

# THIEME

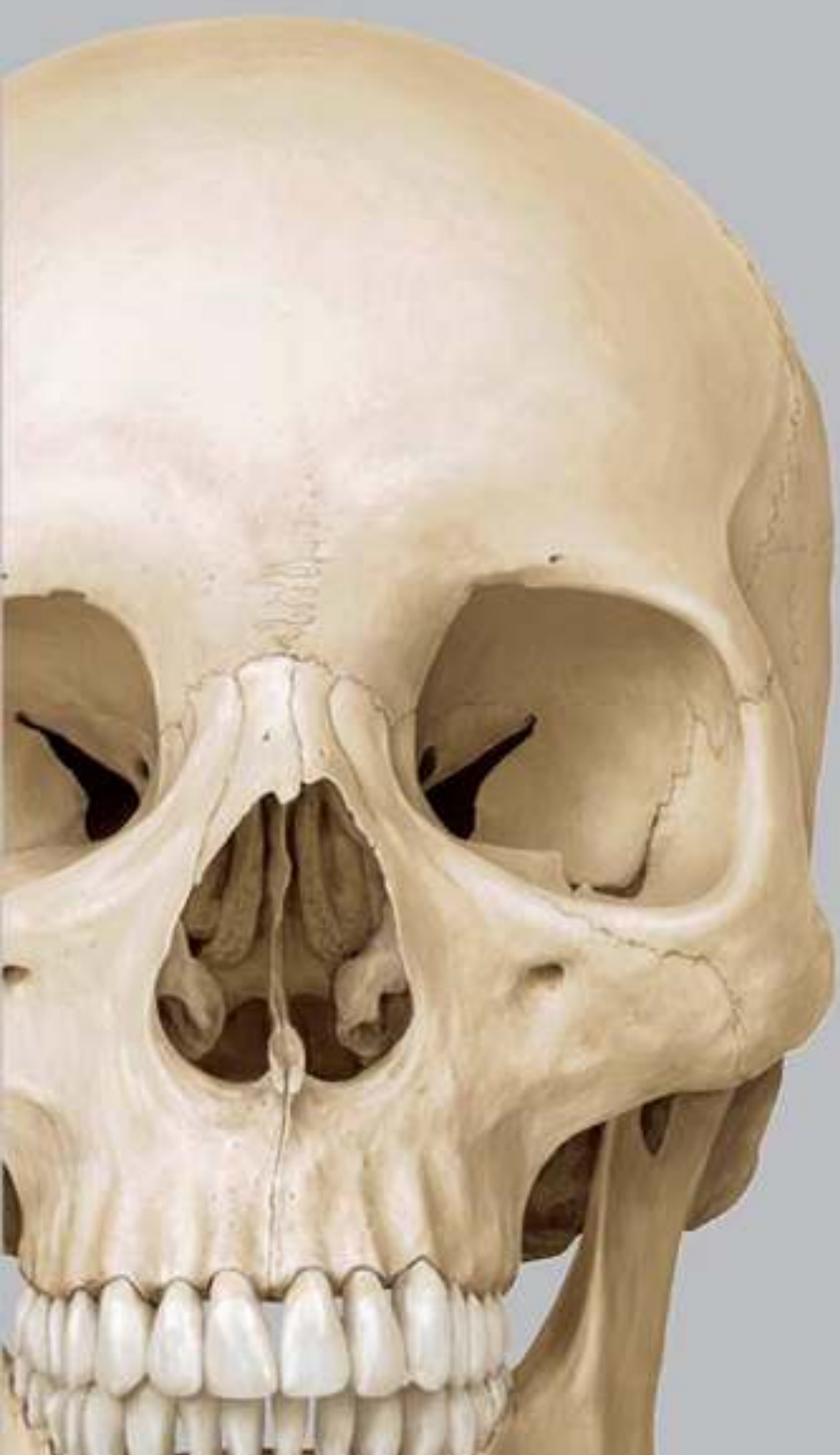
# Atlas of Anatomy

## Head and Neuroanatomy

Michael Schuenke  
Erik Schulte  
Udo Schumacher

Consulting Editors  
Lawrence M. Ross  
Edward D. Lamberth  
Ethan Taub

Illustrations by  
Markus Voll  
Karl Wesker







---

Head  
and Neuroanatomy

# THIEME

## Atlas of Anatomy

### Consulting Editors

Lawrence M. Ross, M.D., Ph.D.,  
Department of Neurobiology and Anatomy  
University of Texas Medical School at Houston

