

Rhoton's Atlas of Head, Neck, and Brain

2D and 3D Images

plus e-content

Maria Peris-Celda
Francisco Martinez-Soriano
Albert L. Rhoton, Jr.



 MediaCenter.thieme.com
plus e-content online

 Thieme

Visualize the images in 3D online at [MediaCenter.Thieme.com](https://www.thieme.com/MediaCenter)!

Simply visit [MediaCenter.Thieme.com](https://www.thieme.com/MediaCenter) and, when prompted during the registration process, enter the code below to get started today.

K234-WQ26-3GD2-24KH



Rhoton's Atlas of Head, Neck, and Brain

2D and 3D Images

Maria Peris-Celda, MD, PhD

Neurosurgeon
Department of Neurosurgery
Albany Medical Center
Albany, New York

Francisco Martinez-Soriano, MD, PhD

Professor and Chairman Emeritus
Department of Human Anatomy and Embryology
University of Valencia
Valencia, Spain

Albert L. Rhoton, Jr., MD[†]

R.D. Keene Family Professor and Chairman Emeritus
Department of Neurosurgery
University of Florida College of Medicine
Gainesville, Florida

Anatomical Labeling:

Alfonso Amador Valverde, MD, PhD

Associate Professor
Department of Human Anatomy and Embryology
University of Valencia
Valencia, Spain

Vicent Teruel Martí, PhD

Associate Professor
Department of Human Anatomy and Embryology
University of Valencia
Valencia, Spain

Anatomical Dissections:

Performed at the Microsurgery and Endoscopic Neurosurgical Laboratory
Department of Neurosurgery, University of Florida College of Medicine, Gainesville, Florida

With 624 Figures

Thieme

New York • Stuttgart • Delhi • Rio de Janeiro

Executive Editor: Timothy Hiscock
Managing Editor: Elizabeth Palumbo
Director, Editorial Services: Mary Jo Casey
Editorial Assistant: Keith Palumbo
Production Editors: Naamah Schwartz, Barbara Chernow
International Production Director: Andreas Schabert
Editorial Director: Sue Hodgson
International Marketing Director: Fiona Henderson
International Sales Director: Louisa Turrell
Director of Institutional Sales: Adam Bernacki
Senior Vice President and Chief Operating Officer: Sarah Vanderbilt
President: Brian D. Scanlan
Typesetting by Carol Pierson, Chernow Editorial Services, Inc.

Cover: Head and Neck Anatomy, lateral view by Maria Peris-Celda, MD PhD

Library of Congress Cataloging-in-Publication Data

Names: Peris-Celda, Maria, author. | Martinez-Soriano, Francisco, author. | Rhoton, Albert L., 1932–2016, author.
Title: Rhoton's atlas of head, neck, and brain : 2d and 3d images / Maria Peris-Celda, Francisco Martinez-Soriano, Albert L. Rhoton, Jr. ; anatomical labeling, Alfonso Amador Valverde, Vicent Teruel Marti.
Other titles: Dissection atlas of head, neck, and brain
Description: New York, NY : Thieme Medical Publishers, Inc., [2018] | Includes bibliographical references and index.
Identifiers: LCCN 2017035765 | ISBN 9781604069006 (alk. paper) | ISBN 9781604069013 (eISBN)
Subjects: | MESH: Head—anatomy & histology | Neck—anatomy & histology | Brain—anatomy & histology | Atlases
Classification: LCC QM535 | NLM WE 17 | DDC 612.9/1—dc23
LC record available at <https://lccn.loc.gov/2017035765>

© 2018 Thieme Medical Publishers, Inc.
Thieme Publishers New York
333 Seventh Avenue, New York, NY 10001 USA
+1 800 782 3488, customerservice@thieme.com

Thieme Publishers Stuttgart
Rüdigerstrasse 14, 70469 Stuttgart, Germany
+49 [0]711 8931 421, customerservice@thieme.de

Thieme Publishers Delhi
A-12, Second Floor, Sector-2, Noida-201301
Uttar Pradesh, India
+91 120 45 566 00, customerservice@thieme.in

Thieme Publishers Rio de Janeiro, Thieme Publicações Ltda.
Edifício Rodolpho de Paoli, 25º andar
Av. Nilo Peçanha, 50 – Sala 2508
Rio de Janeiro 20020-906, Brasil
+55 21 3172 2297

Printed in China by Everbest Printing Ltd.

ISBN 978-1-60406-900-6

Also available as an e-book:
eISBN 978-1-60406-901-3

Important note: Medicine is an ever-changing science undergoing continual development. Research and clinical experience are continually expanding our knowledge, in particular our knowledge of proper treatment and drug therapy. Insofar as this book mentions any dosage or application, readers may rest assured that the authors, editors, and publishers have made every effort to ensure that such references are in accordance with **the state of knowledge at the time of production of the book.**

Nevertheless, this does not involve, imply, or express any guarantee or responsibility on the part of the publishers in respect to any dosage instructions and forms of applications stated in the book. **Every user is requested to examine carefully** the manufacturers' leaflets accompanying each drug and to check, if necessary in consultation with a physician or specialist, whether the dosage schedules mentioned therein or the contraindications stated by the manufacturers differ from the statements made in the present book. Such examination is particularly important with drugs that are either rarely used or have been newly released on the market. Every dosage schedule or every form of application used is entirely at the user's own risk and responsibility. The authors and publishers request every user to report to the publishers any discrepancies or inaccuracies noticed. If errors in this work are found after publication, errata will be posted at www.thieme.com on the product description page.

Some of the product names, patents, and registered designs referred to in this book are in fact registered trademarks or proprietary names even though specific reference to this fact is not always made in the text. Therefore, the appearance of a name without designation as proprietary is not to be construed as a representation by the publisher that it is in the public domain.

This book, including all parts thereof, is legally protected by copyright. Any use, exploitation, or commercialization outside the narrow limits set by copyright legislation without the publisher's consent is illegal and liable to prosecution. This applies in particular to photostat reproduction, copying, mimeographing or duplication of any kind, translating, preparation of microfilms, and electronic data processing and storage.

To the memory of our beloved Professor Rhoton, the most brilliant neurosurgeon, greatest mentor, and kindest human being. To Professor Rhoton's family, especially his wife Joyce, for their warm welcome to all the fellows and for their support of our work through the years.

To all the patients around the world who are, were, and will be saved by Professor Rhoton's teachings.

To those who donate their bodies to the study of anatomy and their families for their generous gift to those who benefit from a better study of the anatomy.

To our families for their unconditional support and love.

Maria Peris-Celda and Francisco Martinez-Soriano

Contents

Foreword by Michael J. Link, MD	ix
Preface	xi
Acknowledgments	xiii
Contributors	xv
Orientation Abbreviations	xvii
Part I Osteology of the Head and Neck	
1 Adult and Fetal Skull	3
<i>Maria Peris-Celda</i>	
2 Bones of the Skull and Skull Bone Articulations	20
<i>Maria Peris-Celda and Carolina Martins</i>	
3 Cervical Vertebrae	111
<i>Maria Peris-Celda</i>	
Part II Face and Neck	
4 Face: Superficial Dissection	143
<i>Maria Peris-Celda</i>	
5 Face: Deep Dissection	160
<i>Maria Peris-Celda and Takeshi Funaki</i>	
6 Anterior Aspect of the Neck: Superficial Dissection	177
<i>Maria Peris-Celda</i>	
7 Anterior Aspect of the Neck: Deep Dissection	192
<i>Maria Peris-Celda</i>	
8 Posterior Aspect of the Neck	223
<i>Maria Peris-Celda</i>	
9 Parapharyngeal Dissection	242
<i>Maria Peris-Celda</i>	
Part III Ear, Nose, Pharynx, Larynx, and Orbit	
10 External and Middle Ear	255
<i>Noritaka Komune, Maria Peris-Celda, and Carlos Diogenes Pinheiro-Neto</i>	
11 Internal Ear	264
<i>Fumitaka Yoshioka</i>	
12 Nose: Sagittal Dissection	268
<i>Maria Peris-Celda</i>	
13 Nose: Coronal Dissection	279
<i>Takeshi Funaki</i>	
14 Endonasal Endoscopy	285
<i>Maria Peris-Celda and Rowan Valentine</i>	

15	Pharynx	299
	<i>Maria Peris-Celda</i>	
16	Larynx	308
	<i>Maria Peris-Celda</i>	
17	Orbit	326
	<i>Fumitaka Yoshioka</i>	
18	Eye and Orbital Contents	346
	<i>Maria Peris-Celda</i>	
19	Internal Structure of the Eyeball	355
	<i>Maria Peris-Celda, Carlos Diogenes Pinheiro-Neto, and Edward J. Wladis</i>	
Part IV Neuroanatomy and Cranial Base		
20	Cerebrum	365
	<i>Maria Peris-Celda</i>	
21	Cerebellum and Brainstem	384
	<i>Ken Matsushima and Maria Peris-Celda</i>	
22	Brain, Meninges, and Sutures	394
	<i>Maria Peris-Celda</i>	
23	Cerebrovascular and Intraventricular Dissection	399
	<i>Maria Peris-Celda and Alejandro Monroy-Sosa</i>	
24	Cranial Base and Craniocervical Junction	450
	<i>Fumitaka Yoshioka, Maria Peris-Celda, and Ken Matsushima</i>	
25	Sagittal and Endoscopic Dissection of the Cranial Base	482
	<i>Maria Peris-Celda, Carlos Diogenes Pinheiro-Neto, and Rowan Valentine</i>	
26	Cranial Nerves	494
	<i>Maria Peris-Celda</i>	
27	Brain Sections	511
	<i>Maria Peris-Celda</i>	
28	Fiber Dissection of the Brain	553
	<i>Kaan Yağmurlu</i>	
Index		593

Foreword

Anatomy does not exclude physiology, but physiology certainly presupposes anatomy. The phenomena that the physiologist investigates occur in special organs with quite characteristic anatomical arrangements; the various morphological parts disclosed by the anatomist are the bearers of properties or, if you will, of forces probed by the physiologist; when the physiologist has established a law, whether through physical or chemical investigation, the anatomist can still proudly state: This is the structure in which the law becomes manifest.

– *Rudolf Virchow*¹

The foundation for success in the operating room is based on the understanding of complex anatomical relationships, normal variations that may exist, and how various pathologic entities can alter the normal anatomy, potentially putting vital structures in harm's way. It was Dr. Albert L. Rhoton, Jr.'s life's work and ambition to better understand the complex anatomy that surgeons face in their daily intrusions into the human body and share that knowledge with the greater medical community. One of his driving themes was the simple phrase, displayed prominently in his lab, "Every second." His goal, shared by the many outstanding fellows who labored under his tutelage, was that somewhere in the world, every second of every day, some patient's life was being made better by a surgeon assisted by the anatomic knowledge his lab helped elucidate and distribute. This atlas is one of those crowning achievements.

Dr. Maria Peris-Celda and Professors Francisco Martinez-Soriano and Albert L. Rhoton, Jr., have compiled an incredible collection of detailed, artful dissections of the brain and head and neck. Each figure is meticulously labeled with English and Latin descriptors for easy cross-reference with other resources. Multiple views of the most complex regions of the head and neck are provided to assist in understanding. No layer of anatomy or structure is neglected. The chapters follow a logical progression through the complex anatomy of the brain, head, and neck, and will be an extremely valuable resource for students, trainees, and accomplished practitioners in neurosurgery, neurology, otorhinolaryngology head and neck surgery, oral maxillofacial surgery, and plastic

and reconstructive surgery, to name just a few of the specialties that should take notice of this work.

While actual anatomic dissection is undoubtedly the best way to learn anatomy, Dr. Rhoton certainly understood that anatomical prosections displayed in a 3D format would be essentially equivalent and reach a far greater audience. Thieme has done a remarkable job of formatting the 2D images in a large 11 × 12-inch format that absolutely optimizes the viewing experience for the reader. The 3D images can be projected on any 3D television or computer to take full advantage of this outstanding collection.

Begun in 2011 and painstakingly assembled over the last 5 years, it is indeed sad Dr. Rhoton could not see the completed project before his death in 2016. Undoubtedly, he would be extremely pleased with the results Dr. Peris-Celda and Dr. Martinez-Soriano have achieved and the knowledge that this work has the possibility to improve the lives of patients around the world, every second of every day.

Those who have dissected or inspected many [bodies] have at least learnt to doubt; while others who are ignorant of anatomy and do not take the trouble to attend it are in no doubt at all.

– *Giovanni Battista Morgagni*²

Michael J. Link, MD
Professor

Departments of Neurologic Surgery and Otorhinolaryngology
Mayo Clinic
Rochester, Minnesota

References

1. Rudolf Virchow. In *Cellular-Pathologie, Archiv für pathologische Anatomie und Physiologie und für klinische Medizin* 1855;8:19, as translated in Lelland J. Rather, *Cellular Pathology, Disease, Life, and Man: Selected Essays by Rudolf Virchow* 1958:84.
2. Giovanni Battista Morgagni. Letter xvi, Art. 25, as translated by Benjamin Alexander. Cited in Edward W. Adams, *Founders of Modern Medicine II: Giovanni Battista Morgagni*, *Medical Library and Historical Journal* 1903;1:27.

