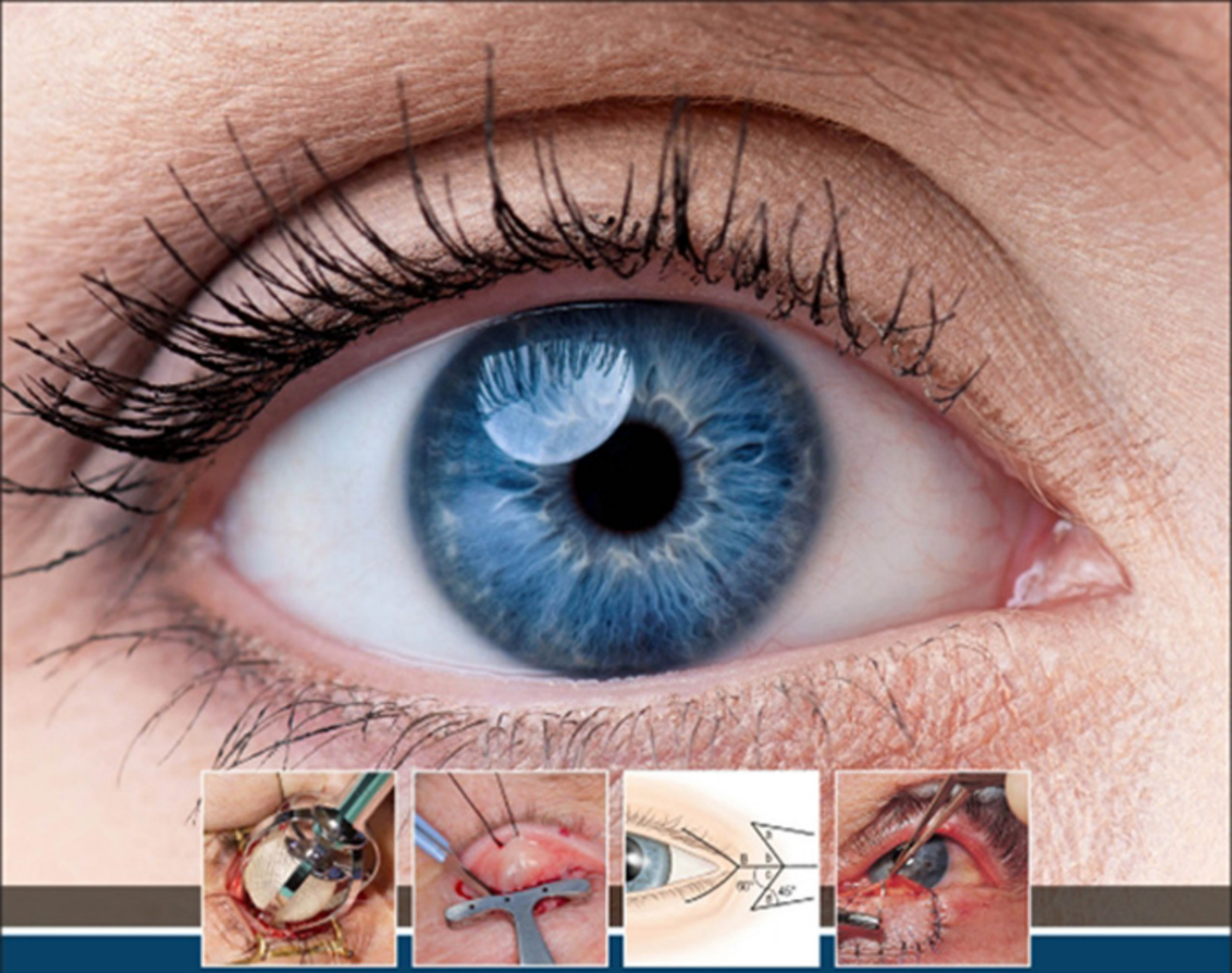

Colour Atlas of Ophthalmic Plastic Surgery

FOURTH EDITION

A.G. Tyers and J.R.O. Collin

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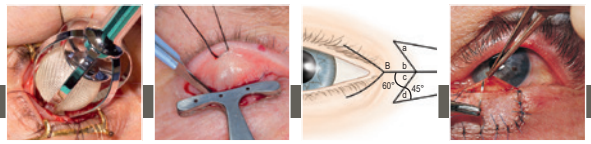

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Second edition 2001

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Fourth edition 2018

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Preface to the Fourth Edition

Ophthalmic plastic surgery continues to progress and develop in an exciting and challenging way. The request by many colleagues, trainees and the publishers, to prepare a Fourth Edition of this Colour Atlas prompted a complete revision of the text, the colour images and the videos.