Edward D. Lamperti, Ph.D.,  
Immune Disease Institute and  
Harvard Medical School

Ethan Taub, M.D.  
Neurosurgery Department University Hospital, Basel

### Authors

Michael Schuenke, M.D., Ph.D.,  
Institute of Anatomy Christian Albrecht University Kiel

Erik Schulte, M.D.,  
Department of Anatomy and Cell Biology  
Johannes Gutenberg University

Udo Schumacher, M.D.,  
FRCPath, CBiol, FIBiol, DSc,  
Institute of Anatomy II: Experimental Morphology  
Center for Experimental Medicine  
University Medical Center Hamburg-Eppendorf

In collaboration with Juergen Rude

### Illustrations by

Markus Voll

Karl Wesker

1182 Illustrations

72 Tables

Thieme  
Stuttgart · New York



---

# Foreword

Our enthusiasm for the THIEME Atlas of Anatomy began when each of us, independently, saw preliminary material from this Atlas. We were immediately captivated by the new approach, the conceptual organization, and by the stunning quality and detail of the images of the Atlas. We were delighted when the editors at Thieme offered us the opportunity to cooperate with them in making this outstanding resource available to our students and colleagues in North America.

As consulting editors we were asked to review, for accuracy, the English edition of the THIEME Atlas of Anatomy. Our work involved a conversion of nomenclature to terms in common usage and some organizational changes to reflect pedagogical approaches in anatomy programs in North America. In all of this, we have tried diligently to remain faithful to the intentions and insights of the original authors.

We would like to thank the team at Thieme Medical Publishers who worked with us. Heartfelt thanks go first to Kelly Wright, Developmental Editor, and Cathrin E. Schulz, M.D., Executive Editor, for her assistance and checking and correcting our work and for their constant encouragement and availability. We are also grateful to Bridget Queenan, Developmental Editor, who provided a uniquely thorough, thoughtful, and cooperative approach from the moment she entered the process in the editing of this volume.

We would also like to extend our heartfelt thanks to Stefanie Langner, Production Manager, for preparing this volume with care and speed.

Lawrence M. Ross,  
Edward D. Lamperti  
Ethan Taub

# Preface

As it started planning this Atlas, the publisher sought out the opinions and needs of students and lecturers in both the United States and Europe. The goal was to find out what the “ideal” atlas of anatomy should be—ideal for students wanting to learn from the atlas, master the extensive amounts of information while on a busy class schedule, and, in the process, acquire sound, up-to-date knowledge. The result of this work is this Atlas. The THIEME Atlas of Anatomy, unlike most other atlases, is a comprehensive educational tool that combines illustrations with explanatory text and summarizing tables, introducing clinical applications throughout, and presenting anatomical concepts in a step-by-step sequence that allows for the integration of both system-by-system and topographical views.

Since the THIEME Atlas of Anatomy is based on a fresh approach to the underlying subject matter itself, it was necessary to create for it an entirely new set of illustrations—a task that took eight years. Our goal was to provide illustrations that would compellingly demonstrate anatomical relations and concepts, revealing the underlying simplicity of the logic and order of human anatomy without sacrificing detail or aesthetics.

With the THIEME Atlas of Anatomy, it was our intention to create an atlas that would guide students in their initial study of anatomy, stimulate their enthusiasm for this intriguing and vitally important subject, and provide a reliable reference for experienced students and professionals alike.

*“If you want to attain the possible, you must attempt the impossible”*  
(Rabindranath Tagore).

Michael Schünke, Erik Schulte, Udo Schumacher,  
Markus Voll, and Karl Wesker



---

# Acknowledgments

We are grateful to Antje Bühl, who was there from the beginning as project assistant, working “behind the scenes” on numerous tasks such as repeated proofreading and helping to arrange the figure labels.

We owe a great debt of thanks to Martin Spencker, Managing Director of Educational Publications at Thieme, especially to his ability to make quick and unconventional decisions when dealing with problems and uncertainties. His openness to all the concerns of the authors and artists established conditions for a cooperative partnership.

Without exception, our collaboration with the entire staff at Thieme Medical Publishers was consistently pleasant and cordial. Unfortunately, we do not have room to list everyone who helped in the publication of this atlas, and we must limit our acknowledgments to a few colleagues who made a particularly notable contribution: Rainer Zepf and Martin Waletzko for support in all technical matters; Susanne Tochtermann, Wenzel and Manfred Lehnert, representing all those who were involved in the production of the book; Almut Leopold for the Index; Marie-Luise Kürschner and her team for creating the cover design; to Birgit Carlsen and Anne Döbler, representing all those who handled marketing, sales and promotion.