Preface

In January 2016, one month before Professor Albert L. Rhoton, Jr. passed away, I promised him that I would do everything possible to publish this work with the quality and scientific accuracy he envisioned. I can only hope that Dr. Martinez-Soriano and I have achieved the high level that he intended. It rests now with the reader to judge this.

We worked on most of the dissections for this project from 2011 to 2013. During these years, I was privileged to work with Professor Rhoton at the University of Florida as his microsurgery and endoscopic neurosurgery fellow. Thieme accepted the challenge of publishing this atlas in 2012 and the labeling process started in 2013 after a thorough selection of pictures. Professor Martinez-Soriano and his team of anatomists combined knowledge of surgical and classical anatomy and international terminology as they meticulously labeled thousands of anatomical structures in English and Latin.

Ten friends, most of them Professor Rhoton's fellows, collaborated by contributing their dissections to chapters of this book. Their names are listed in each chapter according to the number of figures they contributed.

“Accurate, gentle, and safe” are probably the most frequently heard words spoken by Professor Rhoton. Knowledge of anatomy through detailed dissections, as he said, is the way to achieve the precision required in surgery to help our patients. This work will have served its purpose even if only one person benefits from this knowledge.

Maria Peris-Celda, MD, PhD

Acknowledgments

To all the fellows of Prof. Rhoton, whose expertise and skills have helped to build the anatomical knowledge and improved dissection techniques through the years.

To Laura Dickinson, Margaret Barry and Jessica Striley, for their friendship, their valuable advice, and their help with this project.

To Timothy Hiscock, Thieme executive editor and Elizabeth Palumbo, Thieme managing editor, and their team, for their commitment and absolute dedication to this work.

To Barbara Chernow, production editor, and her team, for their expertise and help throughout the process.

Contributors

Takeshi Funaki, MD, PhD

Assistant Professor
Department of Neurosurgery
Kyoto University Graduate School of Medicine
Shogo-in, Sakyo-ku
Kyoto, Japan

Noritaka Komune, MD, PhD

Kyushu University Hospital
Higashi-ku
Fukuoka, Japan

Carolina Martins, MD, PhD

Neurosurgeon
Director of Research and Education
Hospital Pelopidas Silveira
IMIP/SES/SVS
Recife, Brazil

Ken Matsushima, MD

Fellow
Department of Neurosurgery
Tokyo Medical University
Tokyo, Japan

Alejandro Monroy-Sosa, MD

Skull-Base and Vascular Neurosurgeon
Head and Neck Department
National Cancer Institute of Mexico
Tlalpan, Mexico

Carlos Diogenes Pinheiro-Neto, MD, PhD

Associate Professor of Otolaryngology
Co-Director of the Cranial Base Surgery
Albany Medical Center
Albany, New York

Rowan Valentine, PhD, MBBS, FRACS

Otolaryngologist, head and neck surgeon
Adelaide University
Adelaide, South Australia
Australia

Edward J. Wladis, MD, FACS

Associate Professor
Ophthalmic Plastic Surgery
Lions Eye Institute
Department of Ophthalmology
Albany Medical College
Albany, New York

Kaan Yağmurlu, MD

Surgeon
Department of Neurosurgery
University of Florida College of Medicine
Gainesville, Florida

Fumitaka Yoshioka, MD

Assistant Professor
Department of Neurosurgery
Faculty of Medicine
Saga University
Saga, Japan

Orientation Abbreviations

A anterior
P posterior
S superior (or cranial)
I inferior (or caudal)
R right
L left

Osteology of the Head and Neck

1

Adult and Fetal Skull

Maria Peris-Celda

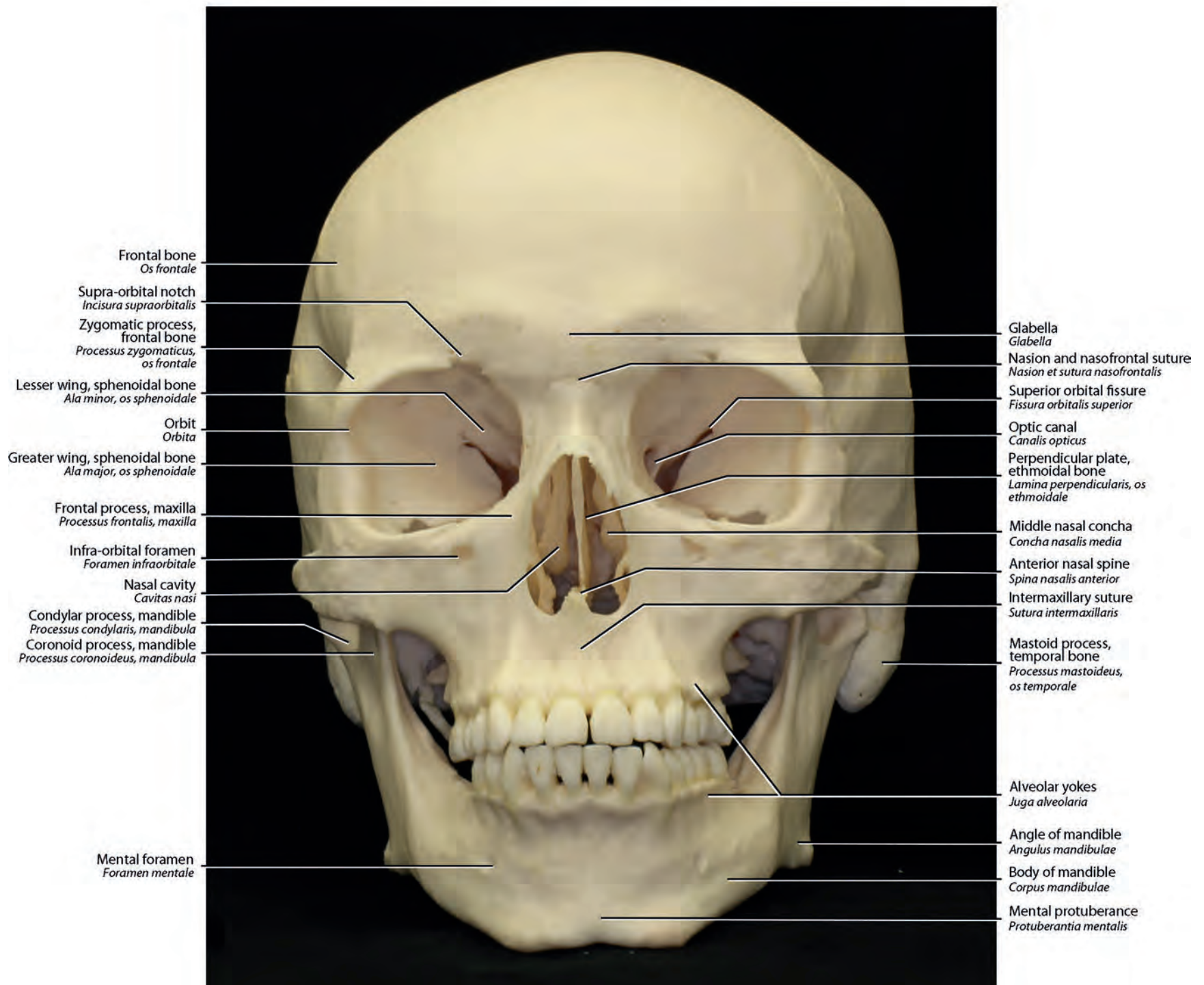


Fig. 1.1. Skull, anterior view.

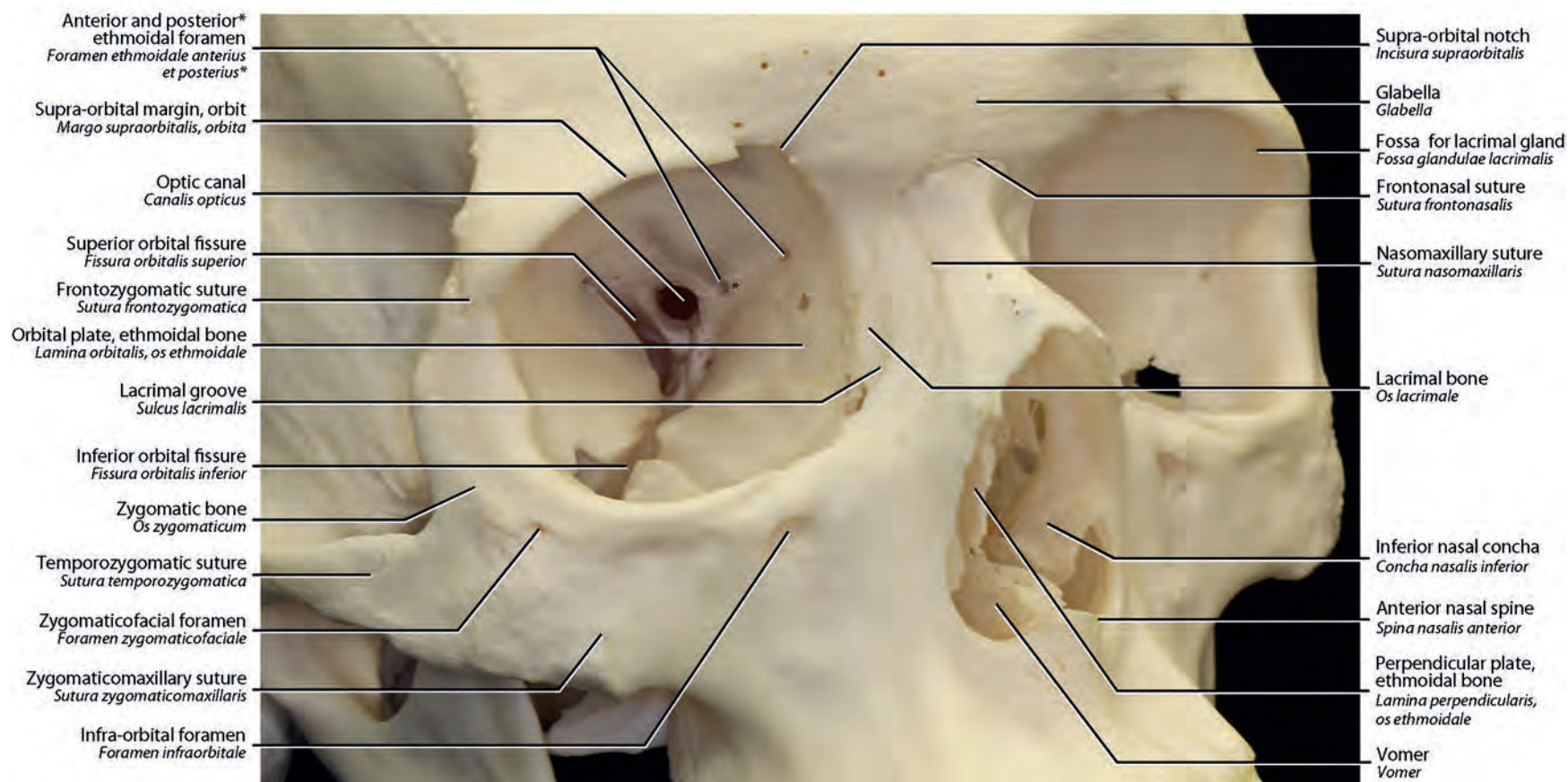


Fig. 1.2. Skull, right oblique view of the upper facial area.