The book has been expanded by the addition of new text, surgical procedures and illustrations in several chapters. To maintain a manageable size, some of the less common surgical series have been placed online, but referenced from within the printed text. The variety of surgical operations on videos has been significantly expanded and several videos from previous editions have been replaced. A very small number of operative series have been omitted from the Fourth Edition. Orbital surgery is increasingly specialised and rapidly changing orbital operations, such as orbital decompression, have been omitted; there are several excellent texts covering these procedures. As in previous editions, lacrimal surgery has been omitted because this field is comprehensively covered in other texts. Cosmetic surgery has continued to expand and develop; while there has been a small increase in cosmetic surgery procedures in the Atlas, non-surgical procedures have been omitted, as in the Third Edition; many recent texts fully cover this rapidly changing field.

The aims of the Fourth Edition are unchanged from previous editions: to stimulate the quest for excellence in ophthalmic plastic surgery and to foster, at all levels, the best teaching of the extensive variety in this fascinating specialty.

AGT

Preface to the Third Edition

Ophthalmic plastic surgery continues to evolve in many areas but especially in the dramatic increase in demand for cosmetic surgery. These developments have prompted a third edition.

The text and illustrations have been extensively revised. The anatomy chapter has been significantly enlarged to include the detailed anatomy of the forehead and face: the superficial musculo-aponeurotic system (SMAS), the sub-orbicularis oculi fat (SOOF), the retro-orbicularis oculi fat (ROOF) and the other deep fat pads of the face, as well as the facial muscles. Aging changes are discussed in detail and the surgical approach to facial rejuvenation has been expanded to include the wider assessment of the aging face, transblepharoplasty brow lift and mid face lift. Other chapters have also been expanded. Additional procedures include rhombic and bilobed flaps and the Hewes procedure, full-thickness upper lid recession for lid retraction and the harvesting of autogenous fat.

Some surgical manoeuvres are more easily understood from a video than a still image. Video clips of selected procedures are to be found on a DVD included with this edition.

We have not included non-surgical treatments such as the use of botulinum toxin, fillers and facial resurfacing. There are many excellent alternative sources for these. Nor have we included lacrimal or orbital surgery which also merit separate texts.

The aims of this edition are unchanged from the first edition. We hope that these photographic series will stimulate the quest for better understanding of the procedures and safer practice in this exciting discipline of ophthalmic plastic surgery.

AGT

JROC

Preface to the Second Edition

Recent advances in ophthalmic plastic surgery have stimulated a revision of both the text and the surgical content of this edition. There has been a trend away from preserved, homologous materials, in the wake of the perceived risk of transmitted infection, and towards autogenous and alloplastic materials. These materials are the subjects of continuing assessment and new ones are regularly introduced. A few surgical procedures omitted from the First Edition, for example the conjunctival-approach lower lid blepharoplasty, gold weight implantation into the upper lid and the autogenous fascia lata lower lid sling, have been included. Newer techniques have also been included, for example in the approach to upper lid retraction, and the use of hard palate grafts.

The aims of this edition of the Atlas are unchanged. Judging by the response to the First Edition these aims have been realized and we have been encouraged to make as few changes as possible! We hope that it will continue to raise surgical standards and to stimulate interest in ophthalmic plastic surgery.

AGT

JROC

Preface to the First Edition

Surgeons commencing ophthalmic plastic surgery commonly find difficulty identifying the anatomy of the eyelids even though they may know the theory well. Cadaver dissection is only part of the answer because of the distortion of colour, morphology and 'feel' of the tissues. The ideal is to spend time with an experienced ophthalmic plastic surgeon and no substitute can compete with this, but it is not always possible.

Our aim in this atlas is to provide surgical photographs sufficiently realistic in colour and detail – and supported by key diagrams where necessary – so that the anatomy can be recognized at operation and each step of the procedure understood. Ideally the reader who is competent in general ophthalmic or plastic surgery should be able in this way to perform many of the operations without the help of an experienced ophthalmic plastic surgeon.