The Authors



---

**To access additional material or resources available with this e-book, please visit <http://www.thieme.com/bonuscontent>. After completing a short form to verify your e-book purchase, you will be provided with the instructions and access codes necessary to retrieve any bonus content.**

# Table of Contents

## Head

### 1 Cranial Bones

1.1	Skull, Lateral View	2
1.2	Skull, Anterior View	4
1.3	Skull, Posterior View and Cranial Sutures	6
1.4	Exterior and Interior of the Calvaria	8
1.5	Base of the Skull, External View	10
1.6	Base of the Skull, Internal View	12
1.7	Orbit: Bones and Openings for Neurovascular Structures	14
1.8	Orbit and Neighboring Structures	16
1.9	Nose: Nasal Skeleton	18
1.10	Nose: Paranasal Sinuses	20
1.11	Temporal Bone	22
1.12	Sphenoid Bone	24
1.13	Occipital Bone and Ethmoid Bones	26
1.14	Hard Palate	28
1.15	Mandible and Hyoid Bone	30
1.16	Temporomandibular Joint	32
1.17	Temporomandibular Joint, Biomechanics	34
1.18	The Teeth in situ	36
1.19	Permanent Teeth and the Dental Panoramic Tomogram	38
1.20	Individual Teeth	40
1.21	Deciduous Teeth	42

### 2 Muscles of the Head

2.1	Muscles of Facial Expression, Overview	44
2.2	Muscles of Facial Expression, Actions	46
2.3	Muscles of Mastication, Overview and Superficial Muscles	48
2.4	Muscles of Mastication, Deep Muscles	50
2.5	Muscles of the Head, Origins and Insertions	52

### 3 Blood Vessels of the Head and Neck

3.1	Arteries of the Head, Overview and External Carotid Artery	54
3.2	External Carotid Artery: Anterior, Medial, and Posterior Branches	56
3.3	External Carotid Artery: Terminal Branches	58
3.4	Internal Carotid Artery: Branches to Extracerebral Structures	60
3.5	Veins of the Head and Neck: Superficial Veins	62
3.6	Veins of the Head and Neck: Deep Veins	64

### 4 Cranial Nerves

4.1	Overview of the Cranial Nerves	66
4.2	Cranial Nerves: Brainstem Nuclei and Peripheral Ganglia	68
4.3	Cranial Nerves: Olfactory (CN I) and Optic (CN II)	70
4.4	Cranial Nerves of the Extraocular Muscles: Oculomotor (CN III), Trochlear (CN IV), and Abducent (CN VI)	72
4.5	Cranial Nerves: Trigeminal (CN V), Nuclei and Distribution	74
4.6	Cranial Nerves: Trigeminal (CN V), Divisions	76
4.7	Cranial Nerves: Facial (CN VII), Nuclei and Distribution	78
4.8	Cranial Nerves: Facial (CN VII), Branches	80
4.9	Cranial Nerves: Vestibulocochlear (CN VIII)	82
4.10	Cranial Nerves: Glossopharyngeal (CN IX)	84
4.11	Cranial Nerves: Vagus (CN X)	86
4.12	Cranial Nerves: Accessory (CN XI) and Hypoglossal (CN XII)	88
4.13	Neurovascular Pathways through the Base of the Skull, Synopsis	90

### 5 Topographical Anatomy

5.1	Face: Nerves and Vessels	92
5.2	Head, Lateral View: Superficial Layer	94
5.3	Head, Lateral View: Middle and Deep Layers	96
5.4	Infratemporal Fossa	98
5.5	Pterygopalatine Fossa	100

### 6 Oral Cavity

6.1	Oral Cavity, Overview	102
6.2	Tongue: Muscles and Mucosa	104
6.3	Tongue: Neurovascular Structures and Lymphatic Drainage	106
6.4	Oral Floor	108
6.5	Oral Cavity: Pharynx and Tonsils	110
6.6	Salivary Glands	112

