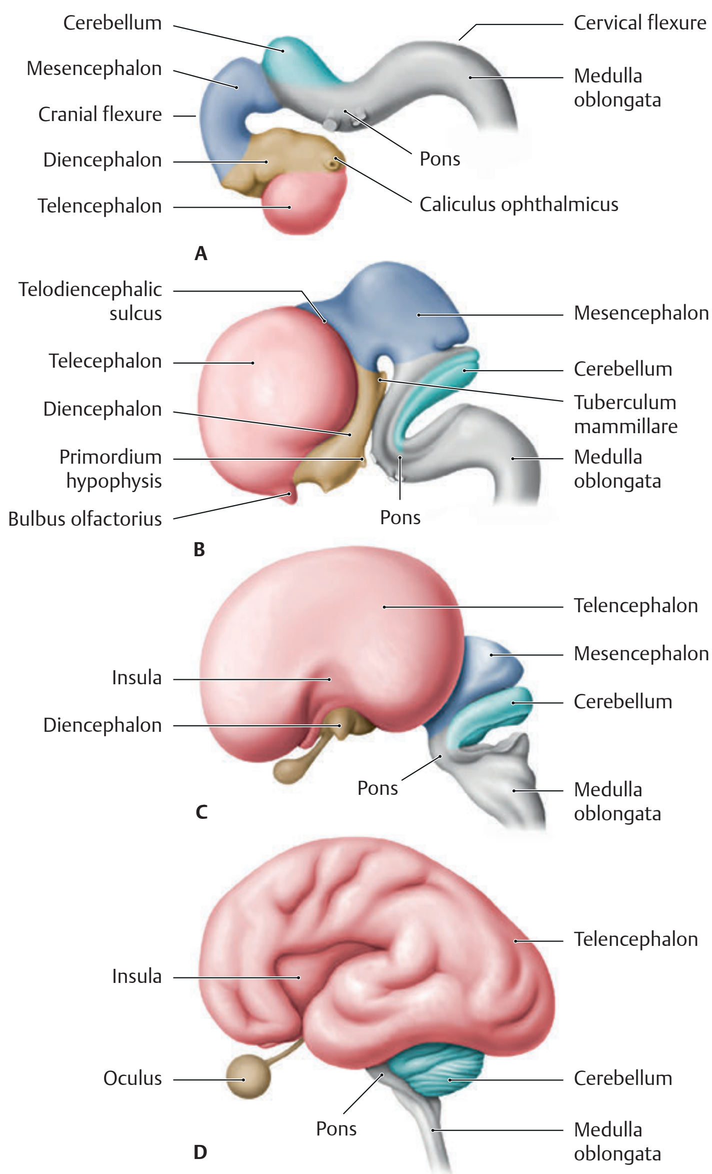


Fig. 1.7 **Development of the encephalon**

A Embryo with the greatest length (GL) of 10 mm at the beginning of the 2nd month of development. Even at this stage, we can see the differentiation of the tubus neuralis into segments that will generate various brain regions.

- Red: telencephalon (cerebrum)
- Yellow: diencephalon
- Dark blue: mesencephalon (midbrain)
- Light blue: cerebellum
- Gray: pons and medulla oblongata

Note: The telencephalon outgrows all of the other brain structures as development proceeds.

B Embryo with a GL of 27 mm near the end of the 2nd month of development (end of the embryonic period). The telencephalon and the diencephalon have enlarged. The bulbus olfactorius is developing from the telencephalon, and the primordium of the hypophysis is developing from the diencephalon.

C Fetus with a GL of 53 mm in approximately the 3rd month of development. By this stage the telencephalon has begun to cover the other brain areas. The insula is still on the brain surface but will subsequently be covered by the hemispheria (compare with **D**).

D Fetus with GL of 27 cm (270 mm) in approximately the 7th month of development. The cerebrum (telencephalon) has begun to develop well-defined gyri and sulci.

Table 1.2 **Development of the encephalon**

Primary vesicle		**Region**		**Structure**
Tubus neuralis	Prosencephalon (forebrain)	Telencephalon		Cortex cerebri, substantia alba, nuclei basales
		Diencephalon		Epithalamus (pineal gland), dorsal thalamus, subthalamus, hypothalamus
	Mesencephalon (midbrain)*			Tectum, tegmentum mesencephali, pedunculus cerebri
	Rhombencephalon (hindbrain)	Metencephalon	Cerebellum	Cortex cerebelli, nuclei, pedunculi cerebellares
			Pons*	Nuclei, fiber tracts
		Myelencephalon	Medulla oblongata*	

*The mesencephalon, pons, and medulla oblongata are collectively known as the truncus encephali.