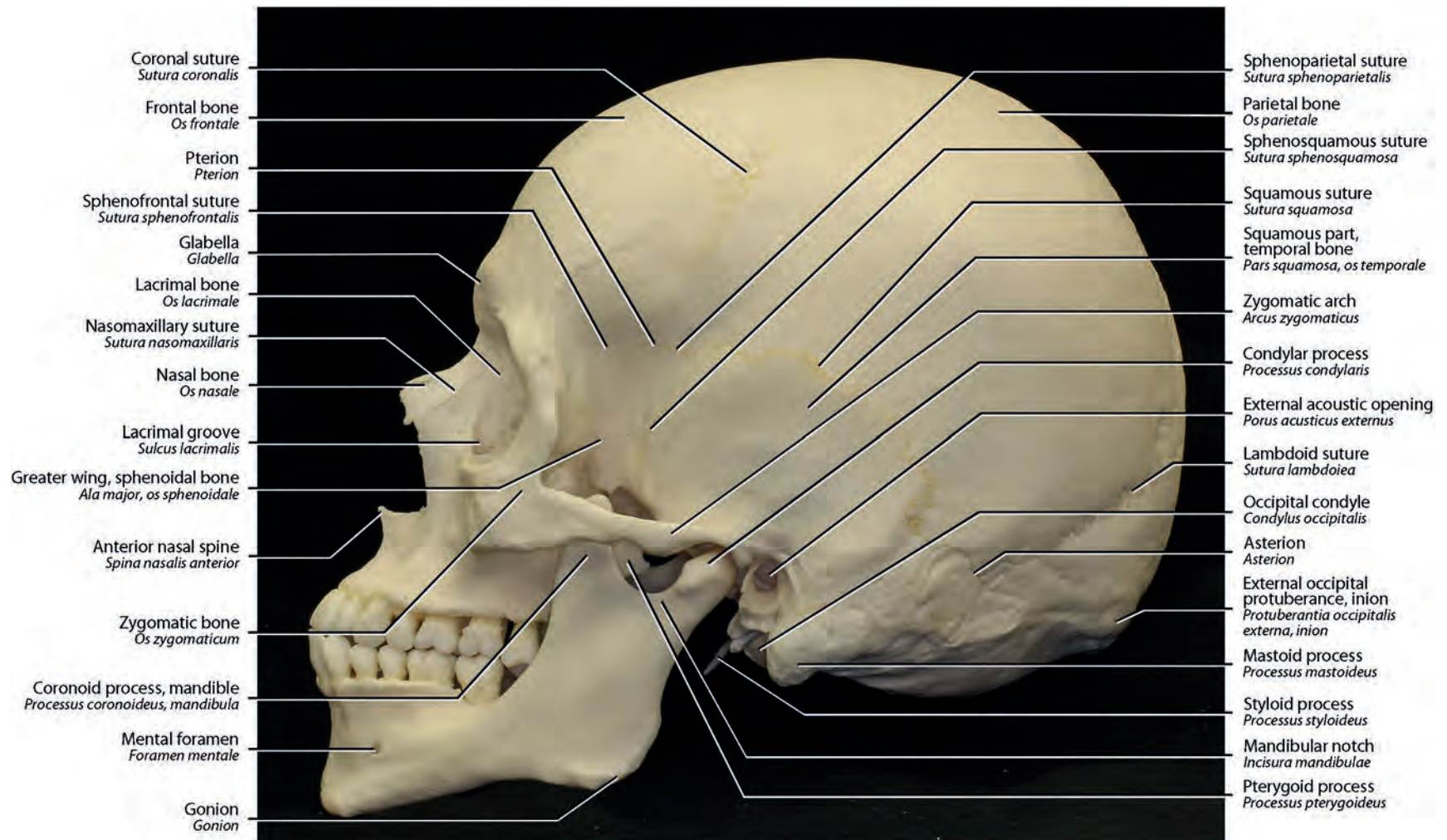


Fig. 1.3. Skull, left lateral view.

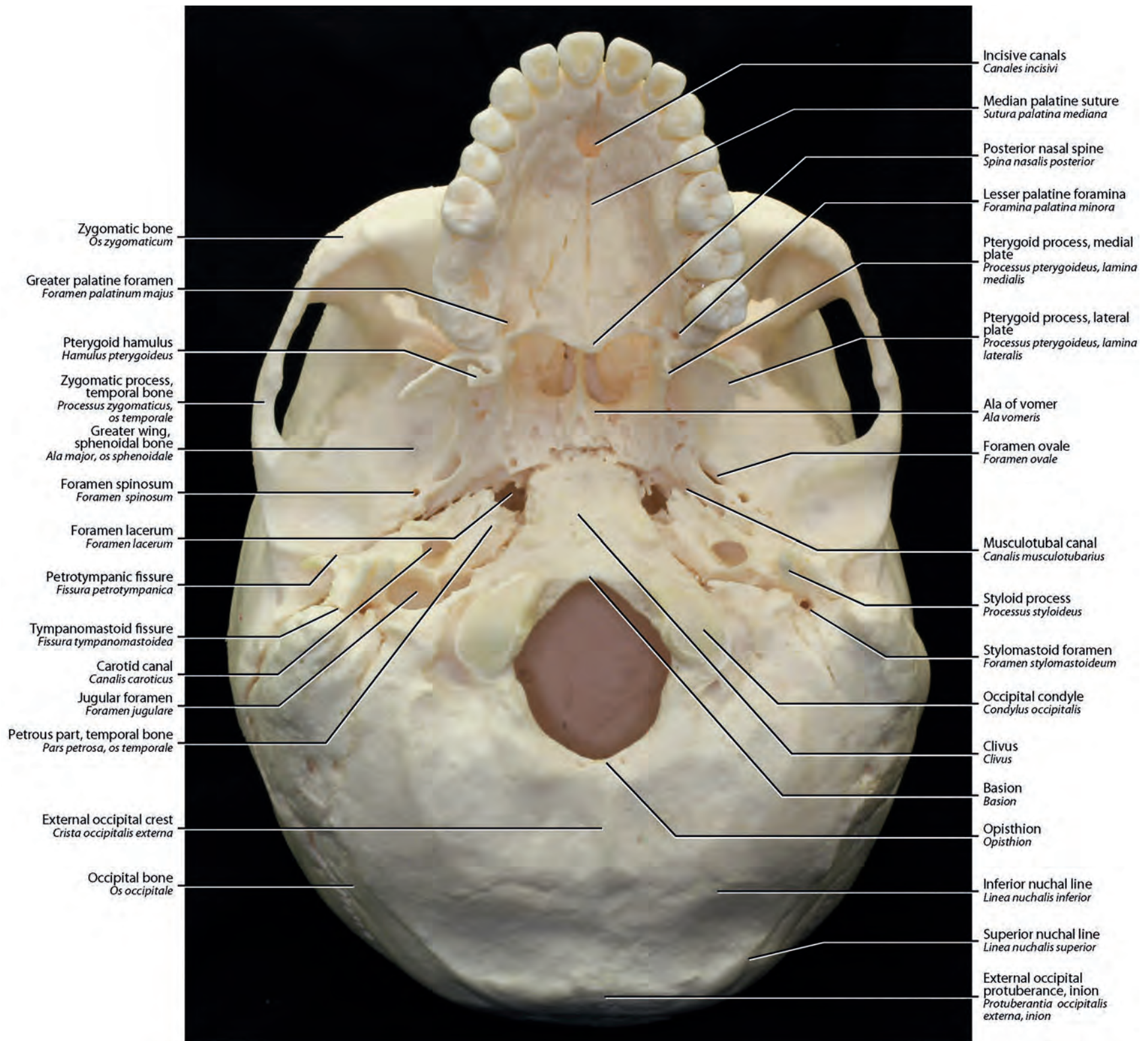


Fig. 1.4. Skull base, inferior view.

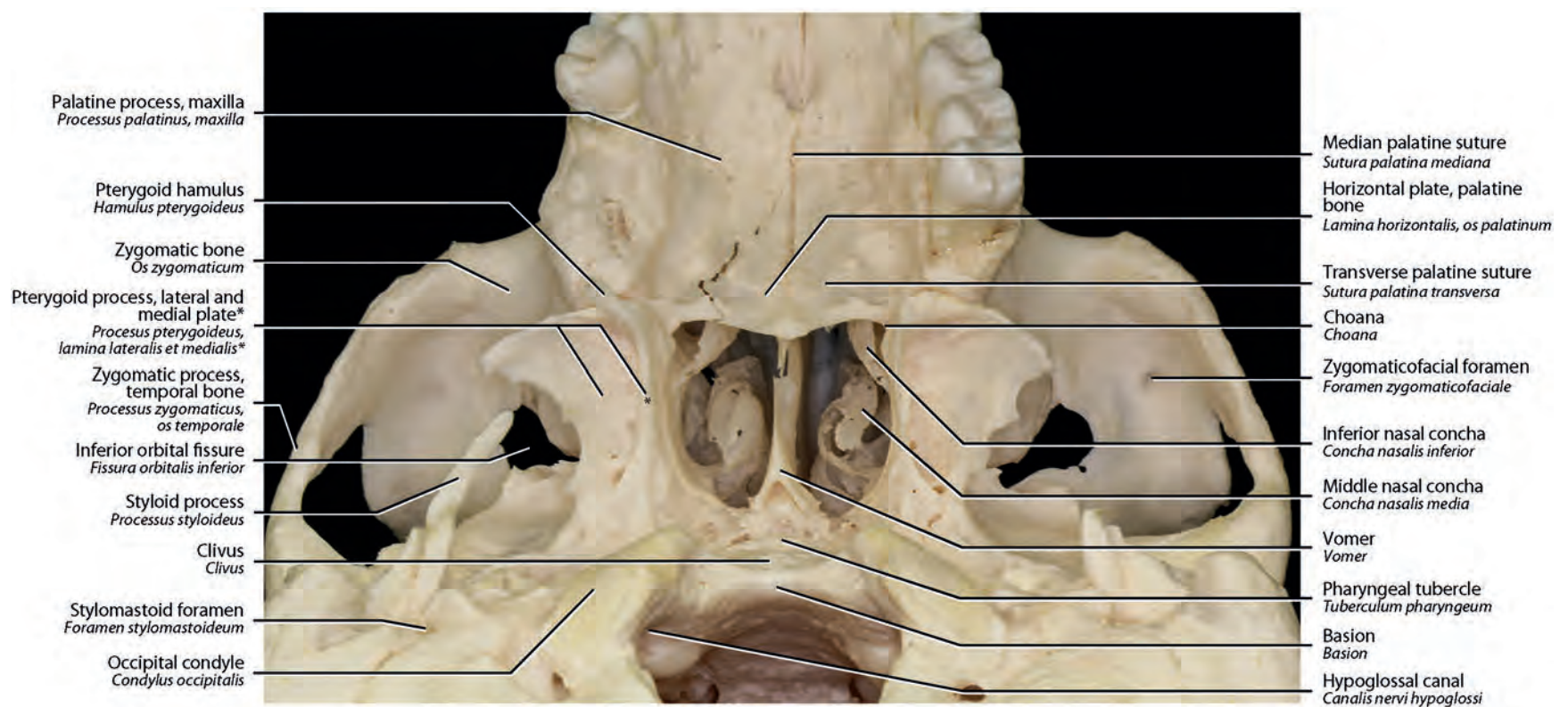


Fig. 1.5. Skull base, inferior view, anterior portion.



Fig. 1.6. Skull, superior view.

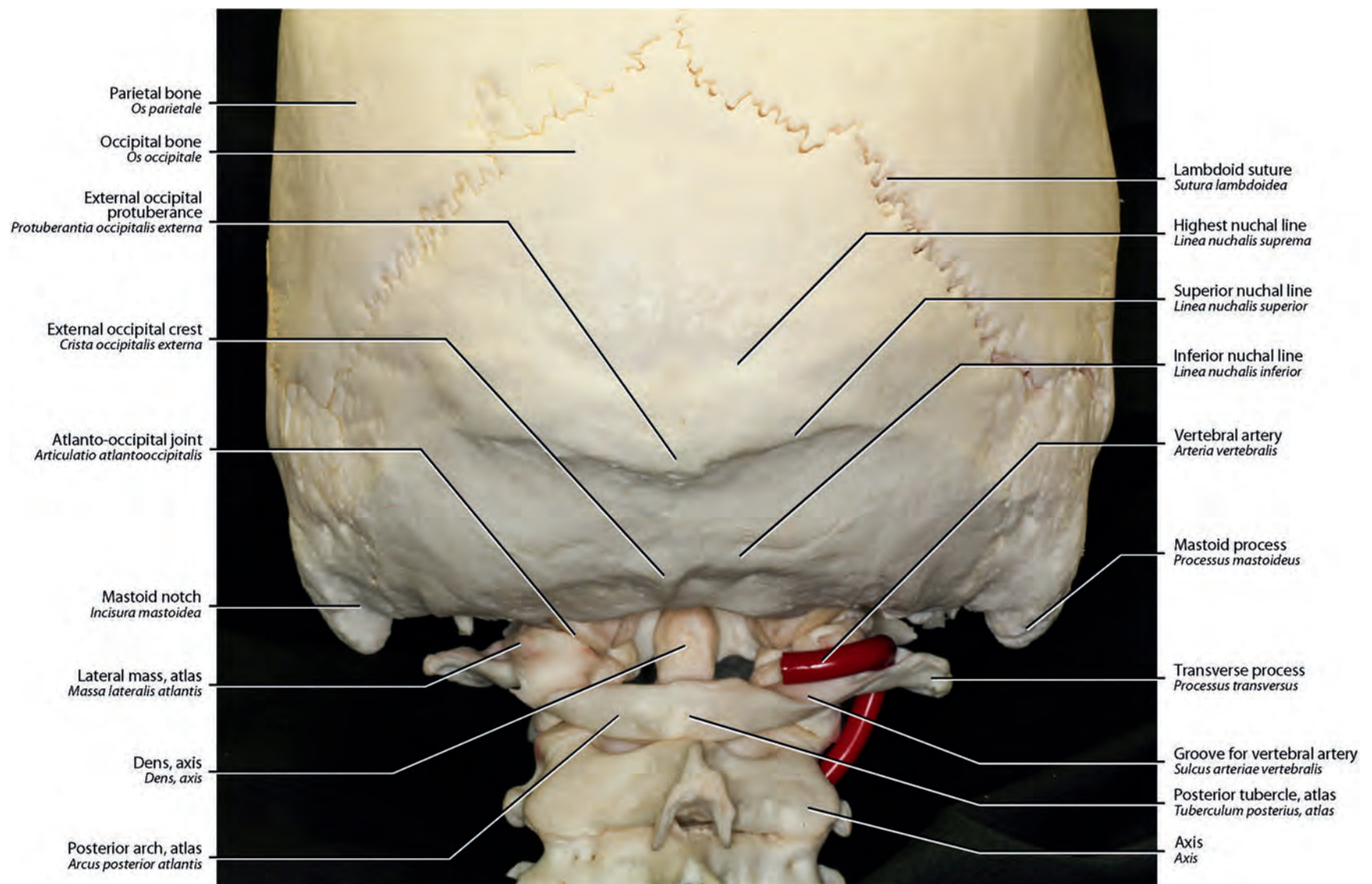


Fig. 1.7. Skull and upper cervical spine, posterior view.

