CUNNINGHAM'S MANUAL OF PRACTICAL ANATOMY

Rachel Koshi

HEAD, NECK AND BRAIN

16th Edition

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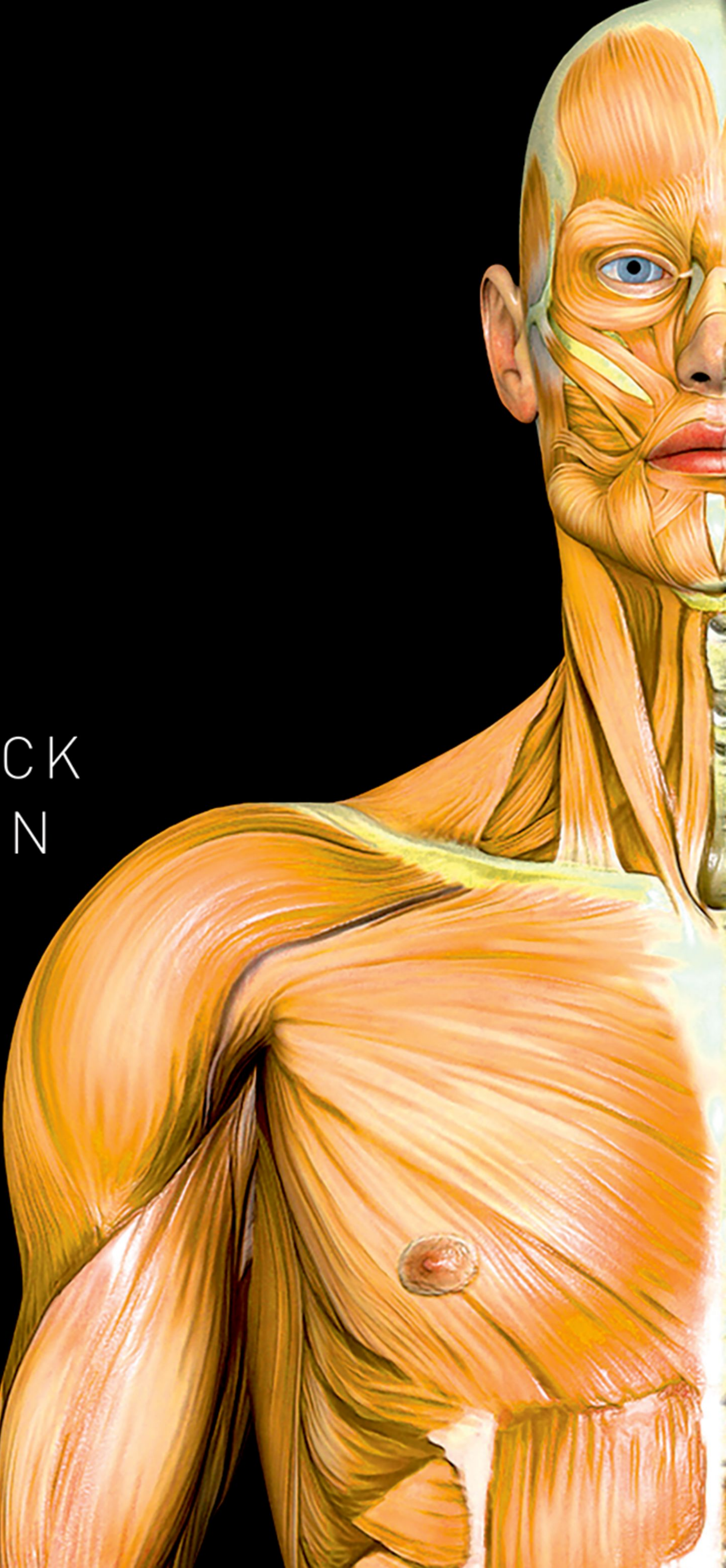

OXFORD

CUNNINGHAM'S MANUAL OF PRACTICAL ANATOMY

Volume 3

Cunningham's Manual of Practical Anatomy

Volume 1 Upper and lower limbs
Volume 2 Thorax and abdomen
Volume 3 Head, neck and brain

CUNNINGHAM'S MANUAL OF PRACTICAL ANATOMY

Sixteenth edition

Volume 3 Head, neck and brain

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OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

Great Clarendon Street, Oxford, OX2 6DP,
United Kingdom

Oxford University Press is a department of the University of Oxford. It furthers the University's objective of excellence in research, scholarship, and education by publishing worldwide. Oxford is a registered trade mark of Oxford University Press in the UK and in certain other countries

Thirteenth edition 1966
Fourteenth edition 1977
Fifteenth edition 1986

Impression: 1

Published in the United States of America by Oxford University Press
198 Madison Avenue, New York, NY 10016, United States of America

British Library Cataloguing in Publication Data
Data available

Library of Congress Control Number: 2016956732

ISBN 978–0–19–251648–0

Printed and bound by Replika Press Pvt Ltd, India

I fondly dedicate this book to the late Dr K G Koshi for his encouragement and support when I chose a career in anatomy, and to Dr Mary Jacob, under whose guidance I learned the subject and developed a love for teaching.

Oxford University Press would like to dedicate this book to the memory of the late George John Romanes, Professor of Anatomy at Edinburgh University (1954–1984), who brought his wisdom to previous editions of *Cunningham's*.

Foreword

It gives me great pleasure to pen down the Foreword to the 16th edition of *Cunningham's Manual of Practical Anatomy*. Just as the curriculum of anatomy is incomplete without dissection, so also learning by dissection is incomplete without a manual.

Cunningham's Manual of Practical Anatomy is one of the oldest dissectors, the first edition of which was published as early as 1893. Since then, the manual has been an inseparable companion to students during dissection.

I remember my days as a first MBBS student, the only dissector known in those days was *Cunningham's* manual. The manual helped me to dissect scientifically, step by step, explore the body, see all structures as mentioned, and admire God's highest creation—the human body—so perfectly. As a postgraduate student, I marvelled at the manual and learnt details of structures, in a way as if I had my teacher with me telling me what to do next. The clearly defined steps of dissection, and the comprehensive revision tables at the end, helped me personally to develop a liking for dissection and the subject of anatomy.

Today, as a Professor and Head of Anatomy, teaching anatomy for more than 30 years, I find *Cunningham's* manual extremely useful to all the students dissecting and learning anatomy.

With the explosion of knowledge and ongoing curricular changes, the manual has been revised at frequent intervals. The 16th edition is more student friendly. The language is simplified, so that the book can be comprehended by one and all. The objectives are well defined. The clinical application notes at the end of each chapter are an academic feast to the learners. The lucidly enumerated steps of dissection make a student explore various structures, the layout, and relations and compare them with the simplified labelled illustrations in the manual. This helps in sequential dissection in a scientific way and for knowledge retention. The text also includes multiple choice questions for self-assessment and holistic comprehension.

Keeping the concept of 'Adult Learning Principles' in mind, i.e. adults learn when they 'DO', and with a global movement towards 'competency-based curriculum', students learn anatomy when they dissect; *Cunningham's* manual will help students to dissect on their own, at their own speed and time, and become competent doctors, who can cater to the needs of the society in a much better way.

I recommend this invaluable manual to all the learners who want to master the subject of anatomy.

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Preface to the sixteenth edition

Cunningham's Manual of Practical Anatomy has been the most widely used dissection manual in India for many decades. This edition is extensively revised. The language has been modernized and simplified to appeal to the present-day student. Opening remarks have been added at the start of a chapter, or at the beginning of the description of a region where necessary. This volume on the head and neck, brain, and spinal cord starts with the description of the bones, cavities, organs, muscles, vessels, and nerves of the head and neck. The brain and spinal cord are discussed in the following section. The last section in the volume presents a series of cross-sectional gross anatomy images, as well as computerized tomograms and magnetic resonance images of the head, neck and brain, to enable further understanding of the intimate relationship between the structures described here.

Dissection forms an integral part of learning anatomy, and the practice of dissections enables students to retain and recall anatomical details learnt in the first year of medical college during their clinical practice. To make the dissection process easier and more meaningful, in this edition, each dissection is presented with a heading, and a list of objectives to be accomplished. Many of the details of dissections have been retained from the earlier edition, but are presented as numbered, stepwise easy-to-follow instructions that help students navigate their way through the tissues of the body, and to isolate, define, and study important structures.

This manual contains a number of old and new features that enable students to integrate the anatomy learned in the dissection hall with clinical practice. Numerous X-rays, CTs, and MRIs enable the student to visualize internal structures in the living. Matters of clinical importance when mentioned in the text are highlighted.

A brand new feature of this edition is the presentation of one or more clinical application notes at the end of each chapter. Some of these notes focus attention on the anatomical basis of commonly used physical diagnostic tests such as the corneal and gag reflex. Others deal with the underlying anatomy of clinical conditions such as stroke, otitis media, and radiculopathy. Clinical anatomy of common procedures, such as tracheostomy, are described. Many clinical application notes are in a Q&A format that challenges the student to brainstorm the material covered in the chapter. Multiple-choice questions on each section are included at the end to help students assess their preparedness for the university examination.

It is hoped that this new edition respects the legacy of *Cunningham's* in producing a text and manual that is accurate, student friendly, comprehensive, and interesting, and that it will serve the community of students who are beginning their career in medicine to gain knowledge and appreciation of the anatomy of the human body.

Dr Rachel Koshi

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Dr Suganthy wrote the MCQs, reviewed manuscripts, and provided help and advice with the artwork.

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Acknowledgements

Dr Koshi would like to thank the following:

Radiology Department, Christian Medical College, Vellore, India.
The Radiology Department kindly provided the radiology images.

Ms Geraldine Jeffers, Senior Commissioning Editor, and **Karen Moore**, Senior Production Editor, and the wonderful editorial team of Oxford University Press for their assistance.

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Contents

PART 1

Head and neck

CHAPTER 1

Introduction to the head and neck

The section on head and neck deals with the bones, cavities, organs, muscles, vessels, and nerves of the head and neck. It does not include the study of the brain, which is dealt with in a separate section devoted to the brain and spinal cord.

The head and neck section begins with a description of the bones of the region—the cervical vertebrae and skull. The dissectors should study these bones and the bony prominences in the living, as a preliminary to the dissection of the head and neck.

The next few chapters (the scalp and face, anterior triangle, posterior triangle, and back of the neck) complete the superficial dissection of the head and neck. The cranial cavity and deeper structures of the head and neck (the orbit, ear, oral cavity, nasal cavity, pharynx, and larynx) are then dissected and described. The joints of the neck and contents of the vertebral canal are discussed last.

CHAPTER 2
The cervical vertebrae

Introduction

The following brief account of the cervical vertebrae should be studied together with the vertebrae, so that the details mentioned can be confirmed.

There are seven cervical vertebrae [Fig. 2.1]. The third to the sixth are typical. The first and second are modified to permit movements of the head on the neck. The seventh shows some features of a thoracic vertebra. All seven cervical vertebrae have a foramen—the **foramen transversarium**—in the transverse process.

Review the features of a typical vertebra as described in Vol. 2, Chapter 1. The bodies of the cervical vertebrae are smaller and more delicate than those in the thoracic and lumbar regions, as they carry less weight. But they have a larger vertebral foramen to accommodate the cervical swelling of the spinal cord [Fig. 2.2]. In the following descriptions, individual cervical vertebrae are identified as C. 1, C. 2, C. 3, etc., with C. 1 being the first cervical vertebra.

The typical cervical vertebrae

The body of the cervical vertebra is oval in shape, with its long axis transverse [Fig. 2.2]. The superior surface is concave from side to side, and the lateral margins project upwards to articulate with the cut-away inferolateral margins of the body above. The pedicles are short and are directed laterally and backwards from the middle of the posterolateral parts of

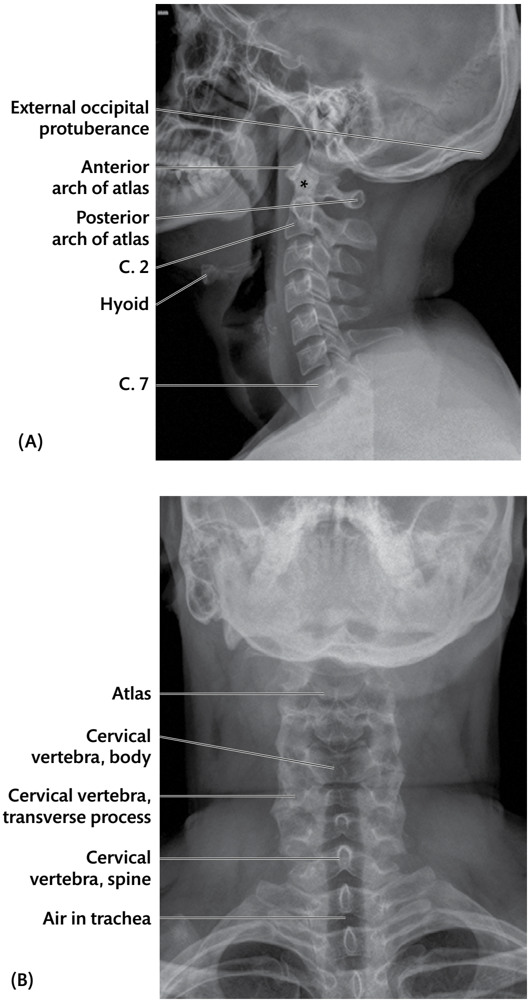

Fig. 2.1 (A) Lateral radiograph and (B) anteroposterior (AP) view of the neck. C. 2, C. 7 = second and seventh cervical vertebrae, respectively. * = dens.

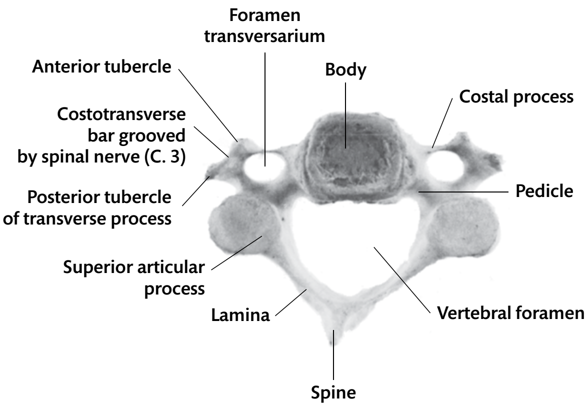

Fig. 2.2 The third cervical vertebra, superior surface.