### 7 Nose

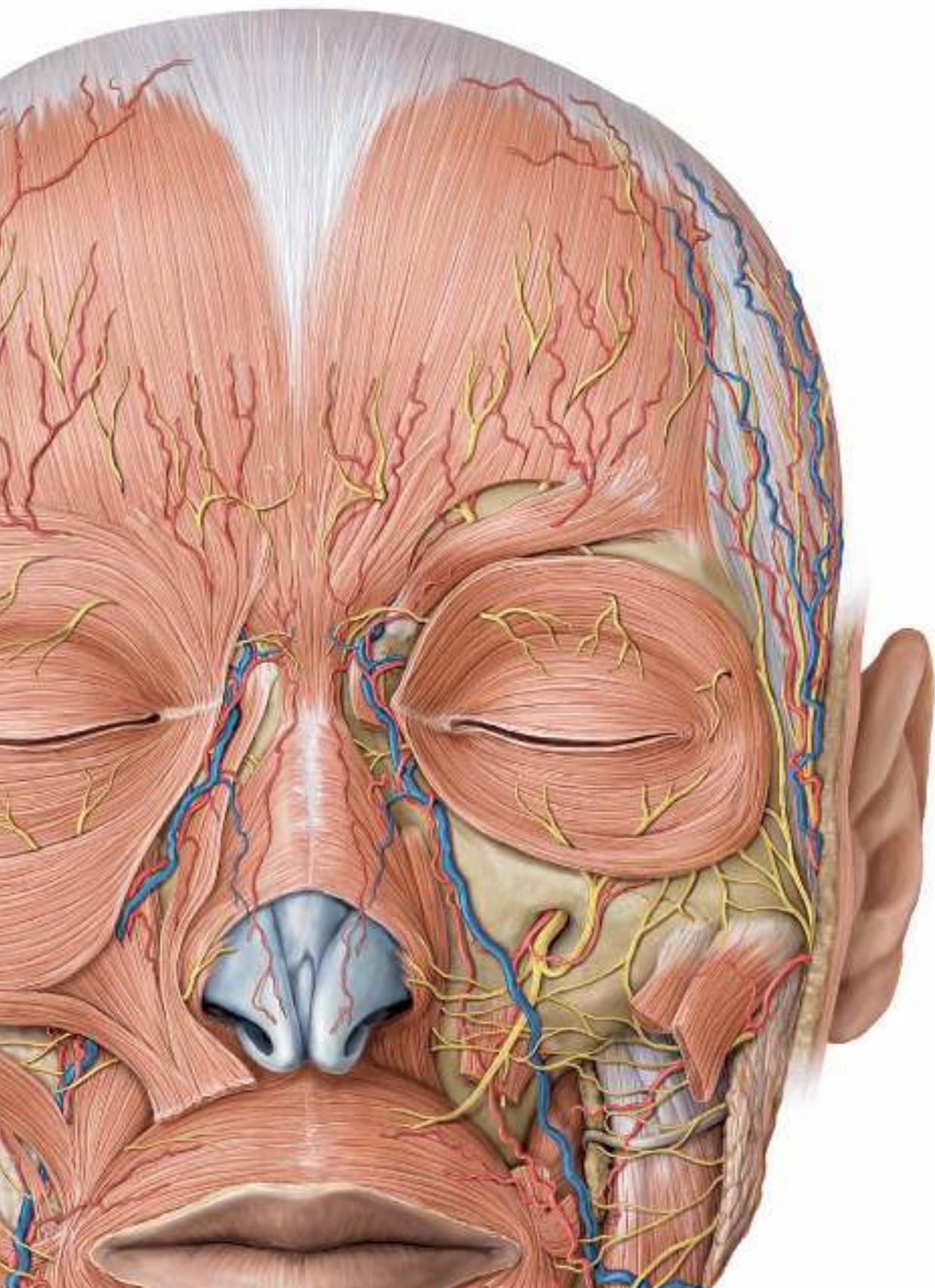
7.1	Nose, Overview	114
7.2	Nasal Cavity: Neurovascular Supply	116
7.3	Nose and Paranasal Sinuses, Histology and Clinical Anatomy	118









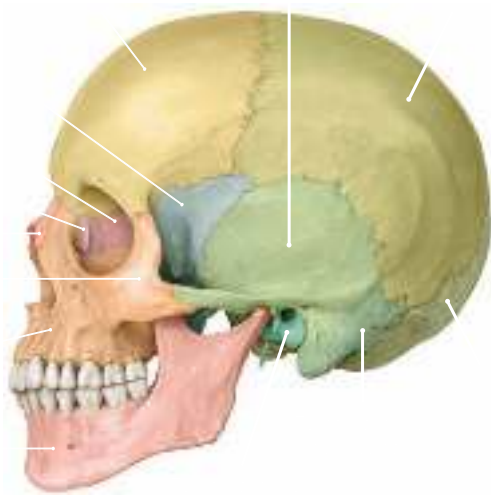






## 1.1 Skull, Lateral View





**B Lateral view of the cranial bones**

Left lateral view. The bones are shown in different colors to demonstrate more clearly their extents and boundaries.