The vertebral artery on the right side has been represented with molding material.

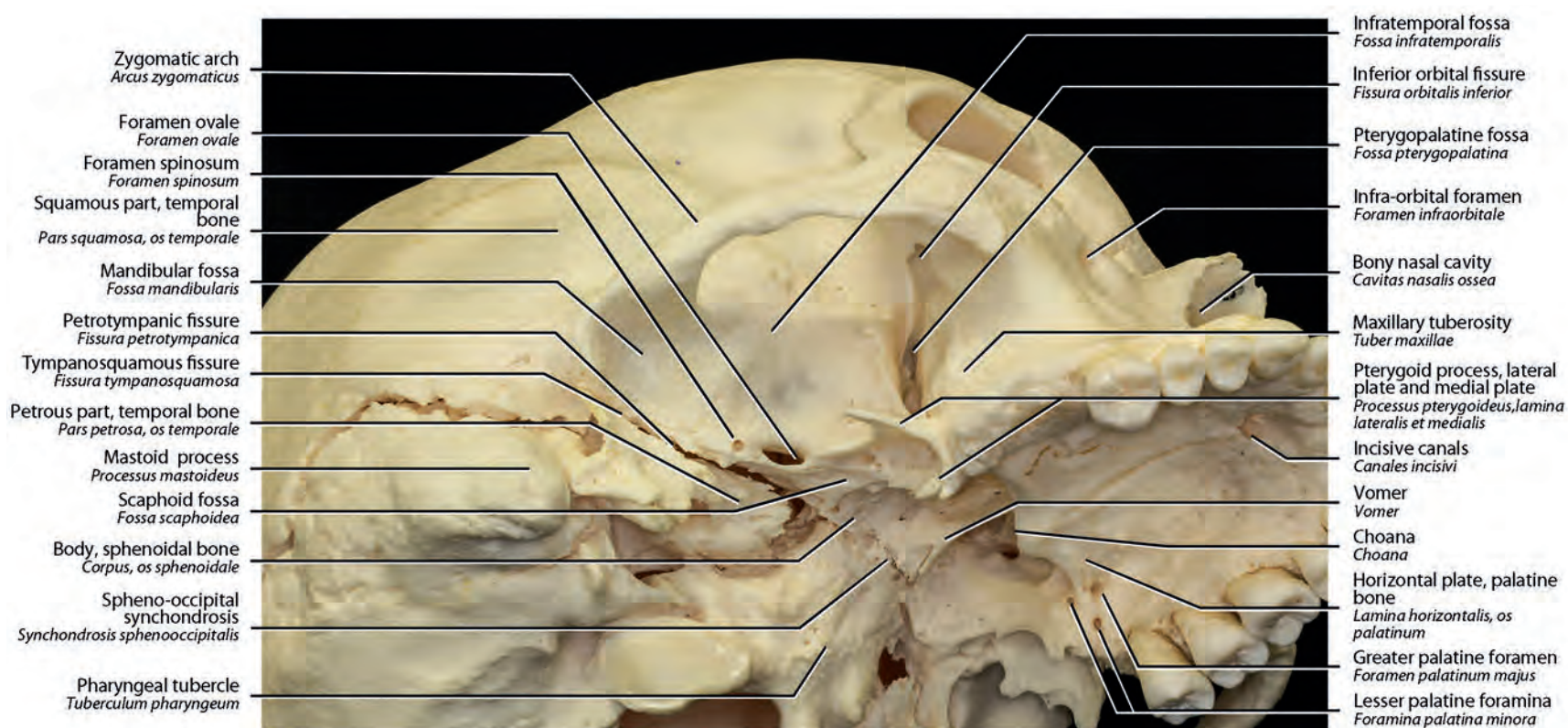


Fig. 1.8. Skull, inferior oblique view of the right side.



Fig. 1.9. Skull base, superior view.

Part of the cranium adjacent to the right middle fossa has been removed.

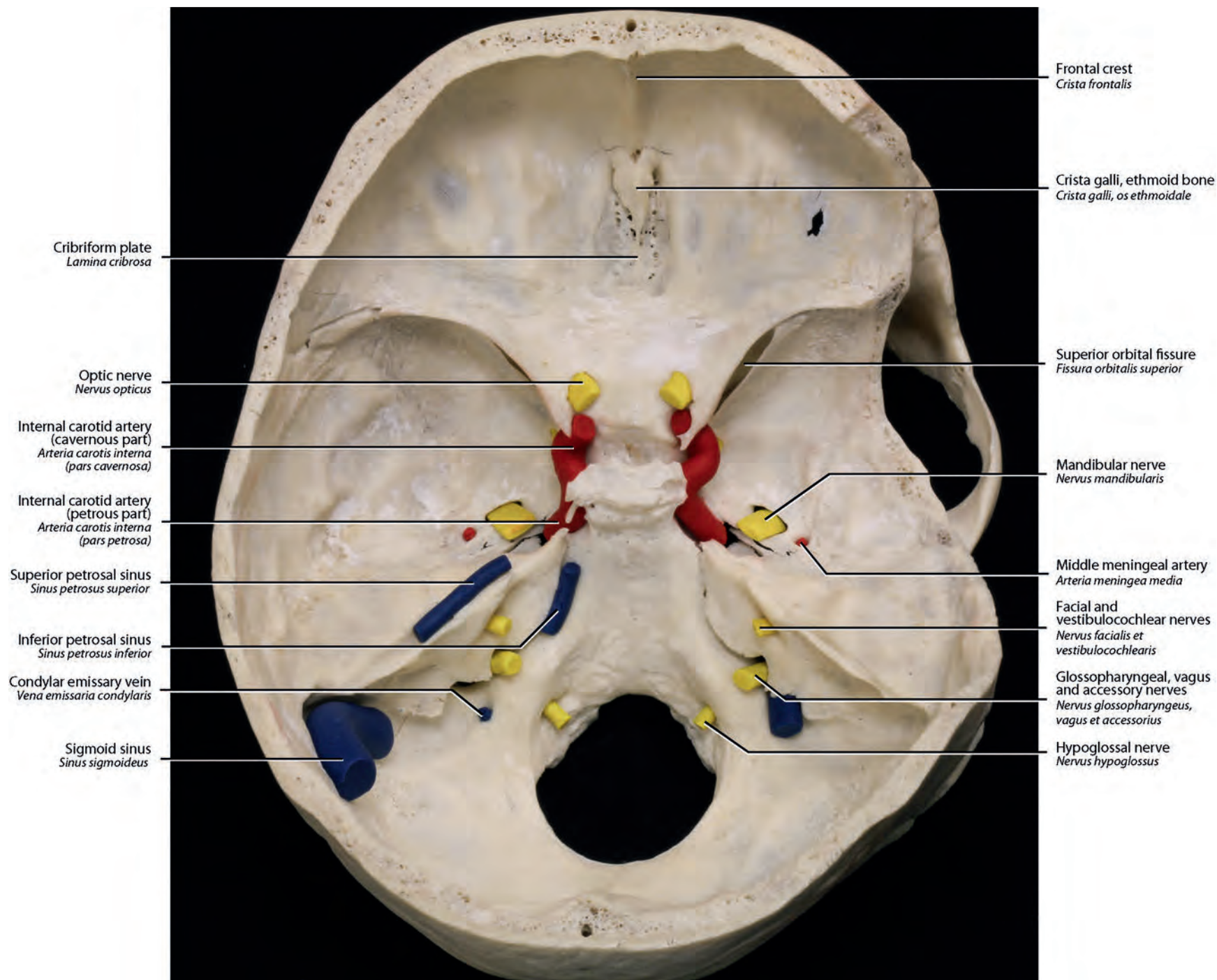


Fig. 1.10. Skull base, superior view.
Arterial, venous, and neural structures have been represented with molding material.

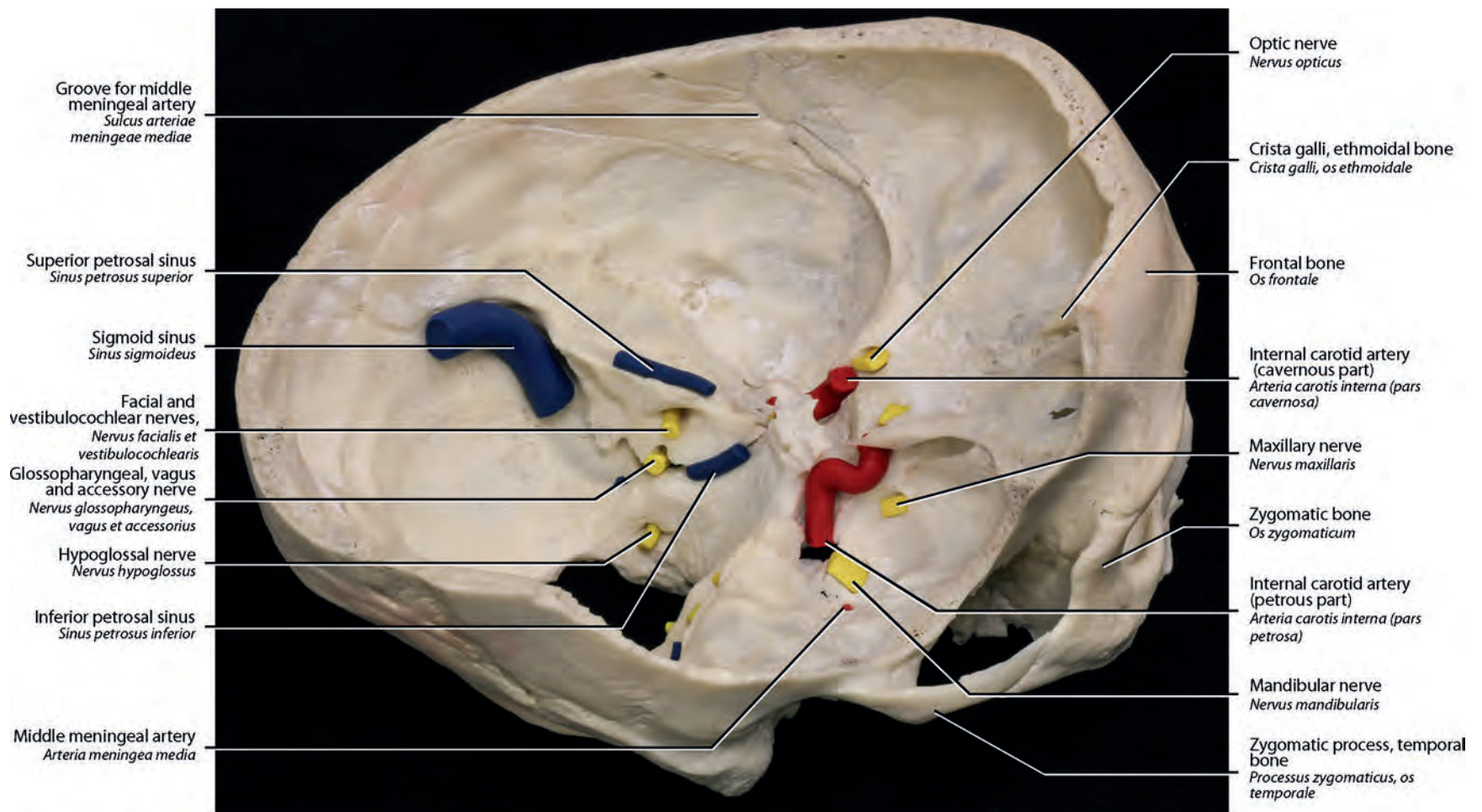


Fig. 1.11. Skull base, superior right oblique view.

Arterial, venous, and neural structures have been represented with molding material.