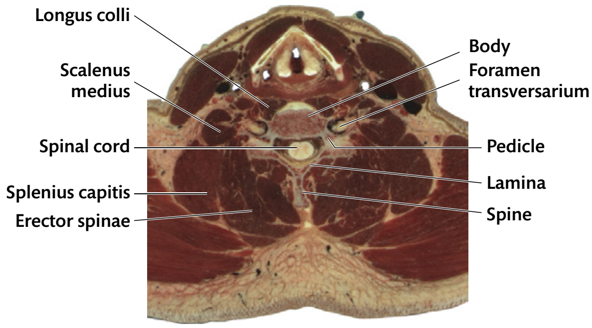

Fig. 2.4 Cervical vertebra, spinal cord, and surrounding muscles seen in a transverse section of the neck.

Image courtesy of the Visible Human Project of the US National Library of Medicine.

the body. They form the posteromedial wall of the foramen transversarium. The laminae are long and rectangular, and almost overlap the adjacent vertebrae in extension. The spines are short and bifid.

The superior and inferior articular processes are short bars of bone at the junction of the pedicle and lamina on each side [Fig. 2.3]. The superior and inferior aspects of the process are obliquely cut to form the articular facets. The superior facets face upwards and backwards, and the inferior facets face downwards and forwards.

The vertebral foramen is large and triangular in shape [Fig. 2.2]. Each transverse process is short and perforated by the foramen transversarium. Anterior to the foramen is a bar of bone—the **costal process**—which projects laterally from the body to the end of the anterior tubercle. The costal process corresponds to the rib and gives attachment to two muscles—the scalenus anterior and longus capitis. Behind the foramen, the true transverse process projects laterally from the junction of the pedicle and lamina. It ends in the posterior tubercle. This tubercle gives attachment to the scalenus medius and other muscles. A bar of bone—the **costotransverse bar**—unites the anterior and posterior tubercles and completes the foramen transversarium. It is concave superiorly and has the ventral ramus of the corresponding spinal nerve lying on it. The foramen transversarium transmits the vertebral artery (C. 1–C. 6 only), vertebral veins, and sympathetic plexus. Fig. 2.4 is a section through the neck showing the cervical vertebra.

The atypical cervical vertebrae

C. 1 (atlas)

The first cervical vertebra has no body and consists only of two **lateral masses** united by an **anterior** and a **posterior arch** [Fig. 2.5]. (The body

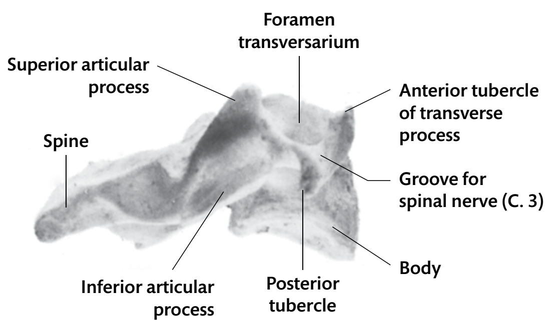

Fig. 2.3 The third cervical vertebra, right surface.

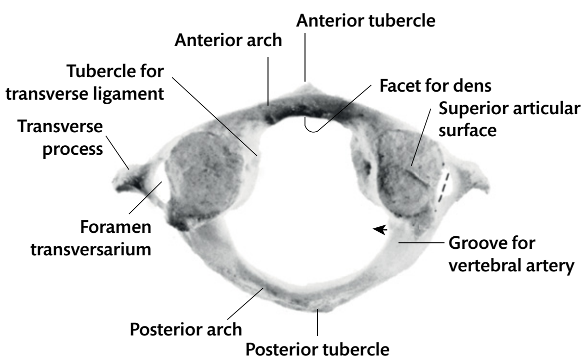

Fig. 2.5 The upper surface of the atlas. The course of the vertebral artery is indicated by a broken line.

of C. 1 is represented by a tooth-like projection from the superior surface of the body of C. 2—the dens.) Each lateral mass has a long, stout transverse process projecting laterally from it. The posterior arch is grooved on its superior surface, behind the lateral mass, by the vertebral artery and the first cervical ventral ramus. The **posterior tubercle** on the posterior arch represents the spine. The superior and inferior **articular facets** lie on the lateral masses anterior to the first and second cervical nerves, respectively. The superior facet is concave and kidney-shaped for articulation with the occipital condyles. The inferior facet is almost circular and slightly concave, and faces downwards and medially. It articulates with the axis. An inward projection from each lateral mass gives attachment to the **transverse ligament of the atlas** which divides the vertebral foramen into a small anterior compartment for the dens, and a larger, oval posterior compartment for the spinal cord and its coverings. The **transverse process** of the atlas is long and thick, and lacks an anterior tubercle. Its **foramen transversarium** is lateral to those of the vertebrae below.

C. 2 (the axis)

The salient feature of the second cervical vertebra is the **dens** [Fig. 2.6]. The dens articulates with, and is held against, the anterior arch of the atlas by the transverse ligament of the atlas. The transverse ligament grooves the posterior surface of the dens.

The thick **pedicle** projects posterolaterally from the side of the body. The **superior articular facet** covers the pedicle, part of the body, and part of the foramen transversarium. It is flatter than the inferior facet of C. 1, with which it articulates. The inferior facet of the axis is typical.

The **laminae** of the axis are thickened for muscle attachments and unite to form a massive **spine**. The transverse process has no anterior tubercle. The **foramen transversarium** turns laterally through 90 degrees under the superior articular facet, so that it is visible from the lateral aspect.

C. 7

The **spine** of the seventh cervical vertebra is long and non-bifid. The **transverse process** does not have an anterior tubercle, and the **foramen transversarium** transmits only veins (not the vertebral artery).

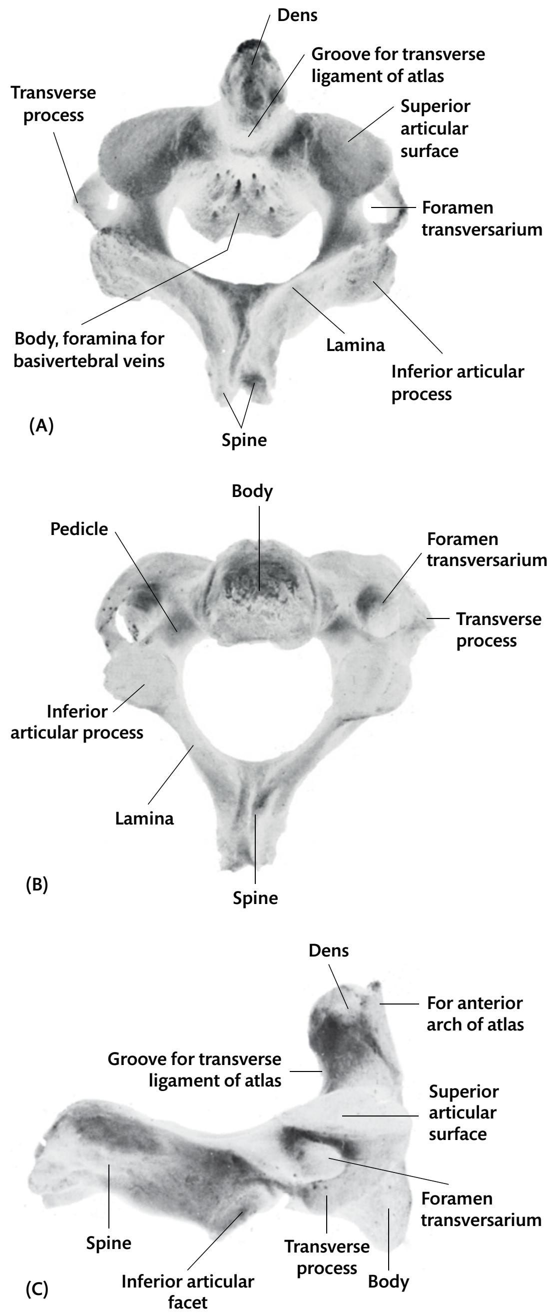

Fig. 2.6 The axis vertebra seen (A) from behind and above, (B) from below, and (C) from the right side.

Surface projections of cervical vertebrae

The **spine of the axis** is palpable at the nape of the neck about 5 cm below the external occipital protuberance.

The **spine of C. 7** (vertebra prominens) is the prominence felt at the root of the neck in the midline.

The **transverse process of C. 1** is palpable through the anterior border of the sternocleidomastoid immediately below the tip of the mastoid process.

See Clinical Application 2.1 for the practical implications of the anatomy discussed in this chapter.

CLINICAL APPLICATION 2.1 Fracture of cervical vertebrae

A 23-year-old biker sustained severe injuries on the face and multiple injuries to the body in a road traffic accident. He was semi-conscious, but completely unable to move both upper and lower limbs. On examination, he had pain and tenderness of the neck, with radiation of pain from the neck to the shoulder. He was carefully moved from the accident site by trained paramedics.

Study question 1: what diagnosis should you consider? (Answer: fracture of cervical vertebrae with compression of the spinal cord. Cervical vertebral injury usually occurs in high-velocity impact in road traffic accidents, sports, and bullet injury to cervical vertebrae.)

Study question 2: what measures should be undertaken while shifting the patient from the accident site? (Answer: fracture of cervical vertebrae can cause compression of the cervical spinal cord. Hence, the neck should be immobilized during transfer. X-rays or computerized tomography (CT) may need to be done to assess fracture of cervical vertebrae.)

Study question 3: what are the complications of cervical fracture? (Answer: fracture of cervical vertebrae can cause damage of the spinal cord, leading to spinal shock, quadriplegia, or even death.) Spinal shock is caused by a concussion injury to the spinal cord. It manifests as a transient flaccid quadriplegia, with complete loss of reflexes that slowly begin to recover after 24 hours. Recovery is usually complete in spinal shock. Quadriplegia is irreversible, partial, or complete loss of motor and sensory function involving all four limbs.

Study question 4: what is the cause for the radiating pain? (Answer: pain radiating from the neck to the shoulder indicates compression of nerve roots by fractured segments.)

Study question 5: how is cervical fracture treated? (Answer: mild compression fractures may be treated with just a cervical brace. More severe fractures may require surgery and traction.)

CHAPTER 3

The skull

General architecture of the skull

The skeleton of the head is the skull. It is formed by a number of separate bones, almost all of which meet each other at linear fibrous joints—the sutures. Sutures are narrow gaps between adjacent bones, filled with dense fibrous tissue in early life. Bony fusion across the fibrous tissue begins after 30 years of age. The mandible (bone of the lower jaw) articulates with the skull at a synovial joint—the temporomandibular joint—the only movable joint in the skull. The skull without the mandible is the **cranium**. For descriptive purposes, the cranium is divided into the neurocranium and viscerocranium. The neurocranium surrounds the brain and its coverings (meninges) and increases in depth from anterior to posterior. The viscerocranium is the facial skeleton and lies inferior to the shallow, anterior part of the neurocranium.

A number of bony foramina are present in the skull, especially at the base. These give passage to nerves and vessels entering and leaving the skull. You should note the positions of these foramina and relate it to the structures which pass through them as you proceed with the study of the head, neck, and brain.

External features of the skull

Frontal or anterior view of the skull

Examine the frontal or anterior aspect of the skull and identify the bones seen in this view. They are the frontal bone, ethmoid, lacrimal bone, maxilla, zygomatic bone, nasal bone, and mandible [Fig. 3.1A]. The bone of the forehead is the **frontal bone**. It consists of right and left halves which usually fuse together early in life. From the top of the head, the frontal bone curves antero-inferiorly to the superior margins of the orbits and the root of the nose. It also forms portions of the roof of the orbits (the sockets for the eyeballs), the roof of the nasal cavities, and the nasal septum between the two nasal cavities. The **frontal eminence** is the most prominent and convex part of the frontal bone.

The main elements of the facial skeleton are the right and left **maxillae**. The body of each maxilla lies below the orbit, lateral to the nasal cavity. It has the shape of a three-sided pyramid and contains the **maxillary air sinus**. The body has (1) an anterolateral or anterior surface; (2) a posterolateral or infratemporal surface; and (3) a superior or orbital surface. The base is directed medially and forms the lateral wall of the nasal cavity. The apex points laterally and is overlapped by the **zygomatic bone** (cheek bone). The anterior surface projects on the face; the posterolateral surface forms the anterior wall of the infratemporal fossa, and the superior surface forms the floor of the orbit.

The curved alveolar process of the maxilla projects down from the body of the maxilla and bears the sockets for the upper teeth. Medial to the orbit, the maxilla articulates directly with the frontal bone through the **frontal process of the maxilla**. This process forms the lower part of the medial margin of the orbit. It articulates anteriorly with the **nasal bone** and posteriorly with the **lacrimal bone**. The lacrimal bone articulates posteriorly with the orbital plate of the **ethmoid** to form the greater part of the **medial wall of the orbit**. [Further details of the bony orbit are described in Chapter 11.]