We have endeavoured to include a wide range of ophthalmic plastic procedures which cover almost every aspect of the specialty. The choice inevitably reflects our own practices but we hope that enough information is given through the illustrations to allow alternative procedures to be performed from a detailed description only. We have not attempted to write a comprehensive textbook of ophthalmic plastic surgery – there are many excellent ones on the market. Our intention has been to facilitate the surgery where there is difficulty due mainly to poor recognition of the anatomy. However, in each chapter we have given guidance on the choice of operations and some suggestions for further reading. In addition, insets of related disorders appear at the end of some chapters to summarize in outline the management of certain conditions, for example facial palsy, which do not fit easily into any single chapter.

We hope that this atlas will allow more direct access to the field of ophthalmic plastic surgery for those with relatively limited experience and provide a sound basis on which to build as experience grows. We also hope that teachers in the specialty will find it a useful resource when describing and illustrating the details of surgical techniques to their trainees. Finally, we hope to stimulate interest and improve standards in this fascinating branch of both ophthalmic and plastic surgery.

1994

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Acknowledgements

This Atlas would not have been possible without the Surgical Theatre Staff and Ophthalmology Residents and Fellows at Salisbury District Hospital, who have given constant input to the planning and hands-on surgical assistance of the procedures recorded. Russell Gabbedy and Nani Clansey of Elsevier have given constant support, encouragement and advice at every step in preparation. Many friends and colleagues, as always too numerous to mention, have guided and supported the preparation of the new edition of this Colour Atlas.

New Images and Videos for this Edition

Dr A.G. Tyers retains the copyright of any new photos (see list below) and video material in this edition:

Chapter 2: Fig. 2.8c; Fig. 2.8d; Fig. 2.15c; Fig. 2.15d; Fig. 2.19c.

Chapter 3: Fig. 3.3e; Fig. 3.3f; Fig. 3.3g; Fig. 3.3h; Fig. 3.3i; Fig. 3.3j; Fig. 3.7a; Fig. 3.7b; Fig. 3.7c; Fig. 3.7d; Fig. 3.10a; Fig. 3.10b; Fig. 3.11a; Fig. 3.11b; Fig. 3.11c; Fig. 3.12a; Fig. 3.12b; Fig. 3.12c; Fig. 3.12d; Fig. 3.13c.

Chapter 5: Fig. 5.3.

Chapter 6: Fig. 6.1c; Fig. 6.1d; Fig. 6.1e; Fig. 6.3a; Fig. 6.3b; Fig. 6.3c; Fig. 6.3d; Fig. 6.3e; Fig. 6.3f; Fig. 6.3g; Fig. 6.3h; Fig. 6.3i; Fig. 6.3j; Fig. 6.3 post A; Fig. 6.3 post B; Fig. 6.4 pre; Fig. 6.4 post; Fig. 6.7b pre; Fig. 6.7b post; Fig. 6.7c pre; Fig. 6.7c post.

Chapter 7: Fig. 7.2a; Fig. 7.2b; Fig. 7.2c; Fig. 7.2d; Fig. 7.2e; Fig. 7.2f; Fig. 7.2g; Fig. 7.2h; Fig. 7.2i; Fig. 7.2j; Fig. 7.2k; Fig. 7.2l; Fig. 7.2m; Fig. 7.2n; Fig. 7.2o; Fig. 7.2p; Fig. 7.2q; Fig. 7.3a; Fig. 7.3b; Fig. 7.3c; Fig. 7.3d; Fig. 7.3e; Fig. 7.3f; Fig. 7.3g; Fig. 7.3h; Fig. 7.10B pre A; Fig. 7.10B post A; Fig. 7.10B pre B; Fig. 7.10B post B; Fig. 7.11a; Fig. 7.11b; Fig. 7.11c; Fig. 7.11d; Fig. 7.11e; Fig. 7.11f; Fig. 7.11g; Fig. 7.11h; Fig. 7.11 pre; Fig. 7.11 post; Fig. 7.12a; Fig. 7.12b; Fig. 7.12c: Fig. 7.12d; Fig. 7.12e; Fig. 7.12f; Fig. 7.12g; Fig. 7.12h; Fig. 7.12i; Fig. 7.12j; Fig. 7.12 pre; Fig. 7.12 post; Fig. 7.13a; Fig. 7.13b; Fig. 7.13c; Fig. 7.13d; Fig. 7.13e; Fig. 7.13f; Fig. 7.14 pre B; Fig. 7.14 post B.