**C Bones of the neurocranium (gray) and viscerocranium (orange)**

Left lateral view. The skull forms a bony capsule that encloses the brain, sensory organs, and viscera of the head. The greater size of the neurocranium (cranial vault) relative to the viscerocranium (facial skeleton) is a typical primate feature directly correlated with the larger primate brain.



**D Ossification of the cranial bones**

Left lateral view. The bones of the skull either develop directly from mesenchymal connective tissue (intramembranous ossification, gray) or form indirectly by the ossification of a cartilaginous model (enchondral ossification, blue). Elements derived from intramembranous and endochondral ossification (desmocranium, chondrocranium) may fuse together to form a single bone (e.g., the occipital bone, temporal bone, and sphenoid bone).

The clavicle is the only tubular bone that undergoes membranous ossification. This explains why congenital defects of *intramembranous* ossification affect both the skull and clavicle (*cleidocranial dysostosis*).

**E Bones of the neurocranium and viscerocranium**

Neurocranium (gray)	Viscerocranium (orange)

**F Bones of the desmocranium and chondrocranium**

Desmocranium (gray)	Chondrocranium (blue)

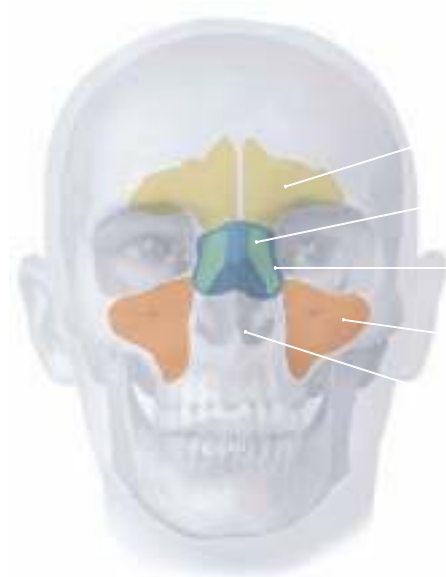