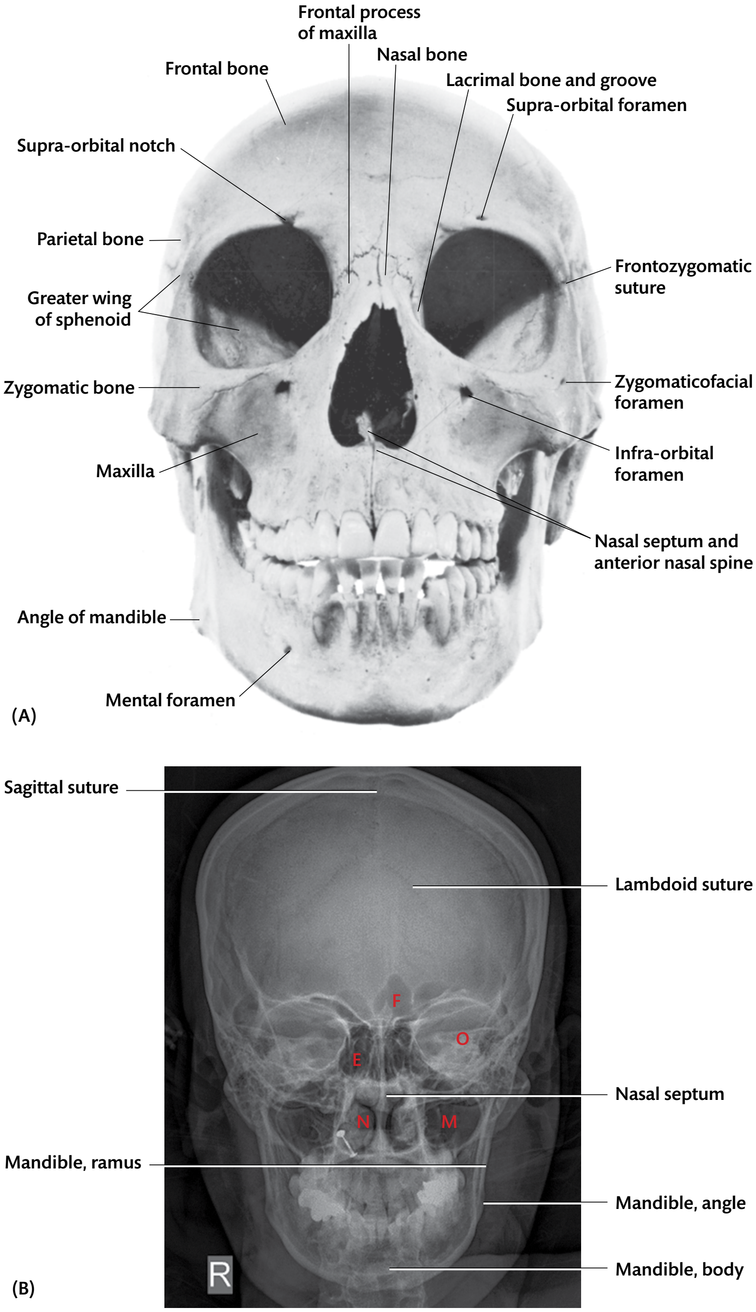

Fig. 3.1 (A) Anterior view of the skull. The alveolar bone has been worn away from the roots of the anterior teeth in the mandible. (B) Plain X-ray of the skull—anteroposterior view. E = ethmoid air sinus. F = frontal air sinus. M = maxillary air sinus. N = nasal cavity. O = orbit. (A nose pin is seen on the right side.)

The zygomatic bone forms the prominence of the cheek and articulates with the apex of the maxilla. The **frontal process** of the zygomatic bone extends upwards along the lateral margin of the orbit to meet the zygomatic process of the frontal bone. It forms the lateral wall of the orbit with the greater wing of the sphenoid bone. The zygomatic bone between the orbit and anterior surface of the maxilla forms the lateral half of the inferior orbital margin.

The anterior nasal aperture lies in the midline and is pear-shaped. The inferior and lateral margins of the aperture are formed by the maxilla. The superior margin is formed by the two nasal bones, which articulate with each other in the midline. The bony nasal septum seen between the two nasal cavities is formed partly by the perpendicular plate of **ethmoid bone**. The ethmoid bone also forms parts of the lateral wall of the nasal cavities. Inferior to the nasal aperture, the two maxillae are firmly united in the median plane by the articulation of the alveolar processes.

The bone of the lower jaw is the **mandible**. Identify the horizontal **body** of the mandible which bears the alveolar sockets for the lower teeth. The lower border of the body extends laterally to the **angle** of the mandible. The two halves of the mandible are fused together in the adult at the **symphysis menti**. The **mental foramen** lies about 4 cm lateral to the midline between the alveolar border and the lower border of the mandible. In the living, it is felt as a slight depression. Fig. 3.1B is a plain radiograph of the skull, anteroposterior view.

Superior view of the skull

The vault of the skull is formed by the frontal bone in front, the two parietal bones laterally, and the occipital bone at the back. The frontal bones have been described in the anterior view. The two **parietal bones** articulate anteriorly with the frontal bone at the **coronal suture**, and with each other in the midline at the **sagittal suture**. From the sagittal suture, the parietal bones arch downwards and laterally and form the greatest and widest part of the dome of the skull. Paired parietal foramina are seen on either side of the sagittal suture. Posteriorly, the parietal bones articulate with the **squamous part of the occipital bone**, at the **lambdoid suture**. The **parietal eminence** is the most convex and prominent part of the parietal bone [Fig. 3.2].

The meeting point of the coronal and sagittal sutures is the **bregma**. It represents the position of the **anterior fontanelle** in the infant. The meeting point of the sagittal and lambdoid sutures is the **lambda**. It represents the position of the **posterior fontanelle** in the infant [Fig. 3.2].

Posterior view of the skull

Most of the posterior aspect of the skull is made up of the parietal and occipital bones, with a small contribution from the temporal bone. The parietal bones make up the superior and lateral aspects. The upper part of the squamous part of the occipital bone lies in the interval between the diverging posterior margins of the parietal bones. The posterior aspect of the mastoid process of the temporal bone is seen inferolaterally. In the lambdoid suture, small bones called sutural bones or wormian bones are often present [Fig. 3.3].

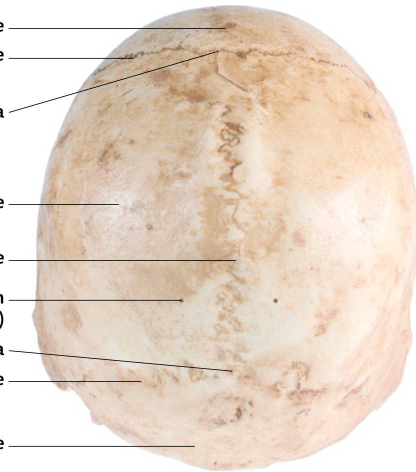

Fig. 3.2 Superior view of the skull.

The **external occipital protuberance** is a midline projection seen at the lower part of the posterior view. On either side, bony linear elevations—the **superior nuchal lines**—extend laterally from the external occipital protuberance. Parallel and approximately 1 cm superior to the superior nuchal lines are faint bony ridges—the **highest nuchal lines**.

At the lower end, the lambdoid suture is continuous with the parietomastoid suture between the parietal bone and the mastoid process, and with the occipitomastoid suture between the occipital bone and the mastoid process [Figs. 3.3, 3.4A].

Lateral view of the skull

Start your study of the lateral view of the skull by identifying the parts of the frontal, parietal, occipital, maxilla, and zygomatic bones described in the anterior and superior views [Fig. 3.4A]. Review the zygomatico-frontal suture on the lateral wall of the orbit, and the coronal, lambdoid, parietomastoid, and occipitomastoid sutures.

The **temporal process** of the zygomatic bone forms the broad, anterior part of the **zygomatic**

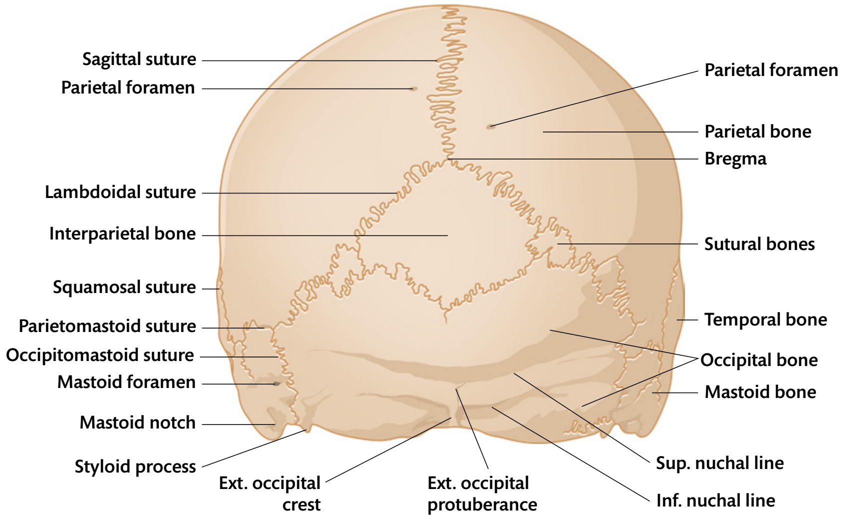

Fig. 3.3 Posterior view of the skull. Note the presence of the sutural bone and the large interparietal bone.

arch lateral to, and below, the orbit. It joins the zygomatic process of the temporal bone to complete the arch.

The **greater wing of the sphenoid** forms the lateral wall of the skull behind the orbit. It articulates anteriorly with the frontal and zygomatic bones, superiorly with the frontal and parietal bones, and posteriorly with the squamous part of the temporal bone. The 'H'-shaped area where the frontal, parietal, temporal, and sphenoid bones meet is called the **pterion**.

Various parts of the **temporal** bone are seen on the lateral surface. The **squamous part of the temporal bone** lies below the inferior margin of the parietal bone. Anteriorly, it articulates with the greater wing of the sphenoid. Superiorly and posteriorly, it articulates with the parietal bone, at the **squamosal suture**. The **zygomatic process** of the temporal bone arises from the postero-inferior aspect of the squamous part. It turns forwards to join the temporal process of the zygomatic bone, to form the zygomatic arch. At the root of the zygomatic process of the temporal bone is the **tubercle**, which is immediately anterior to the head of the mandible when the mouth is shut, but above it when the mouth is open.

Below the root of the zygomatic process, the inferior surface of the squamous part has a large notch—the **mandibular fossa**—for articulation with the head of the mandible. Behind the mandibular fossa is the **tympanic part** of the temporal bone, which forms the anterior, inferior, and lower part of the posterior wall of a bony canal—the **external acoustic meatus**. Anteriorly, the **tympanic part** of the temporal bone meets the squamous part in the posterior wall of the mandibular fossa at the **squamotympanic fissure**. Posteriorly, the tympanic part of the temporal bone fuses with the mastoid process. Also seen in this view is the **styloid process of the temporal bone**, projecting downwards and forwards from the base of the skull [Fig. 3.5].

The **supramastoid crest** is a blunt ridge which begins immediately above the external acoustic meatus and curves posterosuperiorly. It is continuous superiorly with the **superior** and **inferior temporal lines** which curve forwards, marking the upper limit of the temporal region. (The temporal fossa is limited above by the superior temporal line and below by the zygomatic arch [Fig. 3.4A].)

Below the zygomatic arch is the ramus of the mandible—a wide, flat plate of bone which extends superiorly from the posterior part of the body. It ends superiorly in the **condylar** and **coronoid processes** of the mandible. The condylar process projects upwards from the posterior margin of the ramus and forms the **neck** and **head** of the mandible [Fig. 3.4A]. Fig. 3.4B is a lateral radiograph of the skull.

Disarticulate the mandible to get a fuller appreciation of the lateral view of the cranium.

Behind the maxilla, two plates of bone—the **medial** and **lateral pterygoid plates** or

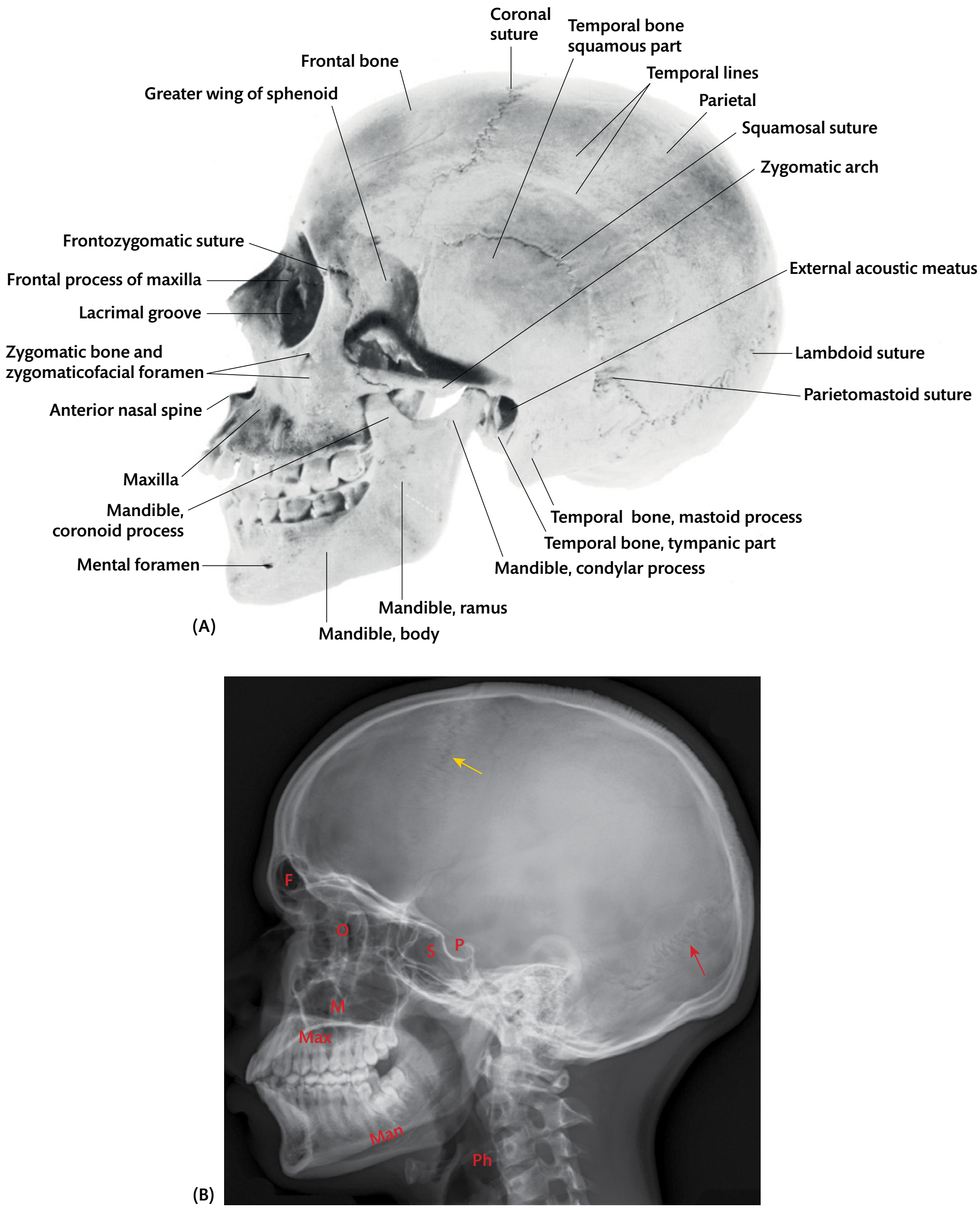

Fig. 3.4 (A) Lateral view of the skull. (B) Lateral radiograph of the skull. F = frontal sinus. M = maxillary sinus. Man = mandible. Max = maxilla. O = orbit. P = pituitary fossa. Ph = pharynx. S = sphenoid sinus. Yellow arrow = coronal suture. Red arrow = lambdoid suture.

laminae—extend downwards and forwards from the base of the sphenoid bone. Inferiorly, the anterior border of the pterygoid plates articulates with the maxilla. Superiorly, the two pterygoid laminae are separated from the maxilla by a narrow fissure—the **pterygomaxillary fissure**. The region lateral to the lateral pterygoid lamina is the **infratemporal fossa** [Fig. 3.5]. (The medial pterygoid plate is not seen in the lateral view.)