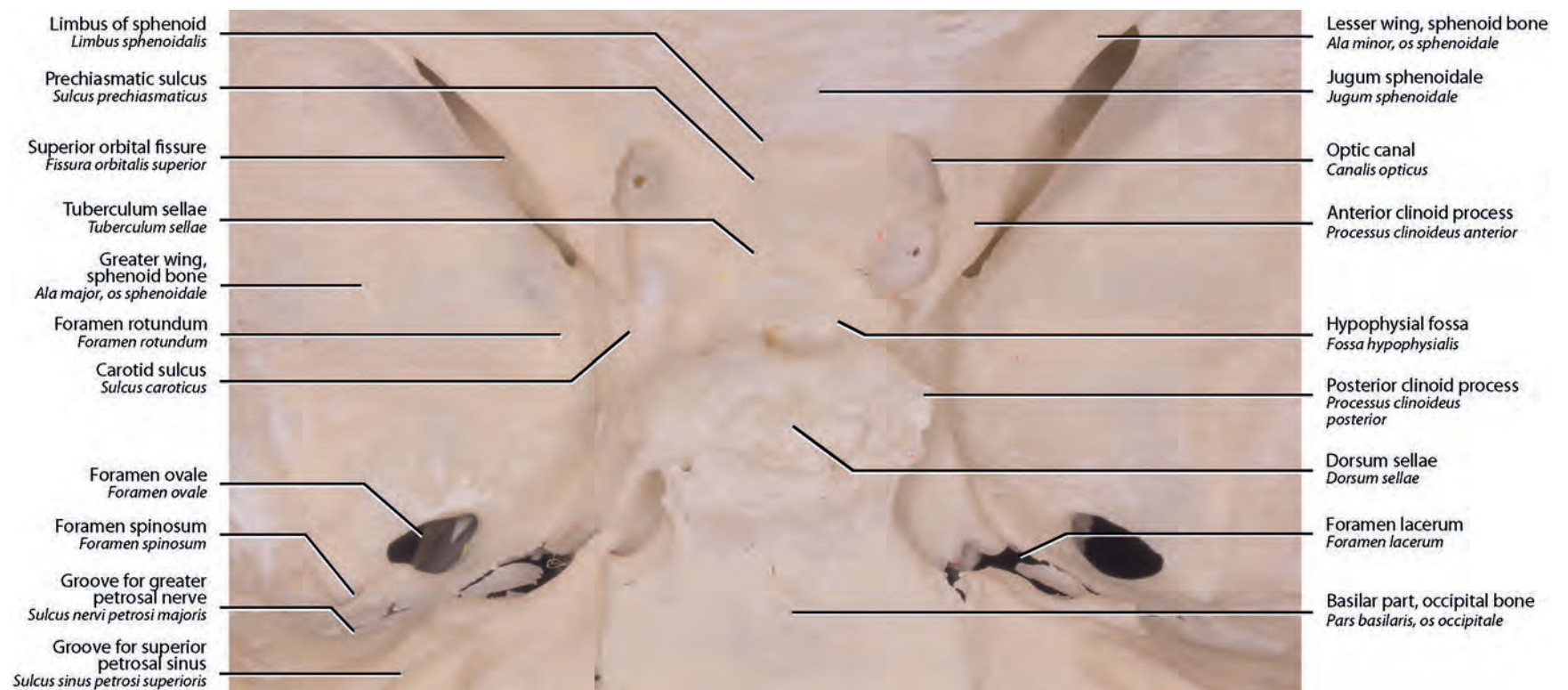


Fig. 1.12. Skull base, superior view.

Enlarged view of the sellar and parasellar areas.

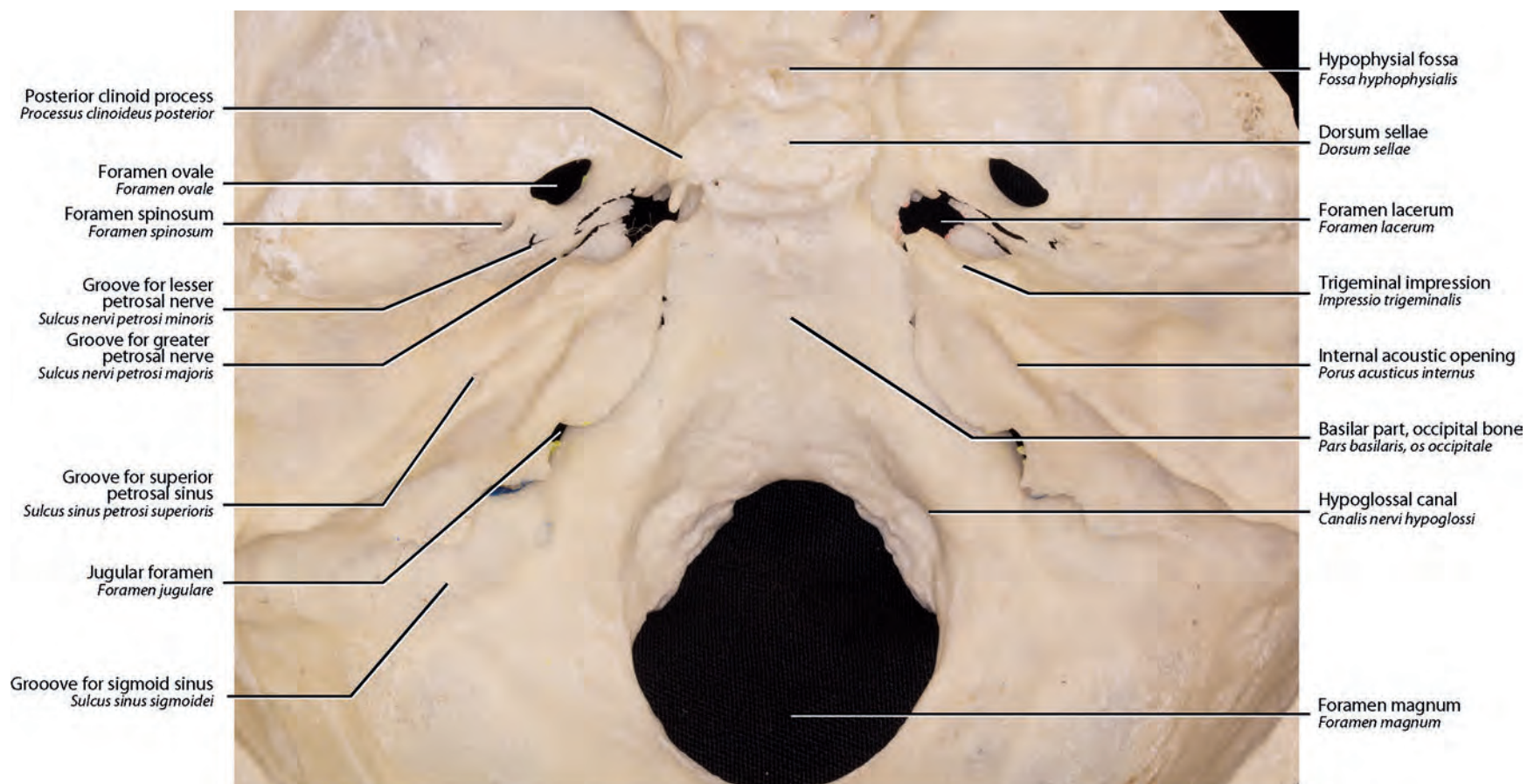


Fig. 1.13. Skull base, superior view.
Enlarged view of the middle and posterior cranial fossae.

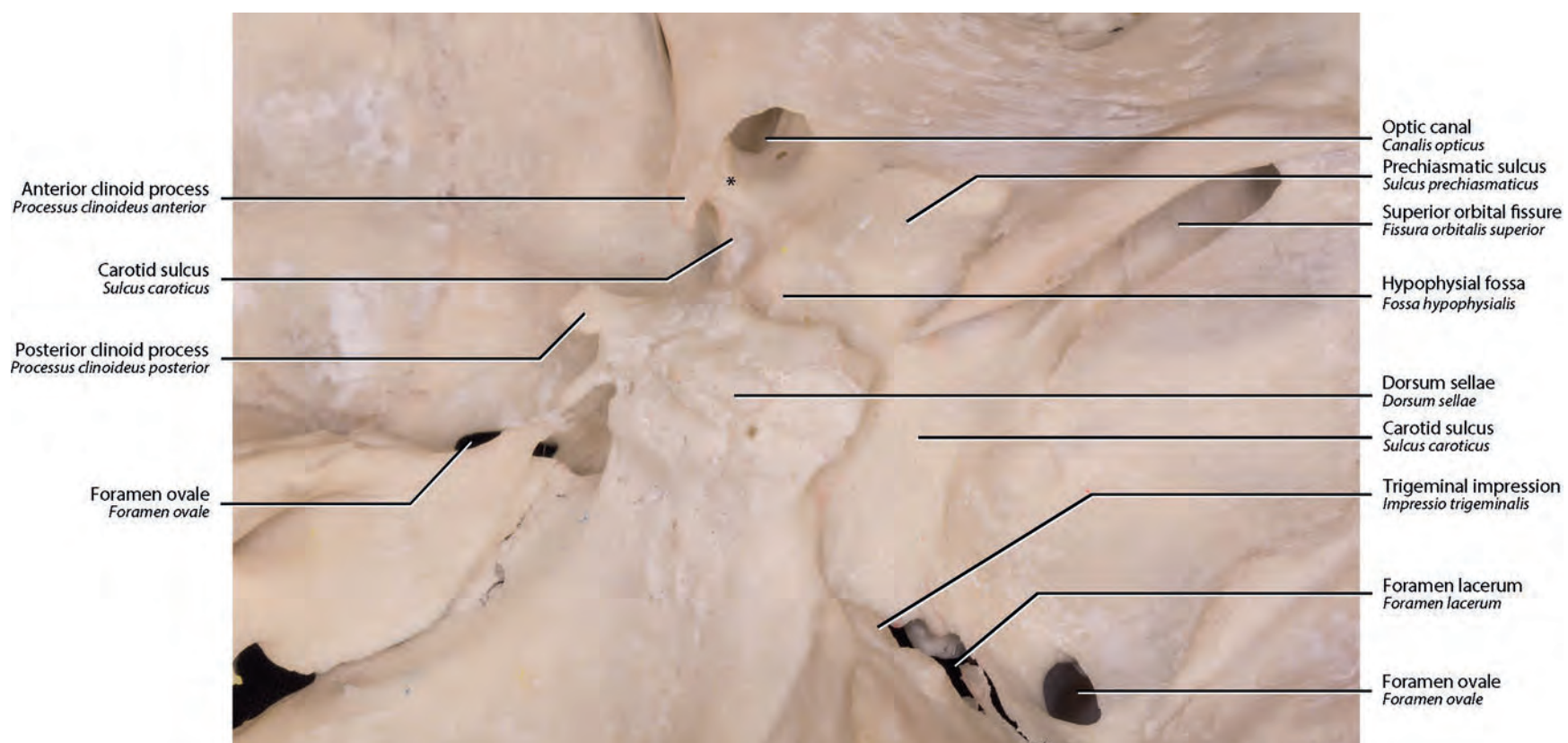


Fig. 1.14. Skull base, superior right oblique view.
Enlarged view of the skull base in midline. * Optic strut (surgical terminology).