## 1.2 Skull, Anterior View



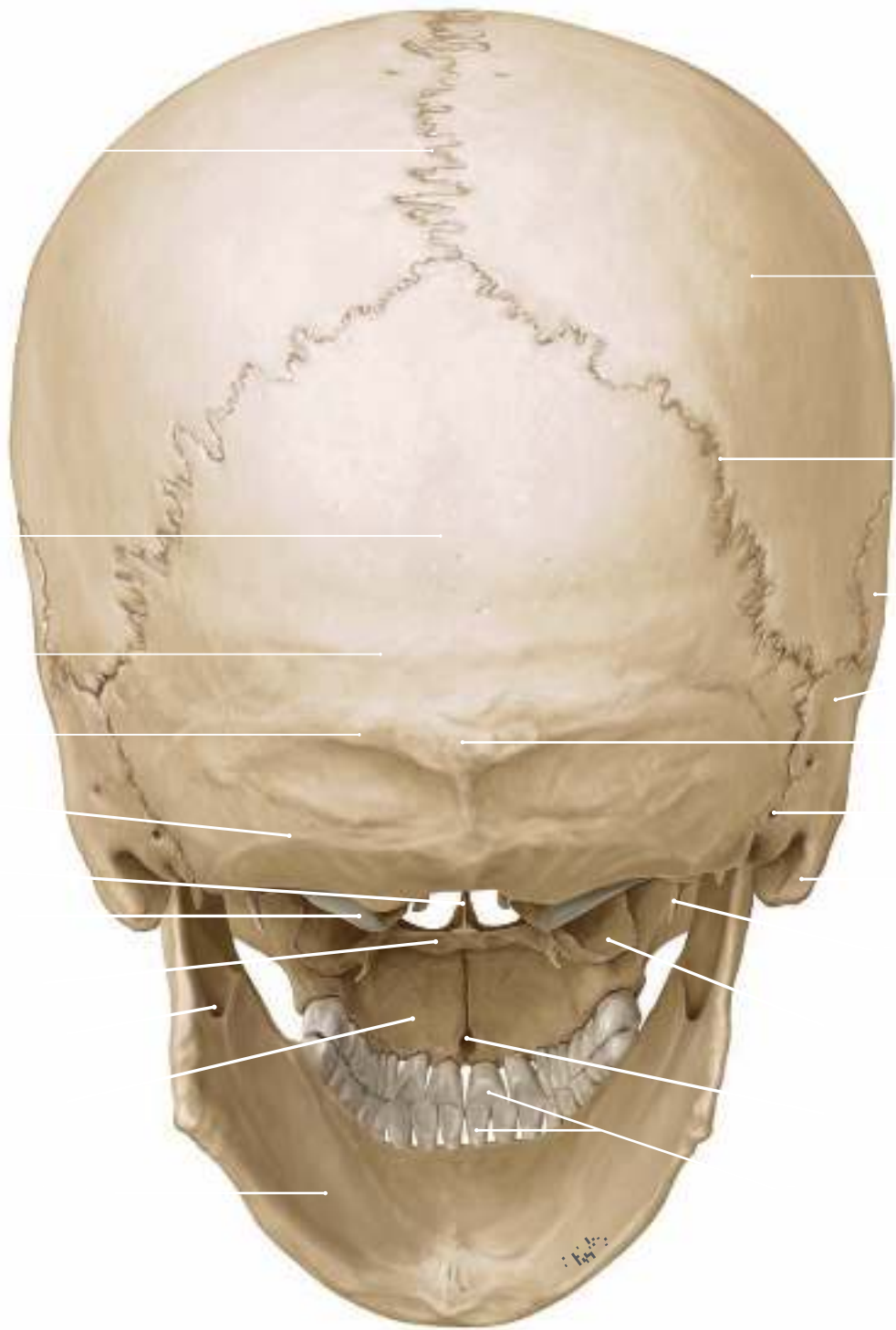
### A Anterior view of the skull

The boundaries of the facial skeleton (viscerocranium) can be clearly appreciated in this view (the individual bones are shown in **B**). The bony margins of the anterior nasal aperture mark the start of the respiratory tract in the skull. The nasal cavity, like the orbits, contains a sensory organ

(the olfactory mucosa). The *paranasal sinuses* are shown schematically in **C**. The anterior view of the skull also displays the three clinically important openings through which sensory nerves pass to supply the face: the supraorbital foramen, infraorbital foramen, and mental foramen (see pp. 77 and 93).



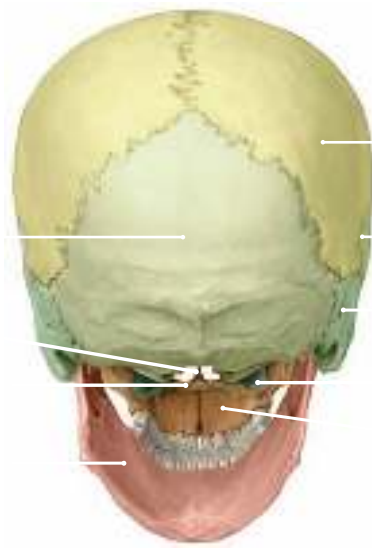
### 1.3 Skull, Posterior View and Cranial Sutures



**A Posterior view of the skull**

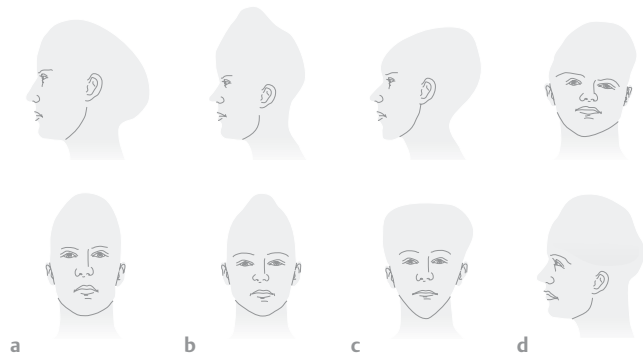
The occipital bone, which is dominant in this view, articulates with the parietal bones, to which it is connected by the lambdoid suture. The cranial sutures are a special type of syndesmosis (= ligamentous attach-

ments that ossify with age, see F). The outer surface of the occipital bone is contoured by muscular origins and insertions: the inferior, superior, and supreme nuchal lines.