Inferior view of the skull

The inferior surface of the skull is described after disarticulating the mandible. It extends from the upper central incisors anteriorly to the external

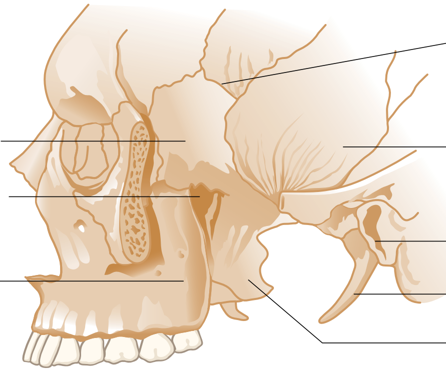

Fig. 3.5 Lateral view of the cranium. (The mandible and zygomatic arch have been removed.)

occipital protuberance posteriorly. It is important to appreciate that the posterior two-thirds of the skull overlie, and are continuous with, the structures in the neck [Figs. 3.6, 3.7].

From the upper margins of the alveolar processes, the **palatine processes of the maxilla** extend horizontally inwards to meet in the midline. Posteriorly, the palatine processes of the maxilla articulate with the **horizontal plates of the palatine bone** to complete the hard palate. As such, the anterior two-thirds of the bony palate are formed by the palatine processes of the maxillae, and the posterior one-third by the horizontal plates of the palatine bones. The hard palate separates the nasal cavities from the oral cavity. Lying lateral to the hard palate, and separated from it by the alveolar arch, are the maxillae and zygomatic bones.

Posterior to the hard palate, and close to the midline, is the **pharyngeal part** of the base of the skull. It is formed by the **body of the sphenoid**

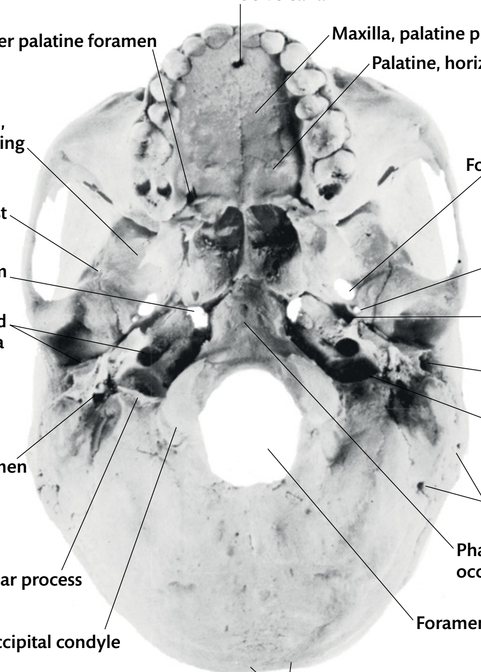

Fig. 3.6 The external surface of the base of the skull. Two molar teeth are missing on the left of the picture, one and a half on the right.

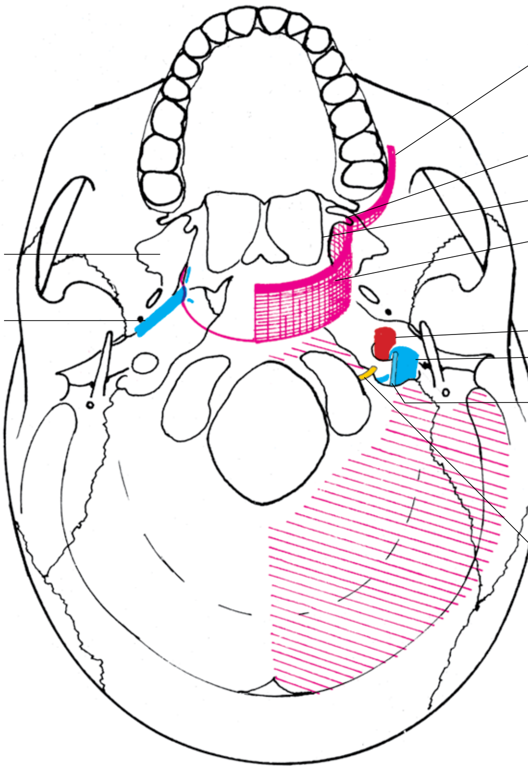

Fig. 3.7 External surface of the base of the skull to show the position of the superior constrictor, buccinator, and auditory tube.

(which is overlapped by the **vomer**) and the **basilar part of the occipital bone**. A small midline prominence on the basilar part of the occipital bone, 1 cm anterior to the foramen magnum, is the **pharyngeal tubercle**. About 1.5 cm from the midline, the two **pterygoid processes** descend from the body of the sphenoid. Each pterygoid process is formed by a **medial** and **lateral pterygoid plate**, which are fused together anteriorly, but separated from each other by the **pterygoid fossa** posteriorly. Inferiorly, the posterior margin of the medial pterygoid plate curves laterally as the **pterygoid hamulus** [Fig. 3.7].

Lateral to the lateral pterygoid plate lies the greater wing of the sphenoid. Traced laterally, this plate of bone turns sharply at the **infratemporal crest** to continue on the lateral surface of the skull. Laterally and posteriorly, the greater wing of the sphenoid articulates with the squamous and petrous parts of the temporal bone. The spine of the sphenoid is a small, sharp bony projection at the posterolateral angle of the greater wing.

A number of important foramina are seen in this region. On the greater wing of the sphenoid are the **foramen ovale** and **foramen spinosum**. The **foramen lacerum** lies at the apex of the petrous part of the temporal bone and is bounded by that bone, the basilar part of the occiput, and the body of the sphenoid. On the inferior aspect of the petrous part of the temporal bone is the **carotid canal**. The **stylomastoid foramen** lies between the styloid and mastoid processes of the temporal bone [Fig. 3.6]. The bony part of the auditory tube lies in the groove between the greater wing of the sphenoid and the petrous temporal bone [Fig. 3.7].

Between the infratemporal crest on the greater wing of the sphenoid and the lateral pterygoid lamina is the **infratemporal fossa**.

Posterior to the pharyngeal area on the base of the skull is the area for attachment to the pre- and post-vertebral muscles of the neck. Identify the large **foramen magnum** which lies in this region [Fig. 3.6]. The foramen magnum is oval and is longer than it is wide. The anterolateral margin of the foramen magnum has an oval, curved articular facet—the **occipital condyle**. The occipital condyles articulate with the superior articular facets of the first cervical vertebra—the atlas [see Fig. 2.5]. Lateral to the condyle is the jugular process of the occipital bone, which articulates with the temporal bone to form the **jugular foramen**. The jugular foramen lies immediately posterior to the carotid canal. The **hypoglossal canal** for the twelfth cranial nerve lies immediately above the occipital condyles.

Posterior to the foramen magnum, the greater part of the inferior surface of the cranium is formed by the occipital bone. This surface is roughened by the attachment of the muscles of the back of the neck. This area is divided transversely by an ill-defined **inferior nuchal line** and is limited posteriorly by the **external occipital protuberance** in the midline and the **superior nuchal line** which extends laterally from it [Fig. 3.6].

Internal features of the skull

Internal features of the vault

The cranial vault or calvaria is oval in shape. The internal surface is deeply concave and is made up of the squamous part of the frontal bone in front, the two parietal bones behind it, and the squamous part of the occipital bone behind. Note the coronal suture between the frontal and parietal bones, the sagittal suture between the two parietal bones, and the lambdoid suture between the occipital and parietal bones [Fig. 3.8].

Internal features of the base of the cranial cavity

The inferior aspect of the cranial cavity supports the brain. It is divided into three distinct fossae—the **anterior**, **middle**, and **posterior** cranial fossae [Fig. 3.9].

Anterior cranial fossa

The floor of the anterior cranial fossa is formed by the orbital plates of the frontal bone which project posteriorly above the orbit. They are separated from each other by the **cribriform plate** of the **ethmoid bone** which lie in the roof of the nasal cavities. In the midline, a bony ridge—the **crista galli**—projects upwards between the two anterior cranial fossae. A small foramen—the **foramen caecum**—lies anterior to the crista galli and transmits an emissary vein. Posteriorly, the anterior cranial fossa is formed by the body of the sphenoid in the midline, and the two lesser wings of the sphenoid laterally. The ethmoid and orbital plates of the frontal bone articulate with the sphenoid to complete the floor of the anterior cranial fossa.

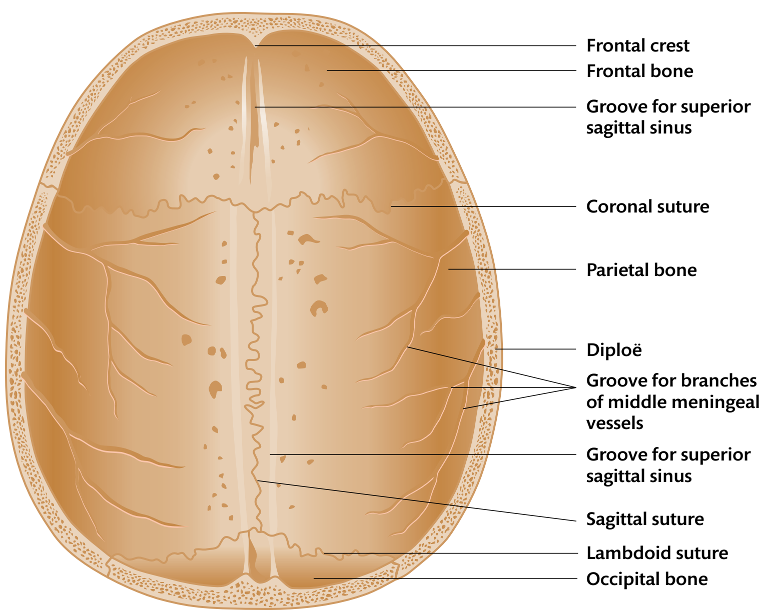

Fig. 3.8 Internal surface of the calvaria.

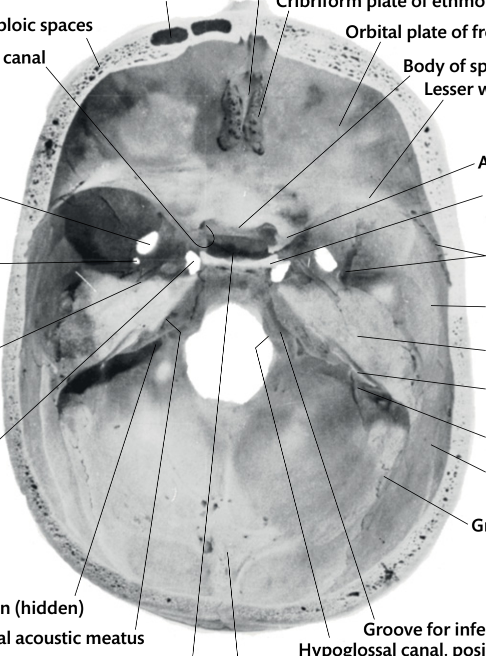

Fig. 3.9 Internal surface of the base of the skull.

Each lesser wing of the sphenoid has a free curved posterior margin which forms the posterior limit of the anterior cranial fossa and ends medially in an **anterior clinoid process**. The anterior clinoid process lies immediately lateral to the optic canal. Laterally, the tip of each lesser wing fuses with the corresponding greater wing of the sphenoid bone. Between the greater and lesser wings of the sphenoid is the **superior orbital fissure**.

Middle cranial fossa

In the midline, the floor of the **middle cranial fossa** is narrow and formed by the **body of the sphenoid**. The central part of the body is hollowed out to form the **hypophysial fossa** which lodges the pituitary gland [Fig. 3.4B]. The hypophysial fossa is limited posteriorly by a rectangular plate of bone—the **dorsum sellae**. The superolateral corners of the dorsum sellae project upwards as the **posterior clinoid processes**. Anteriorly, the fossa is limited by the **tuberculum sellae**, with the horizontal **sulcus chiasmatis** in front of it. On each side, the sulcus leads into an **optic canal**, which transmits the corresponding optic nerve and ophthalmic artery.

The lateral part of the middle cranial fossa is made up mainly of the greater wing of the sphenoid. Each **greater wing** is roughly rectangular in shape and projects laterally from the body. The anterior part of the greater wing has an upturned portion which articulates superiorly with the lesser wing of the sphenoid and the inferior margins of the frontal and parietal bones. The **foramen rotundum** is present on the greater wing of the sphenoid, close to the body, near the medial end of the superior orbital fissure. More posteriorly are the **foramen ovale** and the **foramen spinosum**. The anterior surface of the **petrous part of the temporal bone** forms the posterior part of the floor of the middle cranial fossa.

The apex of the petrous temporal bone is directed towards the body of the sphenoid. The **foramen lacerum** lies between the apex of the petrous temporal bone and the body of the sphenoid [Fig. 3.9].

Posterior cranial fossa

The posterior cranial fossa is large and deep. In the midline, it is made up of the posterior surface of the dorsum sellae in front, followed by the posterior surface of the body of the sphenoid, the basilar part of the occipital bone, and the squamous part of the occipital bone. The **foramen magnum** separates the basilar and squamous parts of the occipital bone. The sloping cranial surface of the median parts of the sphenoid and occipital bones are together known as the **clivus**.

The lateral margin of the basilar part of the occipital bone is separated from the **petrous part of the temporal bone** by the **petro-occipital fissure**. The **jugular foramen** is a large opening situated at the posterior end of this petro-occipital suture. The **hypoglossal canal** lies medial to the jugular foramen, immediately above the anteromedial margin of the foramen magnum. The posterior surface of the petrous part of the temporal bone forms the anterior limit of the posterior cranial fossa laterally. The **internal acoustic meatus** is present on this surface. The medial surface of the **mastoid part of the temporal bone** forms the lateral wall of the posterior cranial fossa. The squamous part of the occipital bone forms a large part of the floor of the posterior cranial fossa. In the midline, a linear elevation—the internal occipital crest—extends backwards from the foramen magnum and ends in a bony prominence—the **internal occipital protuberance**. Extending laterally from the internal occipital prominence to the mastoid angle of the parietal bone is a groove for the transverse sinus. At the lateral end, the groove for the transverse sinus continues with the groove for the sigmoid sinus on the petrous temporal bone. Four shallow fossae are present—two below the groove for the transverse sinus, and two above it [Fig. 3.9].