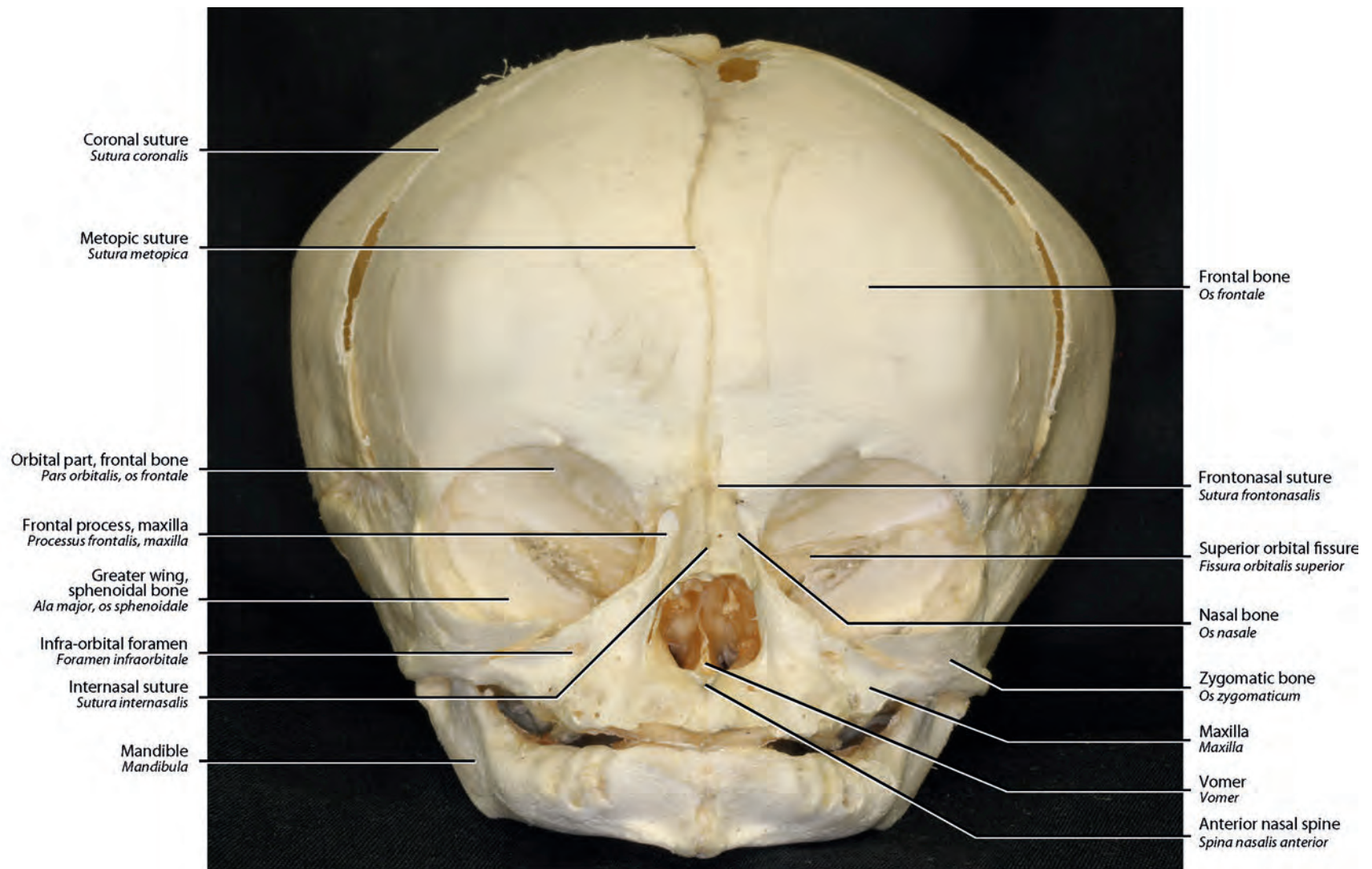


Fig. 1.15. Fetal skull, anterior view.



Fig. 1.16. Fetal skull, right lateral view.



Fig. 1.17. Fetal skull, superior view.

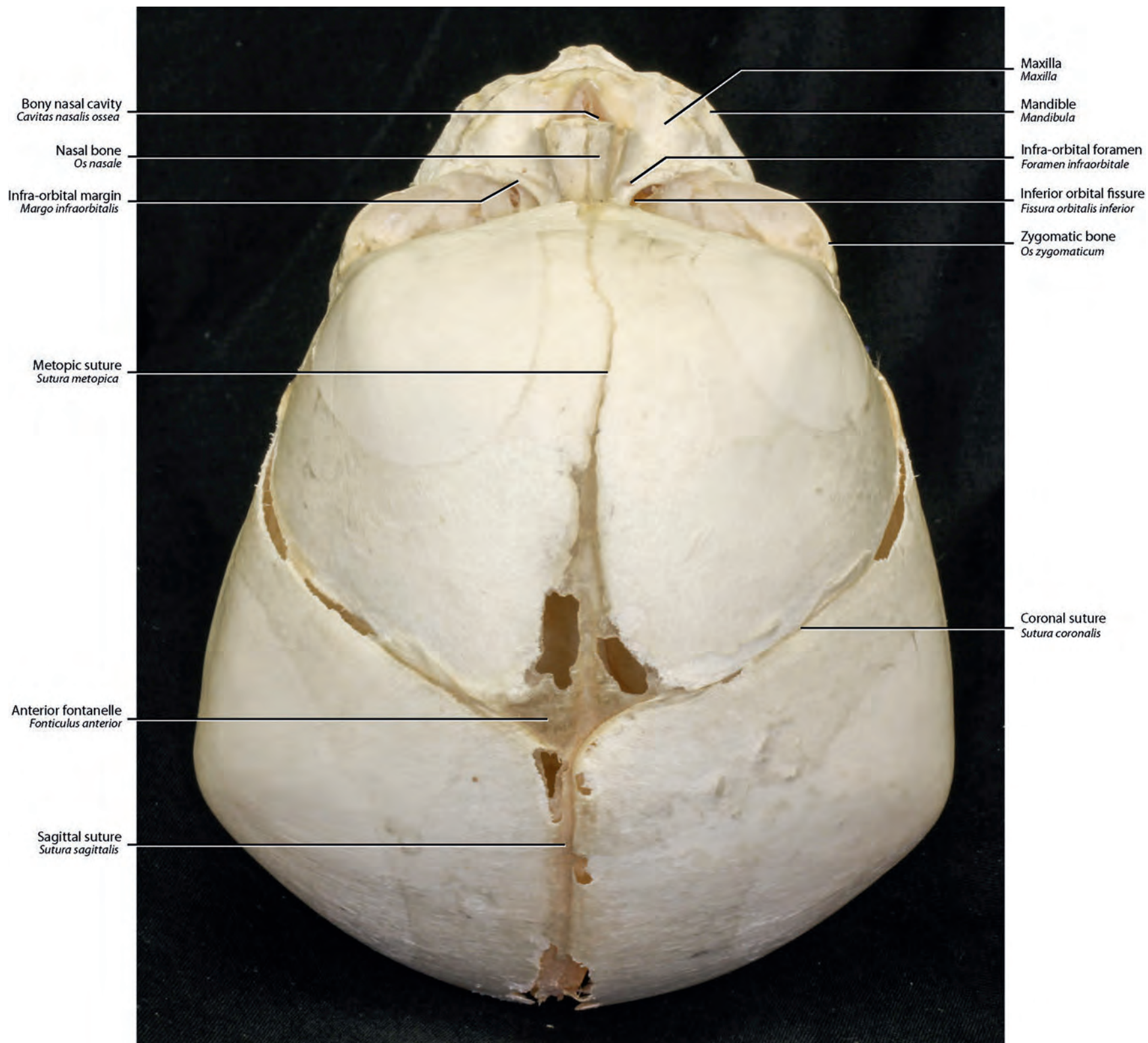


Fig. 1.18. Fetal skull, anterior superior view.

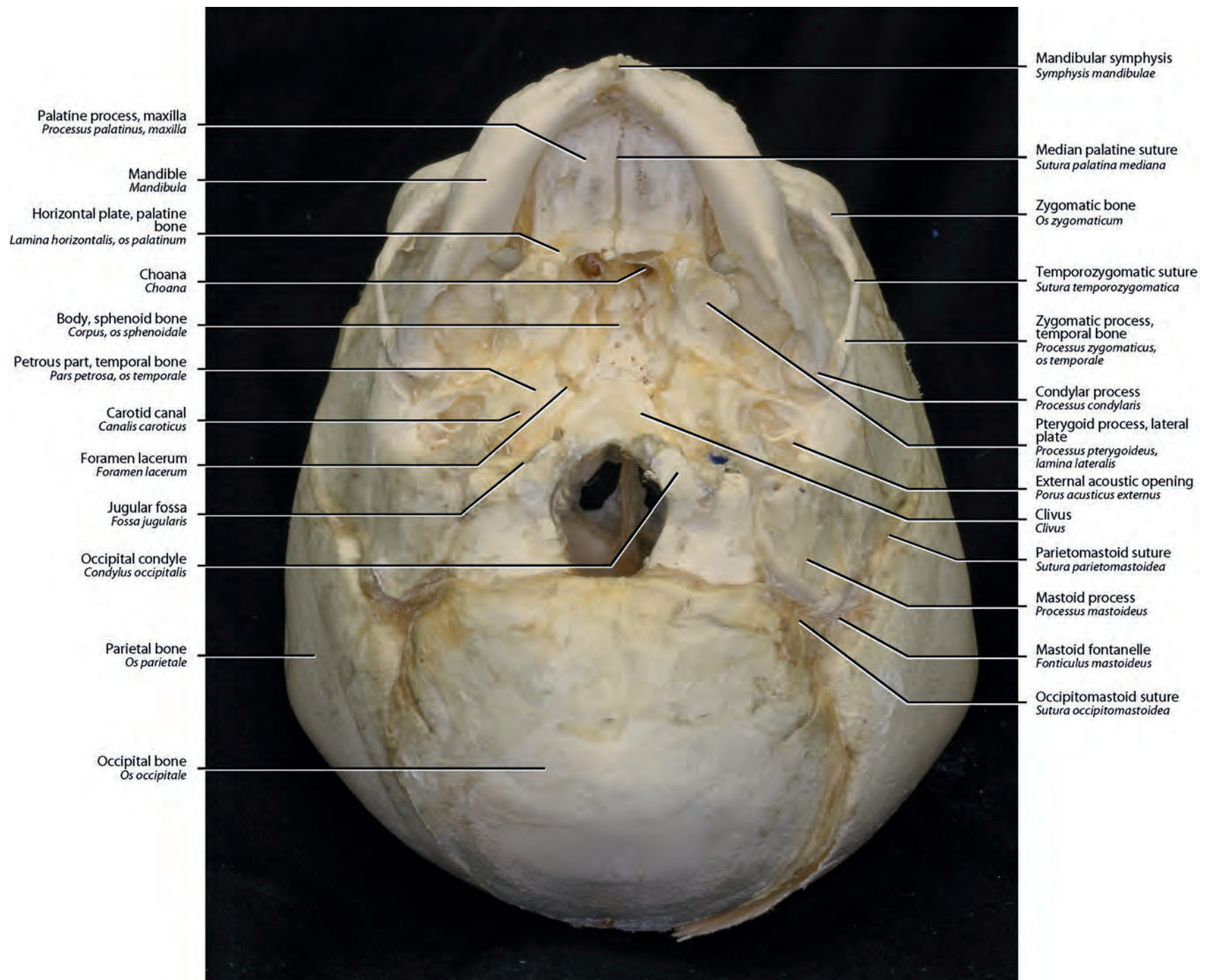


Fig. 1.19. Fetal skull, inferior view.

2

Bones of the Skull and Skull Bone Articulations

Maria Peris-Celda and Carolina Martins

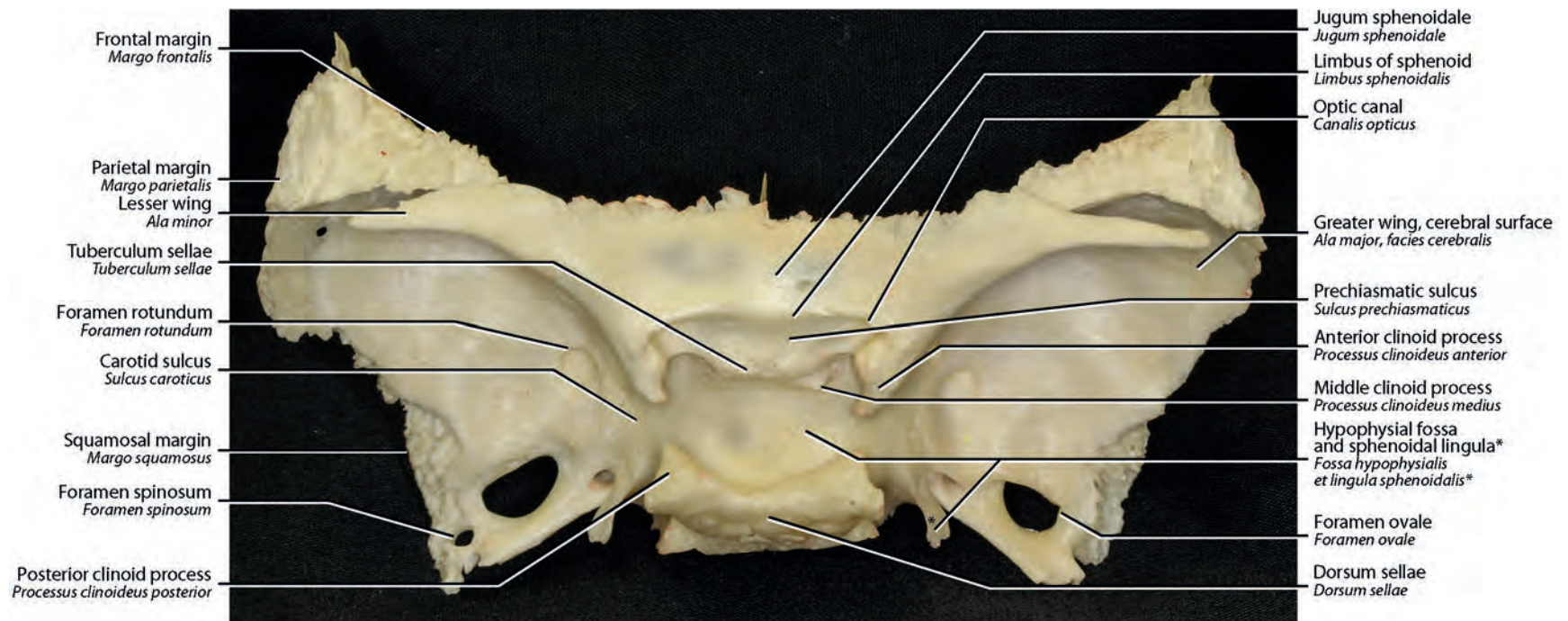


Fig. 2.1. Sphenoidal bone, superior view.