**B Posterior view of the cranial bones**

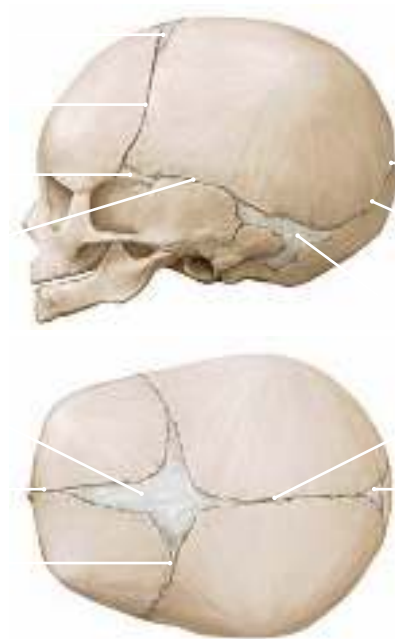
Note: The temporal bone consists of two main parts based on its embryonic development: a squamous part and a petrous part (see p. 22).



**D Cranial deformities due to the premature closure of cranial sutures**

The premature closure of a cranial suture (craniosynostosis) may lead to characteristic cranial deformities. The following sutures may close prematurely, resulting in various cranial shapes:

- a Sagittal suture: scaphocephaly (long, narrow skull)
- b Coronal suture: oxycephaly (pointed skull)
- c Frontal suture: trigonocephaly (triangular skull)
- d Asymmetrical suture closure, usually involving the coronal suture: plagiocephaly (asymmetrical skull)



**C The neonatal skull**

a Left lateral view, b superior view.

The flat cranial bones must grow as the brain expands, and so the sutures between them must remain open for some time (see F). In the neonate, there are areas between the still-growing cranial bones that are not occupied by bone: the fontanelles. They close at different times (the sphenoid fontanelle in about the 6th month of life, the mastoid fontanelle in the 18th month, the anterior fontanelle in the 36th month). The *posterior fontanelle* provides a reference point for describing the position of the fetal head during childbirth, and the *anterior fontanelle* provides a possible access site for drawing a cerebrospinal fluid sample in infants (e.g., in suspected meningitis).



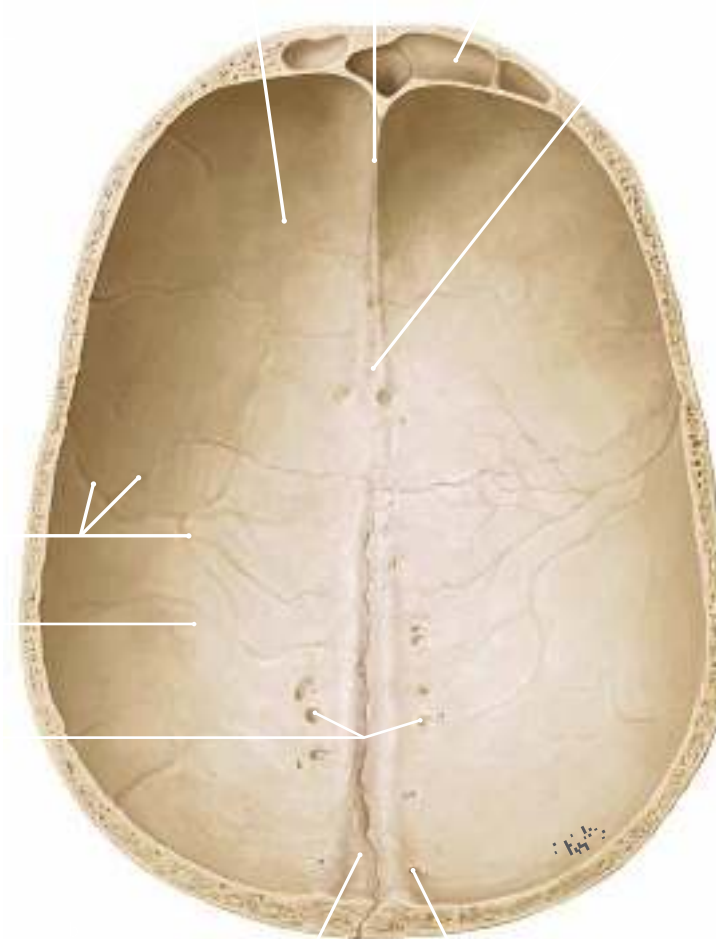
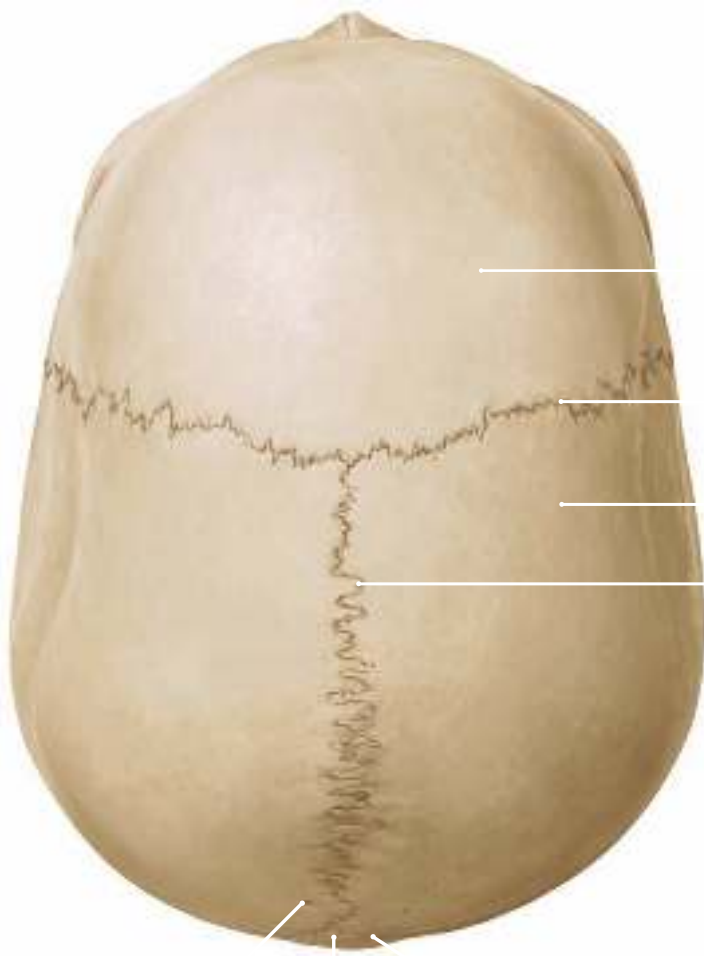
**E Hydrocephalus and microcephaly**