See Clinical Applications 3.1 and 3.2 for the practical implications of the anatomy discussed in this chapter.

CLINICAL APPLICATION 3.1 Anterior fontanelle

The fontanelles are fibrous, membranous gaps between the bones of the vault of the cranium. They are present in the infant and are found at the four angles of the parietal bone where ossification is not yet complete. The anterior fontanelle is the largest. It is diamond-shaped and situated at the junction of the sagittal and coronal sutures. It usually closes by 18 months of age.

Palpation of the anterior fontanelle is an important clinical examination in the infant. A tense, bulging fontanelle may indicate raised intracranial pressures due to meningitis or obstruction to flow of cerebrospinal fluid (CSF). A sunken fontanelle is a sign of dehydration. Delayed closure of the anterior fontanelle commonly occurs in achondroplasia, rickets, and hypothyroidism.

CLINICAL APPLICATION 3.2 Fracture of mandible

A 24-year-old male presented with multiple facial lacerations, following a road traffic accident. Examination revealed severe pain and swelling of the lower jaw, intra-oral bleeding, and an inability to open the mouth. Examination revealed deformity of the lower jaw and loss of sensation over the lower lip.

Study question 1: what is the likely diagnosis? (Answer: fracture of the mandible.)

Study question 2: which are the common sites of fracture of the mandible? (Answer: the mandible is the most common facial bone to be fractured in facial trauma. The second is the maxilla. Common sites of fracture of the mandible include: the coronoid process and the body and angle of the mandible. Fractures involving the coronoid process cause swelling over the temporomandibular joint, severe limitation of mouth opening, and deviation of the jaw to the affected side on opening the mouth.)

Study question 3: why is there loss of sensation of the lower lip? (Answer: injury to the mental branch of the inferior alveolar nerve causes paraesthesiae or loss of sensation over the lower lip [Chapter 4].)

Study question 4: how are fractures of the mandible treated? (Answer: the aim of fracture reduction is functional alignment of bone fragments and restoration of normal occlusion. This can be achieved by reduction, followed by immobilization. Reduction and alignment of fractured segments can be done using surgical incisions of the oral mucosa (open reduction) or simple manipulation without any incision (closed reduction). Immobilization can be achieved with the help of plates and screws or wires.)

CHAPTER 4

The scalp and face

Introduction

We begin the study of the head with dissection of the scalp, including the temple, and the face. The chapter also includes the study of the lacrimal apparatus.

Surface anatomy

Begin by identifying the bony and soft tissue landmarks of the head by examining your own head and those of your partners.

Auricle

The external ear lies nearer the back of the head than the front and is at the level of the eye and nose. The main parts of the auricle or external ear—the lobule, helix, antihelix, tragus, antitragus, and intertragic notch—are shown in Fig. 4.1.

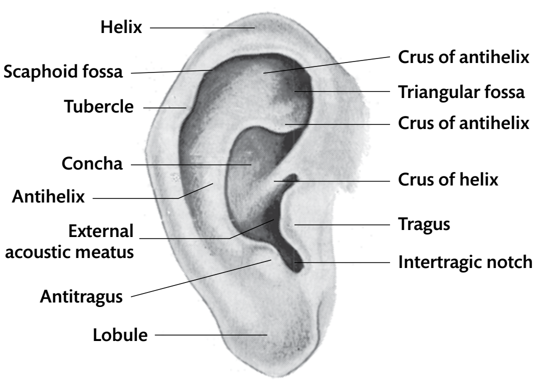

Fig. 4.1 The auricle.

Back and side of the head

The **external occipital** protuberance is the midline bony elevation felt where the back of the head joins the neck. From this protuberance, an indistinct, curved ridge—the **superior nuchal line**—extends laterally on each side between the scalp and the neck. The superior nuchal line passes towards the corresponding **mastoid process**—a rounded bony elevation behind the lower part of the auricle. Press your finger into the surface depression below and in front of the mastoid process. The resistance felt is the transverse process of the atlas. It is covered by the lower part of the parotid salivary gland, the anterior border of the sternocleidomastoid muscle, and the accessory nerve.

At the lateral end of the eyebrow, feel for the anterior end of the **temporal line**. The **parietal** and **frontal eminences** are the most convex parts of the parietal and frontal bones. The **vertex** is the topmost part of the head.

Face

External nose

The term 'nose' includes the paired nasal cavities which extend posteriorly from the nostrils to the pharynx. The mobile anterior part of the external nose consists of skin and cartilage. The rigid upper part—the bridge of the nose—is formed by the two **nasal bones** and the two **frontal processes of the maxillae** [see Fig. 3.1]. The skin is adherent to the cartilages but is mobile over the bones. The part of the nasal cavity immediately above each nostril is the **vestibule of the nose**. The vestibule is lined by hairy skin, and its lateral wall is expanded to form the **ala** of the nose.

Lips, cheeks, and teeth

The lips and cheeks are composed primarily of muscle and fat. They are covered on the external surface with skin, and lined on the internal surface with mucous membrane. The space that separates the lips and cheeks from the teeth and gums is the **vestibule of the mouth**. A full set of adult **teeth** consists of 32 teeth, 8 in each half of the jaw. From before backwards, these are: two incisors, one canine, two premolars, and three molars. There are 20 teeth in the primary dentition, i.e. five in each half of the jaw: two incisors, one canine, and two molars, also called 'milk' molars. The **oral fissure**, the gap or space between the lips, is opposite the biting edge of the upper teeth. The corner or angle of the mouth is opposite the first premolar tooth. The median groove on the external surface of the upper lip is the **philtrum**. In the midline, the internal surface of each lip is attached to the gum by a fold of mucous membrane—the **frenulum of the lip**.

Mandible

Identify the horizontal **body** of the mandible below the lower lip and cheeks. Follow the lower border of the mandible backwards to its **angle**. The wide, flat plate of bone which extends superiorly from the posterior part of the body is the **ramus** of the mandible. The ramus of the mandible is covered laterally by the masseter muscle, so that only its posterior border is felt easily. The condylar process projects upwards from the posterior margin of the ramus and forms the **neck** and **head** of the mandible. The neck lies immediately anterior to the lobule of the auricle; the head lies anterior to the tragus. Place your fingertip in front of your own tragus, and open your mouth. The fingertip slips into a shallow depression created when the head of the mandible glides downwards and forwards. Note that the mouth cannot be closed while the finger remains in this fossa. The two halves of the mandible are united in the midline by the **symphysis menti**. The **mental foramen** is felt as a slight depression on the anterior surface of the mandible, about 4 cm from the midline, halfway between the edge of the gum and the lower border of the mandible [Fig. 4.2].

Zygomatic arch

Palpate the zygomatic arch which extends over the interval between the ear and the eye. The narrow posterior part is formed by the zygomatic process of the temporal bone, and the anterior part by the zygomatic bone [see Fig. 3.4].

Orbit

The bony structure of the orbit has been described in part in Chapter 3. Palpate the orbital margins on yourself, and find: (1) the **supra-orbital notch** on the highest point of the superior margin, about 2.5 cm from the midline; and (2) the **frontozygomatic suture** at the supero-lateral angle [see Figs. 3.1, 3.4].

Eyebrow

The hairy skin above the supra-orbital margin is the eyebrow. Over its medial end is a curved ridge of bone—the superciliary arch. This is well formed only in males and is separated from its fellow on the other side by a smooth median area—the **glabella**.

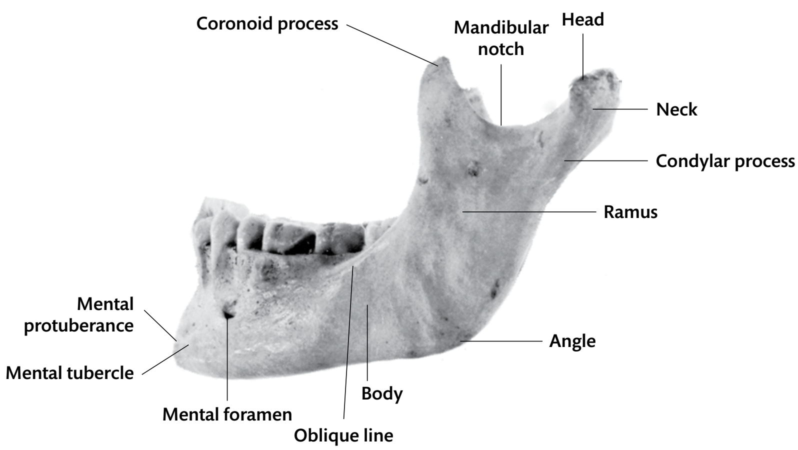

Fig. 4.2 Mandible viewed from the left side.

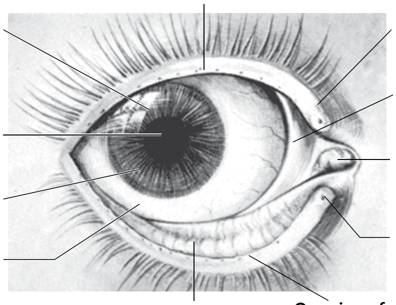

Fig. 4.3 Eyeball and eyelids. Eyelids are slightly everted to show part of the conjunctival sac.

Eye

The white of the eye is the **sclera**. The transparent part of the front of the eye is the **cornea**. The coloured **iris** (usually black or dark brown) is seen through the cornea and has a dark, circular central aperture—the **pupil**. The visible part of the sclera is covered with a moist, transparent membrane—the **conjunctiva**. The conjunctiva passes from the sclera on to the deep surface of the eyelids. The reflection of the conjunctiva on to the eyelids is the **fornix of the conjunctiva**, and the entire conjunctiva encloses the **conjunctival sac**. The sac opens anteriorly between the eyelids through the palpebral fissure [Fig. 4.3].

Eyelids

The eyelids or palpebrae are folds which protect the front of the eye. Each time we blink, the eyelids moisten the exposed surface of the eyeball by spreading lacrimal fluid over it. The upper lid is larger and more mobile than the lower one, and the upper conjunctival fornix is much deeper. When the eyes are closed, the **palpebral fissure** is nearly horizontal and lies opposite the lower margin of the cornea. When the eyes are open, the margins of the eyelids overlap the cornea slightly, the upper eyelid more than the lower.

At the medial angle of the eye is a small, triangular area known as the **lacus lacrimalis**, with a reddish elevation—the **lacrimal caruncle**—near its centre. The lacus carries a few fine hairs which filter the lacrimal fluid passing to the lacrimal canaliculi. Just lateral to the lacus is a small, vertical fold of conjunctiva—the **plica semilunaris** [Fig. 4.3].

The lower eyelid is easily everted by pulling down the skin below it, and the lower fornix is exposed by turning the eyeball upwards. The upper lid is difficult to evert because of the rigid **tarsal plate** buried in it. Once everted, the upper eyelid tends to remain so. Even with the upper eyelid everted, the deep superior fornix is not exposed.

Eyelashes (**cilia**) project from the anterior edge of the free margin of the eyelid. On the deep surface of the eyelids are a number of yellowish, parallel streaks produced by the tarsal glands [Fig. 4.3]. The ducts of these glands open near the posterior edge of the free margin of the eyelids. The free margin of the lids is rounded medially and has a small elevation—the **lacrimal papilla**. Each papilla is surmounted by a tiny aperture—the **lacrimal punctum**. The puncta lead into the lacrimal canaliculus which drains the lacrimal fluid from the conjunctival sac. Note that the puncta face posteriorly into the conjunctival sac, and that the eyelids move medially when the eye is forcibly closed. This action moves the lacrimal fluid towards the puncta at the medial angle of the eye.

Press a fingertip on the skin between the nose and the medial angle of the eye and feel the rounded, horizontal cord—the **medial palpebral ligament**. This ligament connects the upper and lower eyelids (and their muscle the orbicularis oculi) to the medial margin of the orbit. If the eyelids are gently pulled laterally, the medial palpebral ligament is more easily felt and may be seen as a small skin ridge.

Auricle

The auricle is that part of the ear which is seen on either side of the head [Fig. 4.1]. It consists of a thin plate of elastic cartilage covered with skin. (The lobule is devoid of cartilage.)

The cartilage of the auricle is continuous with the cartilage of the external acoustic meatus. The tubular **meatal cartilage** is incomplete above and in front, and its wall is completed by dense fibrous tissue which is continuous with tissue between the tragus and the beginning of the helix.

The muscles of the auricle are supplied by the facial nerve. The skin of the lower part of the auricle is supplied by the great auricular nerve. The upper part of the lateral surface is supplied by the auriculotemporal nerve, and the upper part of the medial surface by the lesser occipital nerve.

The scalp

The scalp extends from the eyebrows in front, to the superior nuchal lines behind. Side to side, it extends between the right and left superior temporal lines. The scalp covers the vault of the skull. It consists of five layers: (1) skin; (2) superficial fascia; (3) **epicranial aponeurosis**; (4) loose connective tissue; and (5) the pericranium [Fig. 4.4]. The epicranial aponeurosis is a flat aponeurotic sheet uniting the frontal and occipital bellies of the occipitofrontalis muscle. The superficial fascia is adherent to the epicranial aponeurosis. The skin is also adherent to the epicranial aponeurosis by dense strands of fibrous tissue which run through the superficial fascia and divide it into a number of separate pockets filled with fat. The blood vessels and nerves of the scalp lie in this superficial layer. Deep to the aponeurosis is a relatively avascular layer of loose areolar tissue which allows the scalp to slide freely on the **pericranium**. The pericranium is the periosteum on the external surface of the skull [Fig. 4.4].

The **temple** is the area bounded by the superior temporal line above and the zygomatic arch below. The skull is thin in this region and covered by the temporalis muscle, the temporal fascia, and a thin extension of the epicranial aponeurosis.

Using the instructions given in Dissection 4.1, dissect the scalp.