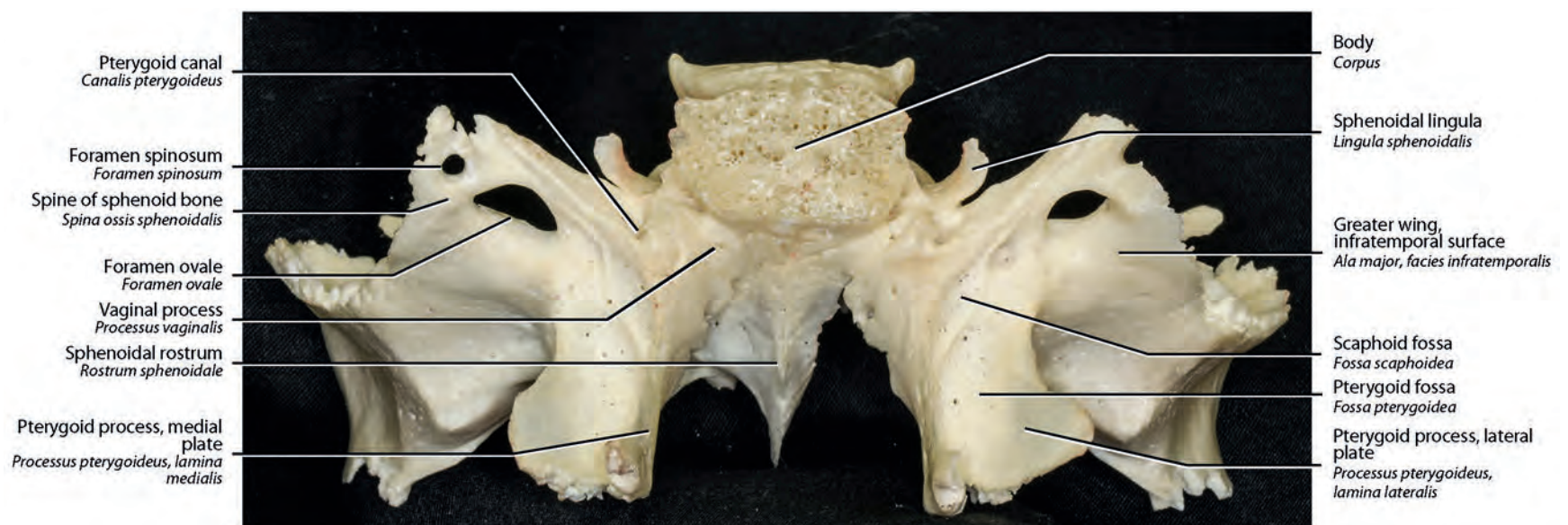


Fig. 2.2. Sphenoidal bone, inferior view.

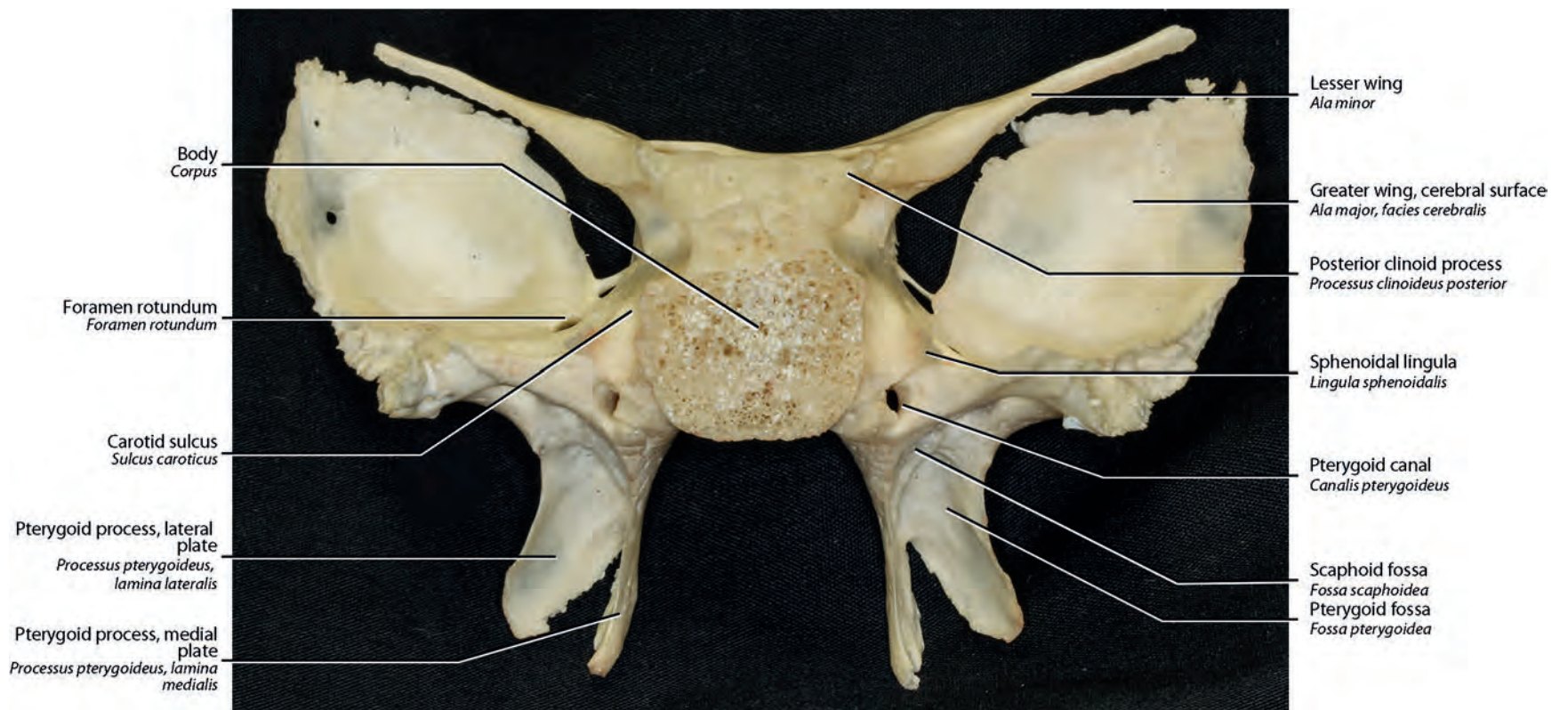


Fig. 2.3. Sphenoidal bone, posterior view.

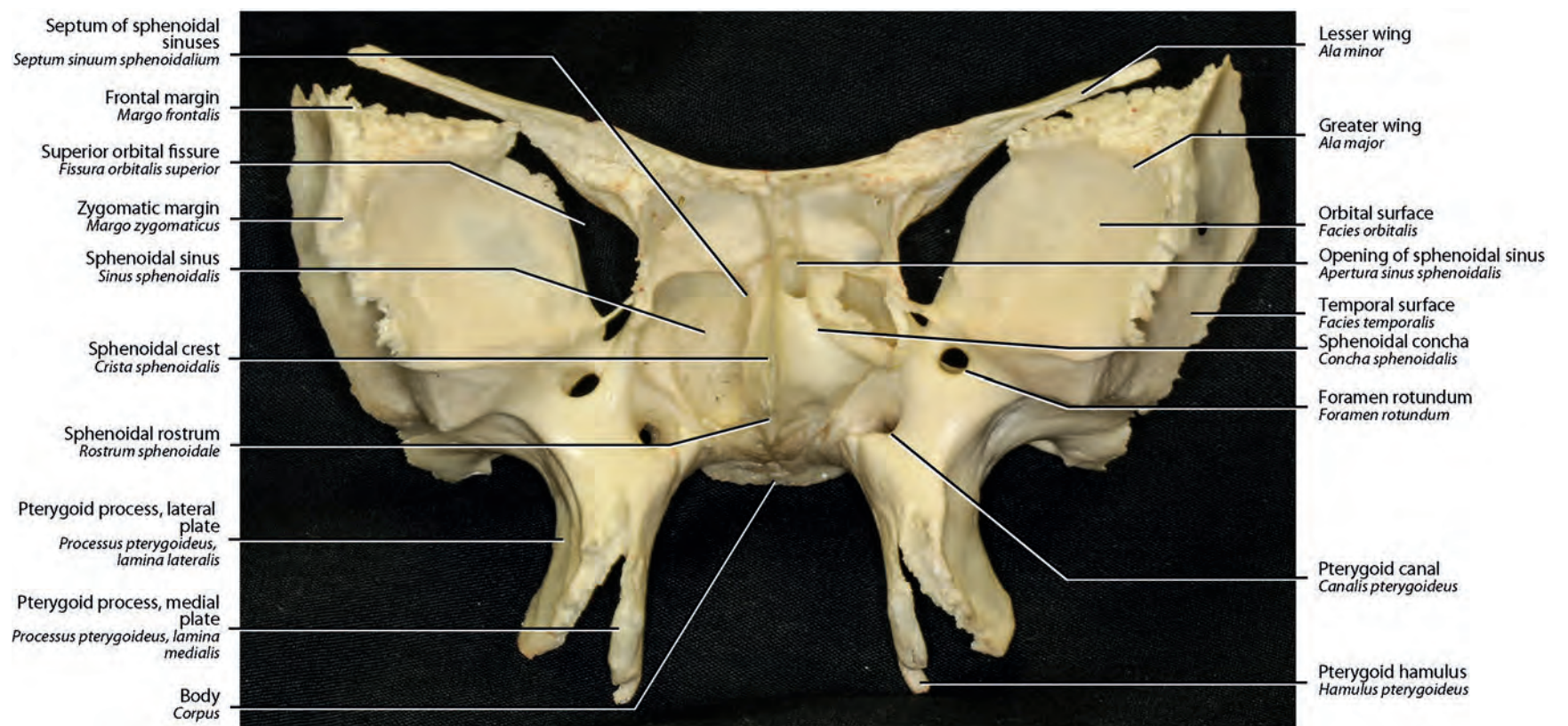


Fig. 2.4. Sphenoidal bone, anterior view.

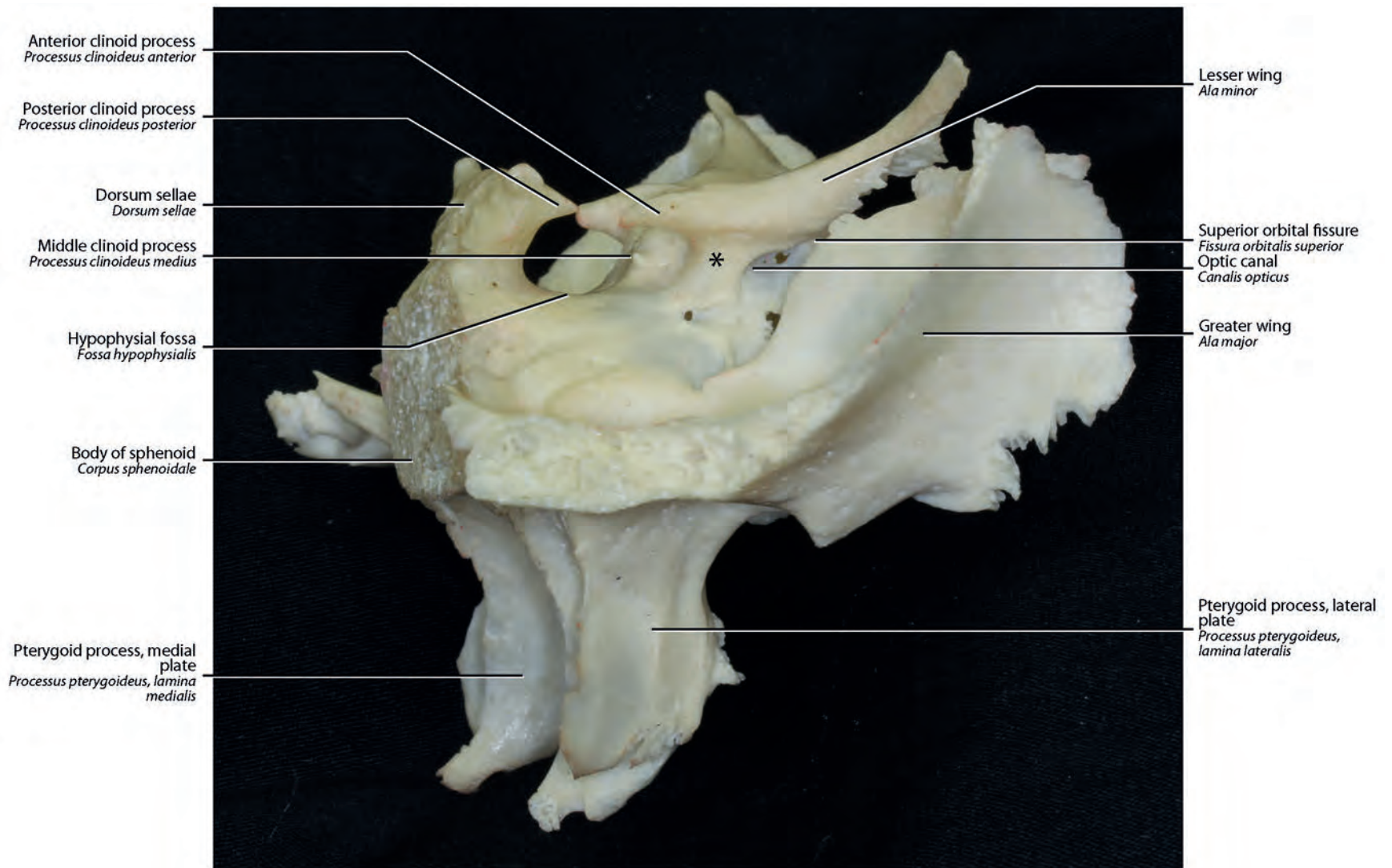


Fig. 2.5. Sphenoidal bone, right oblique view.
(*, optic strut)