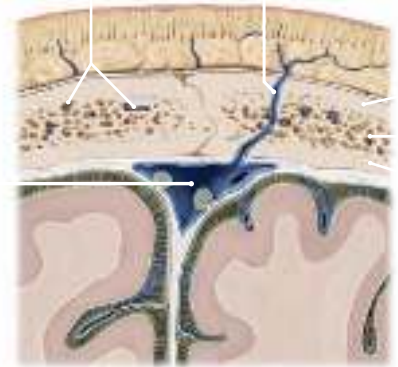
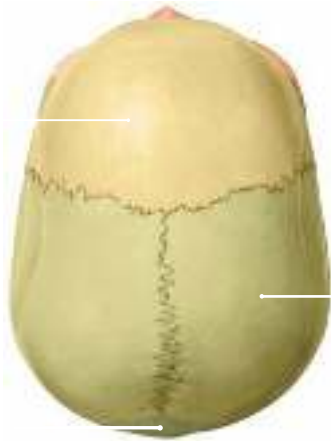
- a Characteristic cranial morphology in *hydrocephalus*. When the brain becomes dilated due to cerebrospinal fluid accumulation *before* the cranial sutures ossify (hydrocephalus, “water on the brain”), the neurocranium will expand while the facial skeleton remains unchanged.
- b *Microcephaly* results from premature closure of the cranial sutures. It is characterized by a small neurocranium with relatively large orbits.

**F Age at which the principal sutures ossify**

Suture	Age at ossification

## 1.4 Exterior and Interior of the Calvaria







---

sample content of Head and Neuroanatomy (THIEME Atlas of Anatomy) (THIEME Atlas of Anatomy Series)

- [download C++ For Game Programmers \(Game Development Series\) \(1st Edition\)](#)
- [read Florence & Tuscany 2015 for free](#)
- [\*\*download online Utamaro \(Temporis Collection\) for free\*\*](#)
- [\*Angel Wars: Light vs. Dark for free\*](#)
  
- <http://reseauplatoparis.com/library/The-Dragon-Men--Clockwork-Empire--Book-3-.pdf>
- <http://honareavalmusic.com/?books/The-Memory-Trap.pdf>
- <http://aneventshop.com/ebooks/Utamaro--Temporis-Collection-.pdf>
- <http://www.shreesaiexport.com/library/The-Epic-of-Gilgamesh--Penguin-Classics-.pdf>