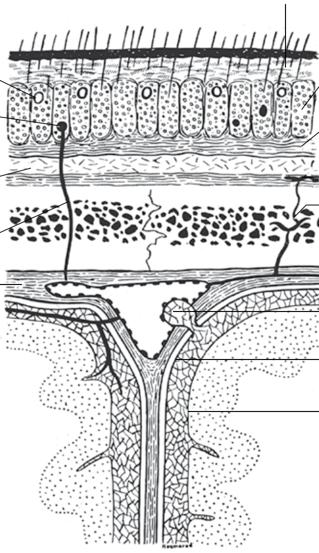

Fig. 4.4 Schematic section through the scalp, skull, meninges, and brain. Note the venous connections through the skull.

Occipitofrontalis muscle

The occipitofrontalis has the occipital belly on the back of the skull, and the frontal belly anteriorly [Figs. 4.5, 4.8]. The occipital belly arises from the lateral part of the superior nuchal line [see Fig. 4.10]. The occipital bellies are shorter and narrower than the frontal bellies and are widely separated by the aponeurosis.

Each frontal belly lies in the forehead and adjoining part of the scalp. It has no attachment to bone but runs between the skin of the forehead and the epicranial aponeurosis. The medial parts of the frontal bellies lie close together and are attached to the skin of the nose. **Action**: when the frontal belly contracts, it raises the eyebrows and wrinkles the forehead and the skin of the nose. **Nerve supply**: the facial nerve.

Epicranial aponeurosis

The epicranial aponeurosis is attached loosely to the superior temporal lines and firmly to the superior nuchal lines. Between these attachments, it slides freely on the pericranium because of the loose connective tissue deep to it. ➲ Traction injuries of the scalp separate the epicranial aponeurosis from the pericranium. This leads to bleeding from the emissary veins which pass through the loose areolar tissue, and collection of blood in this tissue.

Nerves of the scalp and temple

General features of the nerves

The muscles of the scalp receive motor innervation from the **facial nerve** [Fig. 4.7]. Sensory innervation to the scalp comes from the **trigeminal nerve** and the second and third cervical spinal nerves [Figs. 4.7, 4.9]. Sympathetic innervation to blood vessels and the skin run in the plexuses on the arteries.

Sensory nerves of the scalp

The area behind the imaginary line from the auricle to the vertex is supplied by C. 2 and C. 3, through the large **greater occipital nerve** (C. 2), the **third occipital nerve** (C. 3), and branches of the **great auricular** and **lesser occipital nerves** [Fig. 4.9]. The greater occipital nerve enters the scalp with the occipital artery by piercing the trapezius and the deep fascia, 2.5 cm

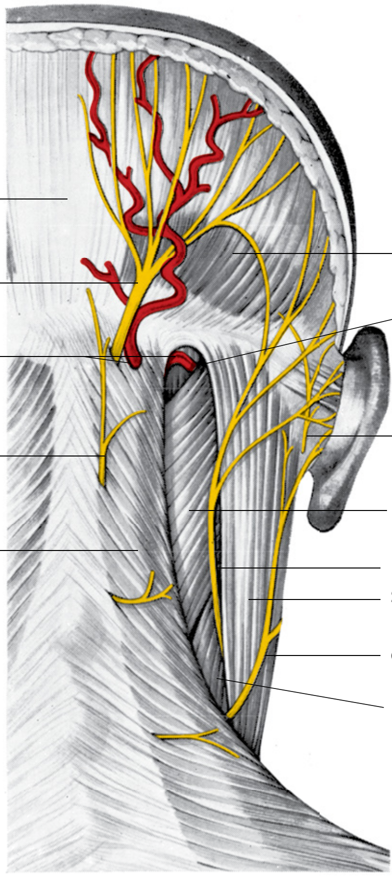

Fig. 4.5 Cutaneous nerves and vessels of the posterior part of the scalp.

DISSECTION 4.1 The scalp

Objectives

I. To reflect the skin of the scalp and trace the vessels and nerves supplying it. **II.** To expose the upper part of the orbicularis oculi and the frontal and occipital bellies of the occipitofrontalis.

Instructions

1. Place a block under the back of the head to raise it to a convenient angle. Make a median incision in the skin of the scalp, from the root of the nose to the external occipital protuberance. Make a coronal incision from the middle of the first incision to the root of each auricle.
2. Continue the coronal incision behind the auricle to the mastoid process, and in front of the auricle to the root of the zygomatic arch. Avoid cutting deeper than the skin to preserve the vessels, nerves, and muscles in the subcutaneous tissue. Reflect the skin flaps superficial to these structures.
3. Make use of Figs. 4.5, 4.6, and 4.7 to identify the positions of the main structures in the scalp—the greater occipital nerve, lesser occipital nerve, third occipital nerve, great auricular nerve, superficial temporal artery, supra-orbital and supratrochlear arteries and nerves, and temporal branches of the facial nerve—so that they are not damaged.
4. Expose the upper part of the orbicularis oculi [Fig. 4.8].
5. Follow the frontal belly of the occipitofrontalis from below upwards [Fig. 4.8].
6. Find the branches of the supratrochlear and supra-orbital vessels and nerves. The supratrochlear vessels and nerve lie about a finger breadth from

the midline, and the supra-orbital another finger breadth further laterally. The supra-orbital nerves and vessels ascend from the supra-orbital notch.

7. Expose the anterior part of the epicranial aponeurosis, and note its extension downwards into the temple.
8. Find two or more **temporal branches of the facial nerve** which cross the zygomatic arch 2 cm or more in front of the auricle [Fig. 4.7]. Trace them upwards to the deep surface of the orbicularis oculi.
9. Find the **superficial temporal artery** [Fig. 4.6] and **veins** and the **auriculotemporal nerve**. These structures cross the root of the zygomatic arch, immediately anterior to the auricle, along with the small branch of the facial nerve to the superior auricular muscles. Trace these structures into the scalp, uncovering this part of the temporal fascia. (The auriculotemporal nerve may be very slender and difficult to find.)
10. Inferior and posterior to the auricle, find the great auricular and lesser occipital nerves [Fig. 4.5], and the posterior auricular vessels and nerve which lie immediately behind the root of the auricle. Trace the branches of these nerves.
11. Look for small terminal branches of the **third occipital nerve** in the fascia over the external occipital protuberance [Fig. 4.5].
12. Cut through the dense superficial fascia over the superior nuchal line, 2.5 cm lateral to the external occipital protuberance, and find the occipital vessels and **greater occipital nerve** which pierce the deep fascia here. Trace them superiorly towards the vertex [Fig. 4.5].
13. Lateral to the greater occipital nerve, find the occipital belly of the occipitofrontalis, and expose the posterior part of the epicranial aponeurosis.
14. Make a small incision through the aponeurosis near the vertex. Introduce a blunt probe through it into the loose areolar tissue beneath the aponeurosis, and expose the extent of this tissue by moving the probe in all directions. Note that the aponeurosis is adherent to the periosteum near the temporal and nuchal lines.

lateral to the external occipital protuberance. The third occipital nerve pierces the trapezius, 2–3 cm inferior to this [Fig. 4.5]. Anterior to an imaginary line from the ear to the vertex, the sensory supply is from the trigeminal nerve.

The trigeminal nerve is the fifth cranial nerve, named so because it divides into three large nerves—ophthalmic, maxillary, and mandibular. Each of the three divisions supplies sensory branches to the skin of the anterior half of the scalp [Fig. 4.9].

The **ophthalmic nerve** gives rise to two cutaneous branches—the supratrochlear and supra-orbital nerves. The **supratrochlear nerve** emerges at the supra-orbital margin, a finger breadth from the midline. It supplies the paramedian part of the forehead and the medial part of the upper eyelid. The **supra-orbital nerve** emerges more laterally through the supra-orbital notch, supplies the upper eyelid, and then divides into lateral and medial branches. Each branch sends a twig through the bone to the mucous lining of the **frontal sinus** (the cavity in the frontal bone above the nose and orbit). The supratrochlear and supra-orbital nerves together supply the skin of the forehead and of the upper anterior part of the scalp as far as the vertex [Fig. 4.7].

The **maxillary nerve** gives rise to the slender **zygomaticotemporal nerve** which arises from the zygomatic branch of the maxillary nerve in the orbit. It pierces the zygomatic bone and temporal fascia to supply the skin of the anterior part of the temple [Fig. 4.7].

The **auriculotemporal** branch of the **mandibular nerve** emerges from the upper end of the parotid gland, close to the auricle, at the root at the zygomatic arch. It supplies the upper part of the auricle, the external acoustic meatus, and the skin of the side of the head [Fig. 4.7].

Motor nerves of the scalp

The **facial nerve** is the seventh cranial nerve. It supplies the muscles of the scalp and auricle.

The **temporal branches** of the facial nerve emerge from the upper part of the parotid gland, cross the zygomatic arch obliquely, and supply the frontal belly of the occipitofrontalis, the upper part of the orbicularis oculi, and the anterior and superior auricular muscles [Fig. 4.7].

The **posterior auricular nerve** arises from the facial nerve, as it emerges from the stylomastoid foramen. It curves posterosuperiorly below the root of the auricle and runs above the superior nuchal

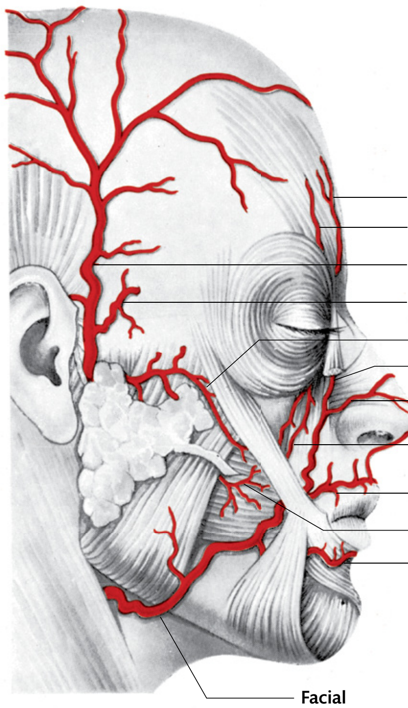

Fig. 4.6 The arteries of the face.

line to supply the occipital belly of the occipitofrontalis and the posterior and superior auricular muscles [Figs. 4.5, 4.7].

Arteries of the scalp and temple

The scalp and temple are mostly supplied by branches of the **external carotid artery**, except for the forehead which is supplied by the supra-orbital and supratrochlear branches of the internal carotid artery. These arteries run with the supra-orbital and supratrochlear nerves.

Branches from the external carotid artery

The **superficial temporal artery** is a large terminal branch of the external carotid artery. It begins behind the neck of the mandible in, or deep to, the parotid gland. It runs upwards with the auriculotemporal nerve and divides into anterior and posterior branches which run towards the frontal and parietal eminences. The anterior branch is frequently seen through the skin in elderly individuals and is often very tortuous.

Small branches of the superficial temporal artery supply the temple and anterior part of the scalp. The **transverse facial branch** [Fig. 4.6] runs forwards on the masseter muscle, below the zygomatic arch. The **middle temporal branch** crosses the root of the zygomatic arch, pierces the temporal fascia, and runs vertically upwards. The **zygomatico-orbital branch** runs anteriorly above the zygomatic arch between the two layers of the temporal fascia. It anastomoses with branches of the ophthalmic artery.

The small **posterior auricular branch** of the external carotid artery curves posterosuperiorly below and behind the root of the auricle, with the posterior auricular nerve.

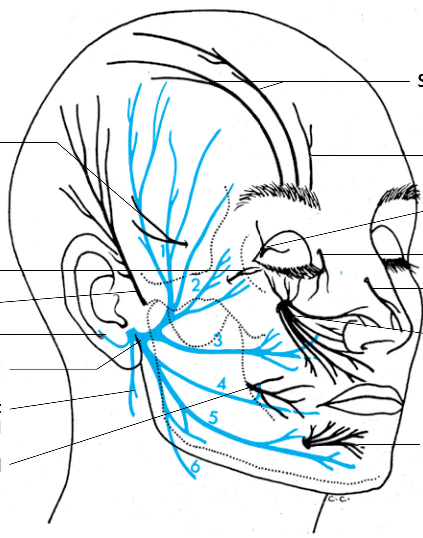

Fig. 4.7 The nerves of the face. The facial nerve (motor) is shown in blue, the branches of the trigeminal (sensory) in black. 1. Temporal branches of facial. 2 and 3. Zygomatic branches. 4. Buccal branch. 5. Marginal mandibular branch. 6. Cervical branch.

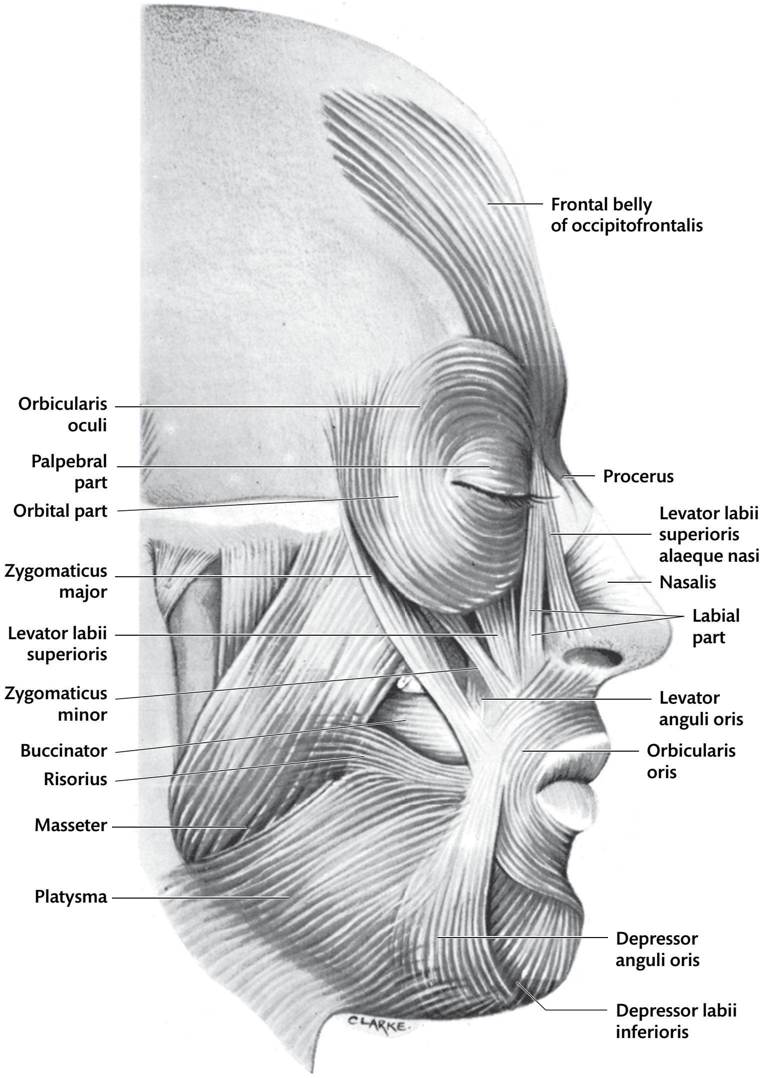

Fig. 4.8 The facial muscles and masseter.