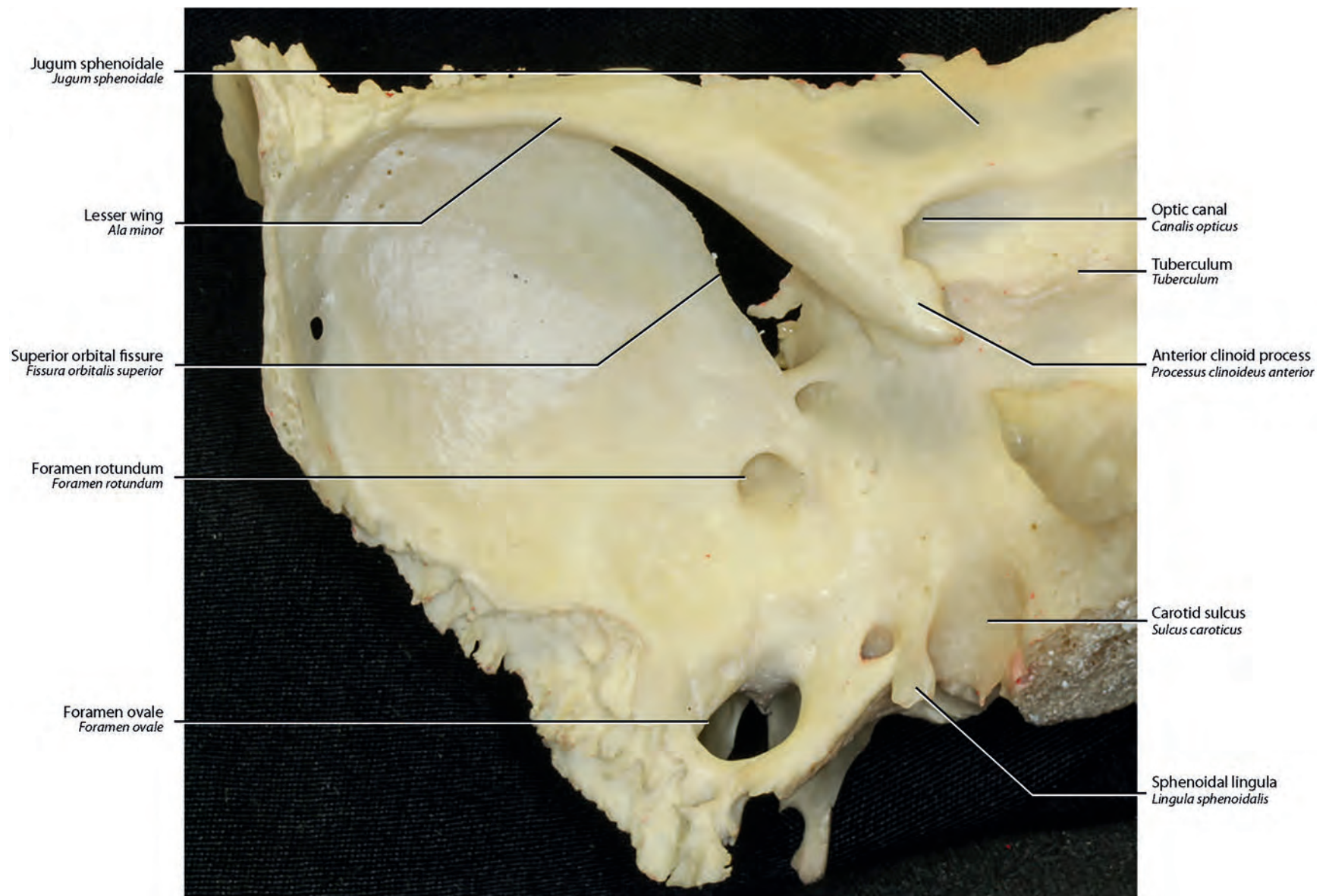


Fig. 2.6. Sphenoidal bone, superior oblique view of the left side.

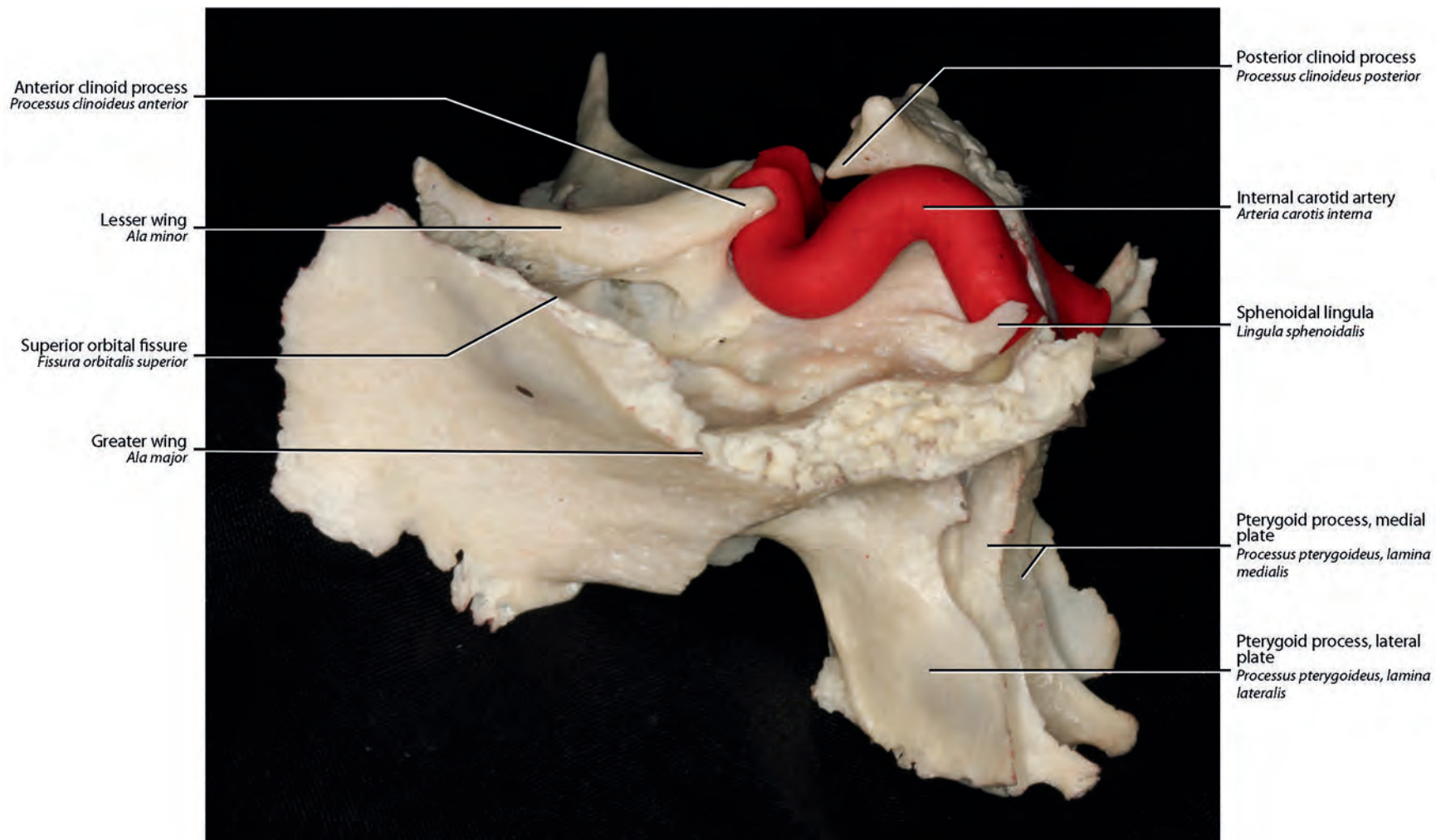


Fig. 2.7. Sphenoidal bone, left lateral view.
The carotid artery has been represented with molding material.

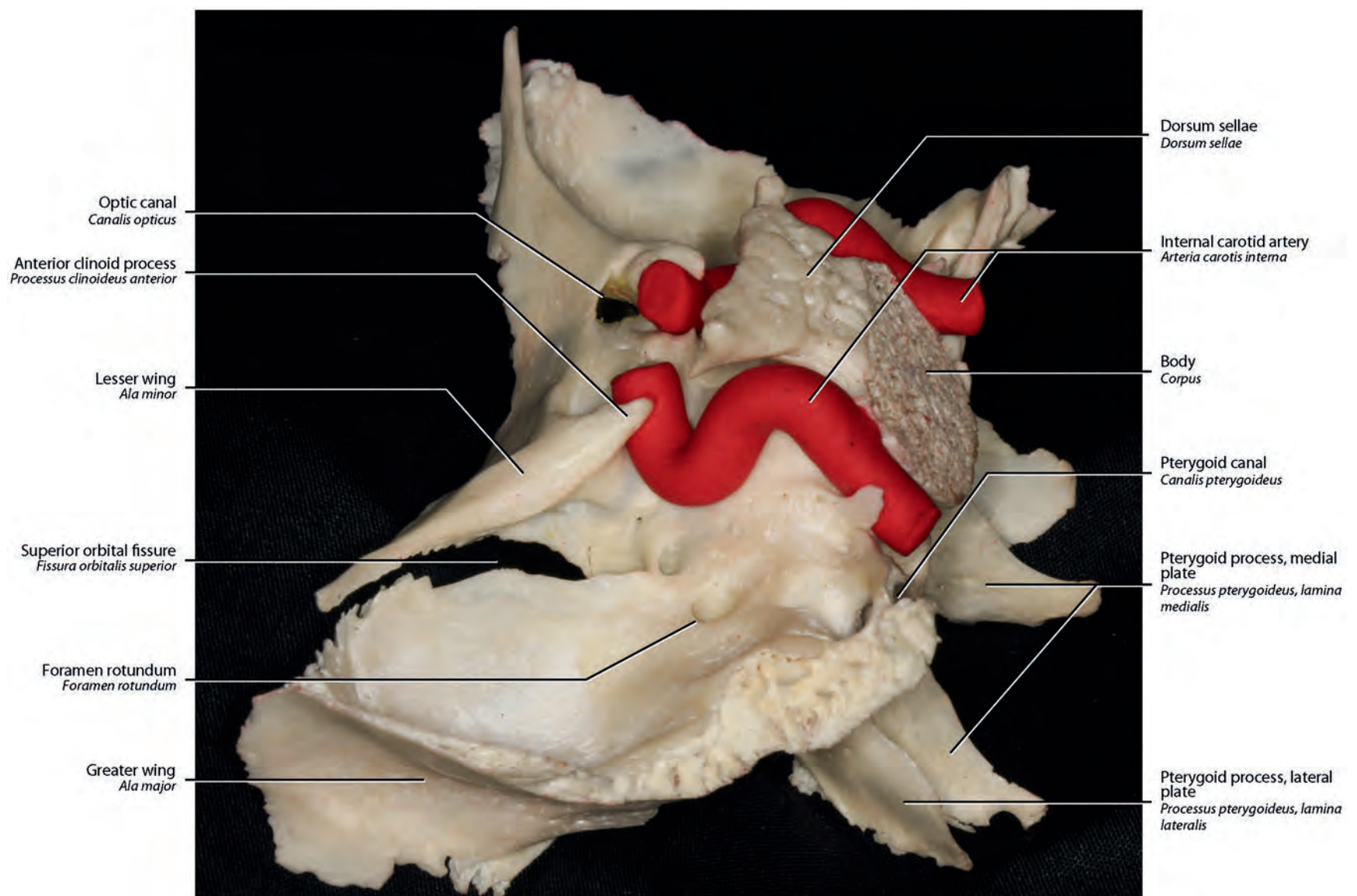


Fig. 2.8. Sphenoidal bone, left superior view.
The carotid arteries have been represented with molding material.