The **occipital artery** is a large branch of the external carotid artery. It arises deep to the angle of the mandible and runs posterosuperiorly. It pierces the trapezius with the greater occipital nerve [Fig. 4.5] and supplies the muscles of the neck and the back of the head.

The arteries of the scalp anastomose freely with each other and with those of the opposite side. ➲ As such, wounds of the scalp bleed profusely but heal rapidly. Also, if a large piece of scalp is torn downwards from the skull, it will survive and heal satisfactorily, provided a part of the peripheral attachment containing an artery is intact.

Veins of the scalp and temple

Like the arteries, the veins of the scalp anastomose freely. The main tributaries accompany the arteries of the scalp, but their proximal parts drain by different routes.

The **supratrochlear** and **supra-orbital veins** unite at the medial angle of the eye to form the **facial vein**. They communicate with veins within the orbit. The **superficial temporal vein** joins the **middle temporal vein** at the root of the zygomatic arch to form the **retromandibular vein**. The **occipital veins** run with the artery in the scalp but leave it to join the suboccipital plexus, deep to the semispinalis capitis muscle at the back of the neck.

Emissary veins pierce the skull and connect the extracranial veins with the venous sinuses within the cranium. Usually one emissary vein passes through each parietal foramen to the superior sagittal sinus, and another through each mastoid

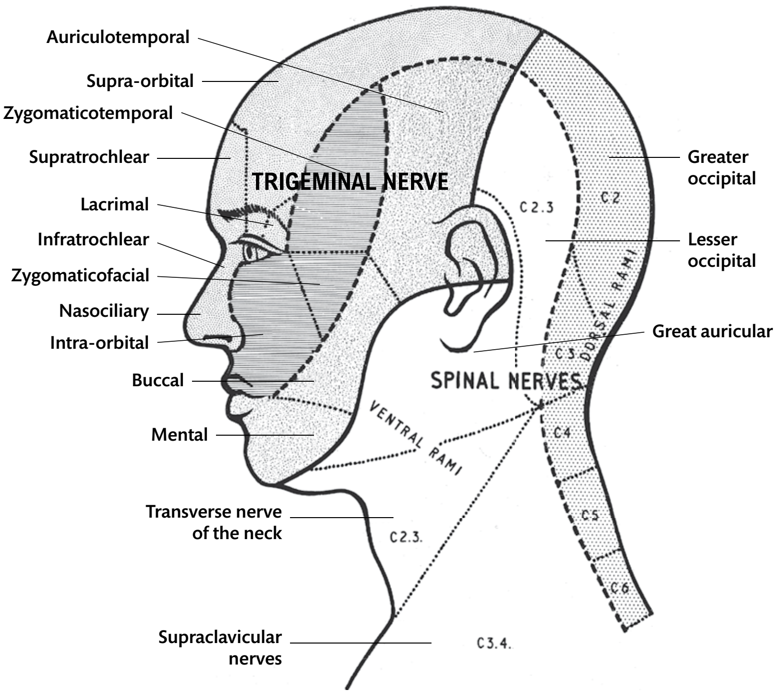

Fig. 4.9 Distribution of cutaneous nerves to the head and neck. The ophthalmic, maxillary, and mandibular divisions of the trigeminal nerve here are indicated by different shading.

foramen to the corresponding sigmoid sinus [see Fig. 3.6]. ➲ These and other emissary veins, and the communications with the veins in the orbits, form routes along which infection may spread into the skull from the scalp.

Lymph vessels of the scalp and temple

Lymph vessels cannot be demonstrated by dissection. Lymph from the area in front of the ear drains into small **parotid lymph nodes** buried in the surface of the parotid gland. Those from the region behind the ear drain into lymph nodes on the upper end of the trapezius (**occipital nodes**) and the sternocleidomastoid (**retroauricular nodes**).

Superficial dissection of the face

The face extends from the hairline on the scalp to the chin, and from one auricle to the other. (The forehead is common to the face and the scalp.)

Anterior to an imaginary line from the ear to the vertex, the sensory supply to the face is from the trigeminal nerve, except for the skin over the postero-inferior part of the jaw and the lower part of the auricle. The area over this part of the jaw and auricle is supplied by the **great auricular** and **lesser occipital nerves** (ventral rami of C. 2 and C. 3 [Fig. 4.9]).

Dissection 4.2 provides instructions on dissection of the face.

Facial muscles

The facial muscles are known collectively as the 'muscles of facial expression'. They are the orbicularis oculi, orbicularis oris, frontal belly of the occipitofrontalis, zygomaticus major, zygomaticus minor, levator labii superioris, levator anguli oris, levator labii superioris alaeque nasi, depressor anguli oris, depressor labii inferioris, mentalis, nasalis, procerus, and risorius. Many of the muscles are named according to their actions, and the actions of others may be inferred from their positions. The muscles of facial expression take origin from the underlying bones [Figs. 4.10, 4.11] and are inserted into the skin of the face. These muscles, including the buccinator, are supplied by the facial nerve [Fig. 4.7].

Orbicularis oculi

The orbicularis oculi has three parts—the orbital part, palpebral part, and lacrimal part.

DISSECTION 4.2 Face

Objectives

I. To identify the muscles of facial expression. **II.** To identify and trace the vessels and nerves of the face.

Instructions

Before you begin, stretch the skin of the eyelids and cheeks by packing the conjunctival sacs and the vestibule of the mouth with cloth or cotton wool soaked in preservative. When the skin of the face is reflected, the attachments of the facial muscles to it are inevitably damaged. This can be minimized by keeping the knife as close to the skin as possible.

1. Make a median incision from the root of the nose to the point of the chin. Make a horizontal incision from the angle of the mouth to the posterior border of the mandible. Reflect the lower flap downwards to the lower border of the mandible, and the upper flap backwards to the auricle.
2. Expose the major facial muscles [Figs. 4.8, 4.10], taking care not to cut through them and damage major branches of the nerves and vessels.
3. Pull the eyelids laterally and identify the medial palpebral ligament; then expose the orbital part of the orbicularis oculi, subsequently following the palpebral part to the margins of the eyelids.
4. Attempt to find the small palpebral branch of the lacrimal nerve entering the lateral part of the upper eyelid through the orbicularis oculi.
5. The orbicularis oris is more difficult to expose because of the large number of facial muscles which fuse with, and help to form it [Fig. 4.8]. At the side of the nose, find the **levator labii superioris alaeque nasi**, with the facial vein lying on its surface.
6. Trace the **facial vein** downwards till it passes deep to the zygomaticus major. Expose that muscle, and then the levator labii superioris, following it upwards to its origin deep to the orbicularis oculi [Fig. 4.8].
7. At the lower border of the mandible, expose the broad, thin sheet of muscle—the **platysma**—which ascends over the mandible from the neck. Note that its posterior fibres curve forwards towards the angle of the mouth to form part of the **risorius muscle** [Fig. 4.8].
8. Find the depressor anguli oris and the depressor labii inferioris [Fig. 4.8].

(The buccinator muscle lies in a deeper plane immediately external to the mucous membrane of the cheek. It is continuous with the lateral part of the orbicularis oris and will be dissected later.)

Orbital part

The fibres of the orbital part arise from the medial palpebral ligament and the adjacent part of the orbital margin [Figs. 4.10, 4.11]. They form complete loops on and around the orbital margin. Muscle fibres sweep superiorly into the forehead (mingling with fibres of the frontalis), laterally into the temple, and inferiorly into the cheek, before returning to their point of origin. A few fibres which arise from the bone superior to the medial palpebral ligament end in the skin of the eyebrow, but the remainder are only loosely attached to the skin [Fig. 4.8].

Palpebral part

The palpebral part of the orbicularis oculi consists of thin fibres which arise from the medial palpebral ligament and form similar loops within the eyelids. They form a continuous layer with the orbital part. A small, partially isolated bundle of muscle fibres—the ciliary bundle—lies in the margin of the eyelid and runs posterior to the roots of the eyelashes.

Lacrimal part

The lacrimal part of the orbicularis oculi is a small sheet of muscle fibres which arises from the posterior margin of the fossa for the lacrimal sac and from the sac itself. It forms slips which pass laterally into the eyelids. **Actions**: a number of different actions are attributed to the orbicularis oculi. (1) The palpebral part, acting alone, closes the eye lightly, as in sleep or blinking. (2) The orbital part screws up the eye to give partial protection from bright light, sun, or wind. (3) The fibres passing to the eyebrows draw them together, as in frowning. (4) The orbital and palpebral parts contract together to close the eye forcibly, protecting it from a blow, and in strong expiratory efforts such as coughing, sneezing, or crying in a child. Tight closure of the eyes during strong expiratory movements prevents over-distension of the orbital veins by compressing the orbital contents. (5) The muscle draws the skin and eyelids medially towards the bony attachments and promotes the flow of

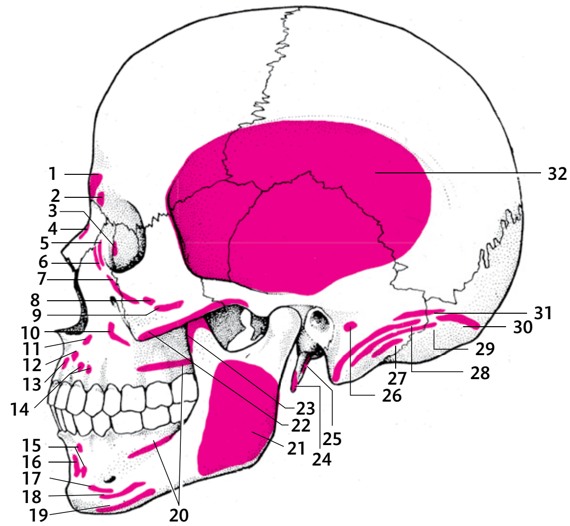

Fig. 4.10 Lateral view of the skull showing the muscle attachments. 1, 2, and 3. Orbicularis oculi. 4. Procerus. 5. Orbicularis oculi. 6. Levator labii superioris alaeque nasi. 7. Levator labii superioris. 8. Zygomaticus minor. 9. Zygomaticus major. 10. Levator anguli oris. 11 and 12. Nasalis. 13. Depressor septi. 14 and 15. Incisive Mm. 16. Mentalis. 17. Depressor labii inferioris. 18. Depressor anguli oris. 19. Platysma. 20. Buccinator. 21 and 22. Masseter. 23. Temporalis. 24. Styloglossus. 25. Stylohyoid. 26. Auricularis posterior. 27. Longissimus capitis. 28. Sternocleidomastoid. 29. Splenius capitis. 30. Trapezius. 31. Occipitalis. 32. Temporalis.

lacrimal fluid towards the lacrimal canaliculi. (6) The lacrimal part probably also dilates the lacrimal sac and promotes the flow of fluid through it. **Nerve supply**: facial nerve—temporal and zygomatic branches.

➲ Paralysis of the orbicularis oculi prevents the eye from being closed. This results in a number of clinical conditions: (1) the exposed cornea becoming dry, sore, and opaque; (2) the lower eyelid falls away from the eyeball, creating a space where tears collect and spill over onto the face; and (3) dirt entering the conjunctival sac is not moved to the caruncular filter and the sac rapidly becomes infected.

Orbicularis oris

The orbicularis oris is the sphincter muscle of the mouth. It is a complex muscle which forms the greater part of the lips. It is composed mainly of interlacing fibres of muscles which converge on the mouth. These muscles include the levator labii superioris, levator labii superioris alaeque nasi, levator anguli oris, zygomaticus major, zygomaticus minor, risorius, depressor labii inferioris, and depressor anguli oris [Fig. 4.12].

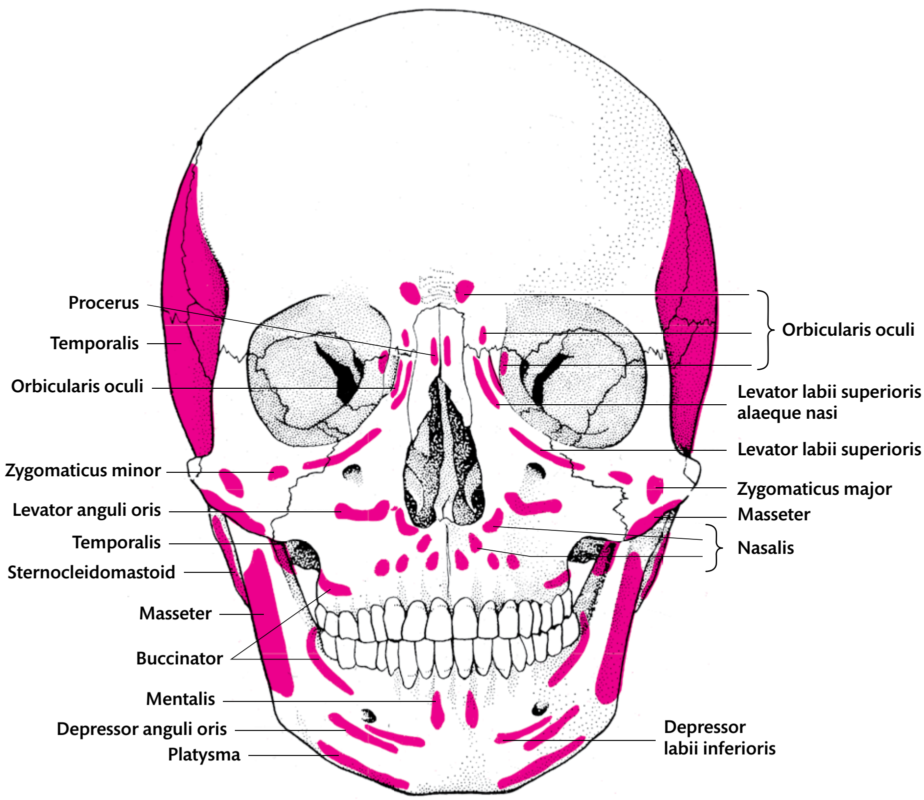

Fig. 4.11 Anterior view of the skull showing muscle attachments.

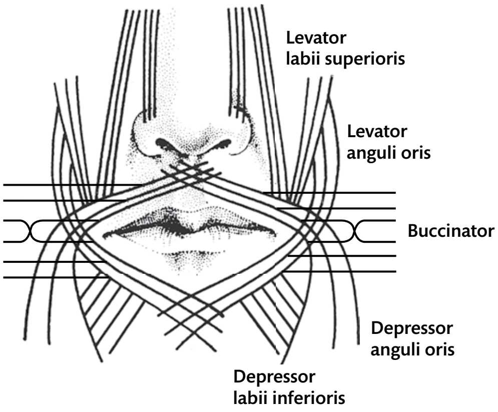

Fig. 4.12 Schematic diagram of the orbicularis oris muscle.

The fibres of the various muscles converging on the mouth mingle and sweep in curves through the lips. The **buccinator** [p. 33] passes horizontally forwards in the cheek [Figs. 4.8, 4.10, 4.11, 4.12]. Its middle fibres interlace near the corner of the mouth to form a marginal bundle and enter the lips. The upper and lower fibres enter the corresponding lip and interdigitate with fibres of the opposite muscle in the midline.

Actions: they confer a wide variety of movements on the lips. They elevate the upper lip, depress the lower lip, and evert or retract both the lips. They act as sphincters at the oral fissure. **Nerve supply**: facial nerve, upper and lower buccal branches.

➲ Paralysis of one-half of the orbicularis oris prevents proper closure of the mouth and affects movements of the lips on that side. Speech is slurred. Food and fluids collect in the vestibule or fall out of the mouth. The lips are pulled towards the normal side by the unopposed action of those muscles. When the patient attempts to blow against resistance, the cheek and lips are blown out and air escapes on the paralysed side.

Dissection 4.3 provides instructions on deep dissection of the vessels and nerves of the face.

DISSECTION 4.3 Vessels and nerves of the face

Objectives

I. To find and trace the facial artery and vein. **II.** To find and trace the parotid duct. **III.** To find and trace the branches of the facial nerve. **IV.** To find and trace the infra-orbital and auriculotemporal nerves.

Instructions

1. Detach the risorius, and reflect it with the remains of the platysma towards the corner of the mouth. Avoid injury to the underlying vessels and nerves.
2. Find the cut end of the great auricular nerve, and trace it upwards over the lower part of the parotid gland.
3. Expose the facial artery and vein at the antero-inferior angle of the masseter, but do not trace them further at the moment [Fig. 4.6].
4. Cut through the fascial covering of the **parotid gland** immediately in front of the auricle from the zygomatic arch to the angle of the mandible. Dissect the fascia carefully forwards to the margins of the gland, looking for the nerves, the vessels, and the duct of the gland which emerge at the anterior border.
5. The **parotid duct** appears at the anterior border of the parotid, about a finger breadth below the zygomatic arch. It is large [Fig. 4.6] and readily palpated in the living by rolling it against the anterior border of the tightened masseter.
6. Above the duct, find: (1) a small detached part of the parotid gland—the **accessory parotid**; (2) the transverse facial artery and vein [Fig. 4.6]; and (3) the zygomatic branches of the facial nerve [Fig. 4.7].
7. Find the **branches of the facial nerve** emerging from the anterior border of the parotid gland, and trace them forwards. This is difficult because they communicate with each other and with the branches of the trigeminal nerve in the face. (The facial nerve is motor to the muscles of the face; the trigeminal nerve is sensory.)
8. Identify the muscles of facial expression: the zygomaticus major, zygomaticus minor, levator labii superioris, and depressor anguli oris.
9. Follow the upper zygomatic branches of the facial nerve. They pass deep to the lateral part of the orbicularis oculi. At this point, the **zygomaticofacial nerve** (sensory) may be found emerging from the zygomatic bone.
10. Trace the lower zygomatic branches of the facial nerve forward, inferior to the orbit and deep to the

zygomatic muscles. Find their communications with the **infra-orbital nerve** (sensory).

11. Trace the branches of the infra-orbital nerve.
12. Cut through the zygomaticus major and minor and levator labii superioris at their origins, and turn them downwards to expose the facial artery and vein. Trace these vessels and their branches.
13. Find the **buccal branch of the facial nerve** at the anterior border of the parotid gland. Trace it forwards through the fat of the cheek to the buccinator muscle.
14. Attempt to find the communications between the buccal branch of the facial nerve and the buccal (sensory) branch of the trigeminal nerve. Follow the buccal branch of the trigeminal nerve posteriorly, till it disappears deep to the ramus of the mandible.
15. Trace the marginal mandibular branch of the facial nerve forwards from the lower border of the parotid gland to the depressor anguli oris. Cut through the depressor anguli oris, and trace the communication of the nerve with the **mental nerve** (sensory) which emerges through the mental foramen. Follow the branches of the mental nerve to the chin and lower lip.
16. At the upper border of the parotid gland, identify: (1) the superficial temporal artery and veins; (2) the **auriculotemporal nerve** close to the auricle; and (3) the temporal branches of the facial nerve anterior to the vessels.
17. At the lower border of the gland, identify again: (1) the anterior and posterior branches of the retromandibular vein; and (2) the cervical branch of the facial nerve.
18. Trace the facial vein downwards, till it joins the anterior branch of the retromandibular vein [see Fig. 5.4].

Arteries of the face

The face has a rich arterial supply. The facial and transverse facial arteries anastomose freely with the smaller arteries which accompany the branches of the trigeminal nerve into the face, and with the arteries of the opposite side, especially in the lips. ➲ As such, wounds of the face bleed a lot but also heal rapidly.

Transverse facial artery

The transverse facial artery arises from the superficial temporal artery under cover of the parotid gland. It emerges near the upper end of the gland and runs forwards over the masseter below the zygomatic arch [Fig. 4.6].

Facial artery

The facial artery is a branch of the external carotid artery. It is the main artery of the face. It enters the face by turning around the lower border of the mandible and piercing the deep fascia at the antero-inferior angle of masseter. (It can be palpated against the mandible at this point.) It runs antero-superiorly to a point 1.5 cm lateral to the angle of the mouth, and then ascends more vertically to end near the medial angle of the eye [Fig. 4.6]. It has a sinuous course on the face.

The facial artery gives large branches to the chin, lips (**inferior labial** and **superior labial**), and nose (**lateral nasal**), and smaller branches to the adjacent muscles. An important anastomosis is present at the medial angle of the eye between the facial vessels and those of the orbit. Through this arterial anastomosis, blood from the external carotid artery can reach the internal carotid artery in the skull. Similarly, venous blood from the face can drain into the orbit and skull.

Veins of the face

The face is drained by veins that accompany the arteries that supply it. The veins of the face anastomose freely with each other.

Facial vein

The facial vein is formed by the union of the supra-orbital and supratrochlear veins at the medial angle of the eye. The initial segment of the vein (near the angle of the eye) is also known as the **angular vein**. It runs postero-inferiorly, behind and in the same plane as the artery, but takes a straighter course, close to the anterior border of the masseter. It lies close to the artery again on the surface of the mandible. The vein then descends into the neck, pierces the deep fascia, and receives the anterior branch of the retromandibular vein. In the neck, it crosses the carotid arteries and drains into the internal jugular vein.

The facial vein receives tributaries which correspond to the branches of the facial artery. On the surface of the buccinator, it gives off the **deep facial vein**, which passes medial to the masseter to join the **pterygoid plexus of veins**.

Nerves of the face

Sensory nerves of the face

The great auricular nerve and trigeminal nerve supply sensory innervation to the face [Fig. 4.9]. The trigeminal nerve is the main sensory nerve of the face. It gives rise to three nerves—ophthalmic, maxillary, and mandibular—each of which supplies cutaneous branches to one of three roughly concentric areas of the face [Figs. 4.7, 4.9]. The trigeminal cutaneous area abuts on that supplied by the ventral and dorsal rami of the second cervical nerve. The first cervical nerve does not supply skin.

Great auricular nerve

The skin over the parotid gland and the angle of the mandible are supplied by the **great auricular nerve** (ventral rami of C. 2, C. 3) [Fig. 4.9].

Ophthalmic nerve

The ophthalmic division of the trigeminal nerve supplies the area of skin between the angle of the eye and the vertex of the head [Figs. 4.7, 4.9] through the lacrimal, frontal, and nasociliary branches. These branches pass through the orbit and give rise to five nerves on the face.

1. The **palpebral branch of the lacrimal** nerve supplies the lateral part of the upper eyelid.

2 and 3. The **supra-orbital** and **supratrochlear** branches of the frontal nerve supply the forehead and anterior scalp.

3. The **infratrochlear** branch of the nasociliary nerve supplies the medial parts of the eyelids and the root of the nose.
4. The **external nasal** nerve emerges between the nasal bone and the lateral nasal cartilage [see Fig. 4.16] and supplies the skin of the lower half of the dorsum of the nose. It is a branch of the **anterior ethmoidal nerve** which arises from the nasociliary nerve in the orbit, and enters the nasal cavity through the cribriform plate of the ethmoid.

Maxillary nerve

The maxillary division of the trigeminal nerve supplies an area of skin inferior and lateral to the eye by three branches [Figs. 4.7, 4.9].

1. The **infra-orbital nerve** emerges from the infra-orbital foramen under cover of the orbicularis oculi and levator labii superioris. It gives the **labial**, **palpebral**, and **nasal branches** which supply the skin and mucous membrane of the upper lip, the lower eyelid, the skin between them, and the skin on the side of the nose. These nerves form a **plexus** with the zygomatic branches of the facial nerve. Such plexuses are not the site of union of nerve fibres, but merely places where the nerve fibres run together, so that sensory nerves from the muscles of the face can enter the trigeminal nerve.
2. The **zygomaticofacial nerve** supplies the skin over the bony part of the cheek. It passes from the orbit through the zygomatic bone on to its facial surface [Fig. 4.7].
3. The **zygomaticotemporal nerve** also pierces the zygomatic bone and emerges from its temporal surface. It passes through the temporal fascia and supplies the skin over the anterior part of the temple.

Mandibular nerve

The mandibular division of the trigeminal nerve supplies an area of skin posterior and inferior to the previous areas, by three branches [Figs. 4.7, 4.9].

1. The **auriculotemporal nerve** emerges from the upper border of the parotid gland beside the auricle. It supplies the upper part of the auricle, the external acoustic meatus, and the skin of the side of the head [Fig. 4.7].
2. The **buccal nerve** passes antero-inferiorly, deep to the masseter and the ramus of the mandible. It supplies the skin over the buccinator and sends branches through it to the mucosa of the mouth [Fig. 4.7].
3. The **mental nerve** is a branch of the inferior alveolar nerve. It appears on the face through the mental foramen of the mandible. It divides into branches deep to the depressor anguli oris. These branches supply the skin and mucous membrane of the lower lip, and the skin over the mandible from the symphysis to the anterior border of the masseter [Fig. 4.7].

Motor nerves of the face

The facial nerve is the motor nerve to the muscles of facial expression. It has five terminal branches, or groups of branches—temporal, zygomatic, buccal, marginal mandibular, cervical—which emerge from the parotid gland [Fig. 4.7].

1. The **temporal branches** have been described in the scalp.
2. Small **zygomatic branches** run across the zygomatic arch to supply the orbicularis oculi. Larger branches run forwards below the arch to supply the muscles of the nose—the nasalis and levator labii superioris alaeque nasi—and those between the eye and the mouth—the zygomaticus major, zygomaticus minor, and levator labii superioris.
3. The **buccal** branches run towards the angle of the mouth and supply the muscles of the cheek—the buccinator.
4. The **marginal mandibular** branches run forwards along the mandible and usually curve down into the neck, before running with the inferior labial branch of the facial artery to supply the muscles of the lower lip—the depressor labii inferioris, depressor anguli oris, and mentalis.
5. The **cervical branch** leaves the lower border of the parotid gland and runs forwards and downwards into the neck, to supply the platysma and communicate with the transverse nerve of the neck [Fig. 4.7].

Dissection 4.4 provides instructions on dissection of the buccinator.

DISSECTION 4.4 Buccinator

Objective

I. To expose and study the buccinator.

Instructions

1. Expose the levator anguli oris and the buccinator.
2. Remove the buccal fat from the buccinator, avoiding injury to the buccal nerve. Note the small buccal glands that lie in the fat.
3. Remove the fascia covering the buccinator. Define its attachments to the maxilla and mandible, and trace its fibres towards the angle of the mouth.

Structures in the cheek and lips

The bulk of the cheek and lips is formed by muscles. The muscles are covered externally by skin, and internally by the mucous membrane of the mouth. In addition, the cheek and lips contain buccal and labial salivary glands, few lymph nodes, fascia enclosing the buccinator, and the buccal pad of fat.

Buccinator

The **buccinator** muscle is made up of horizontal fibres which take origin from the outer surfaces of the maxilla and mandible opposite the sockets of the molar teeth, and the **pterygomandibular raphe** [Fig. 4.10]. The pterygomandibular raphe is formed by the interlacing tendinous fibres of the buccinator and the superior constrictor muscle of the pharynx where these muscles meet edge to edge [Fig. 4.8; see also Fig. 6.5]. (The superior constrictor will be seen later when the pharynx is dissected.)

Anteriorly, fibres of the buccinator converge on the corner of the mouth and blend with the orbicularis oris to form a large part of it [Fig. 4.12]. The upper and lower fibres pass directly into the corresponding lips. But the middle fibres decussate (cross each other) near the angle of the mouth, so that the upper fibres enter the lower lip and vice versa. Some of the posterior fibres pass almost vertically downwards from the maxilla to the mandible.

Nerve supply: the buccal branch of the facial nerve. **Actions**: the buccinator is used during mastication to press the cheek against the teeth and prevent food from collecting in the vestibule of the mouth. It also compresses the blown-out cheek (as when blowing a balloon) and raises the intra-oral pressure [Fig. 4.8; see also Figs. 6.5, 17.6].

Buccopharyngeal fascia

The buccopharyngeal fascia covers the external surface of the buccinator and continues backwards over the constrictor muscles of the pharynx. The **parotid duct** pierces the buccopharyngeal fascia and the buccinator, and opens into the vestibule of the mouth, opposite the upper second molar tooth. The fascia and muscle are also pierced by the nerves and vessels of the mucous membrane.