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Chapter 11: Fig. 11.3 preB; Fig. 11.3 post B; Fig. 11.12 post.

Chapter 12: Fig. 12.3g; Fig. 12.3h; Fig. 12.3i; Fig. 12.4a; Fig. 12.4b; Fig. 12.4c; Fig. 12.4d; Fig. 12.4e; Fig. 12.4f; Fig. 12.5 preA; Fig. 12.5 postA.

Chapter 13: Fig. 13.4 pre; Fig. 13.4 post; Fig. 13.7 pre; Fig. 13.7 post; Fig. 13.10 post.

Chapter 14: Fig. 14.3a; Fig. 14.3b; Fig. 14.3c; Fig. 14.3d; Fig. 14.3 post.

Chapter 15: Fig. 15.3a; Fig. 15.3b; Fig. 15.3c; Fig. 15.3 post; Fig. 15.6a; Fig. 15.6b; Fig. 15.6c; Fig. 15.6d; Fig. 15.6

post A; Fig. 15.6 post B; Fig. 15.9a, Fig. 15.9b; Fig. 15.9c; Fig. 15.9A pre: Fig. 15.9A post; Fig. 15.9B pre; Fig. 15.9B post; Fig. 15.10a; Fig. 15.10b; Fig. 15.10c; Fig. 15.10d; Fig. 15.10e; Fig. 15.10 pre; Fig. 15.10 post; Fig. 15.11B pre a: Fig. 15.11B pre b; Fig. 15.11 B post; Fig. 15.12d; Fig. 15.12e; Fig. 15.12f; Fig. 15.12g; Fig. 15.12A pre; Fig. 15.12A post; Fig. 15.12B pre; Fig. 15.12B post a; Fig. 15.12B post b; Fig. 15.12C pre a; Fig. 15.12C pre b; Fig. 15.12C post a; Fig. 15.12C post b; Fig. 15.13B pre; Fig. 15.13B post; Fig. 15.19a; Fig. 15.19b; Fig. 15.19 post.

Chapter 16: Fig. 16.4a; Fig. 16.4b; Fig. 16.4c; Fig. 16.4d; Fig. 16.4e; Fig. 16.4f; Fig. 16.4g; Fig. 16.4h; Fig. 16.4i; Fig. 16.4j;

Fig. 16.4a pre: Fig. 16.4a post; Fig. 16.4b pre; Fig. 16.4b post; Fig. 16.4c pre; Fig. 16.4c post A; Fig. 16.4c post B.

Chapter 18: Fig. 18.2a; Fig. 18.2b; Fig. 18.2c; Fig. 18.2d; Fig. 18.2e; Fig. 18.2f; Fig. 18.2g; Fig. 18.2 pre; Fig. 18.2 post.

Renee, Jonathan, Richard, Johanna and Rebecca

and

The Staff and Patients at The St John Eye Hospital, Jerusalem

CHAPTER 1

Anatomy

Introduction

The eyelids protect the eyes. Disease which alters eyelid structure or function threatens sight and an understanding of eyelid anatomy and physiology is fundamental to good reconstructive surgery. The eyelids should not be studied in isolation but in the context of the surrounding structures – the forehead, temples and cheeks. Safe surgery in these regions of the face depends on an understanding of the sometimes complex anatomy.

Muscles arising from the bones of the facial skeleton insert either into the soft tissues of the face, the muscles of facial expression (1.5), or into the mandible, the muscles of mastication (1.6). The forehead and scalp muscles – the frontalis and occipitalis – function separately.

The spaces between the muscles are filled by fat pads which are discrete and individually named (1.7). Vessels and nerves weave around the muscles and at certain points they are at risk from the surgeon's knife (1.15, 1.17).

The actions of the muscles of the temple, forehead and face are supported and disseminated smoothly across the face by a multilayered sheet of fascia of varying thickness: the superficial musculo-aponeurotic system, or SMAS (1.7).

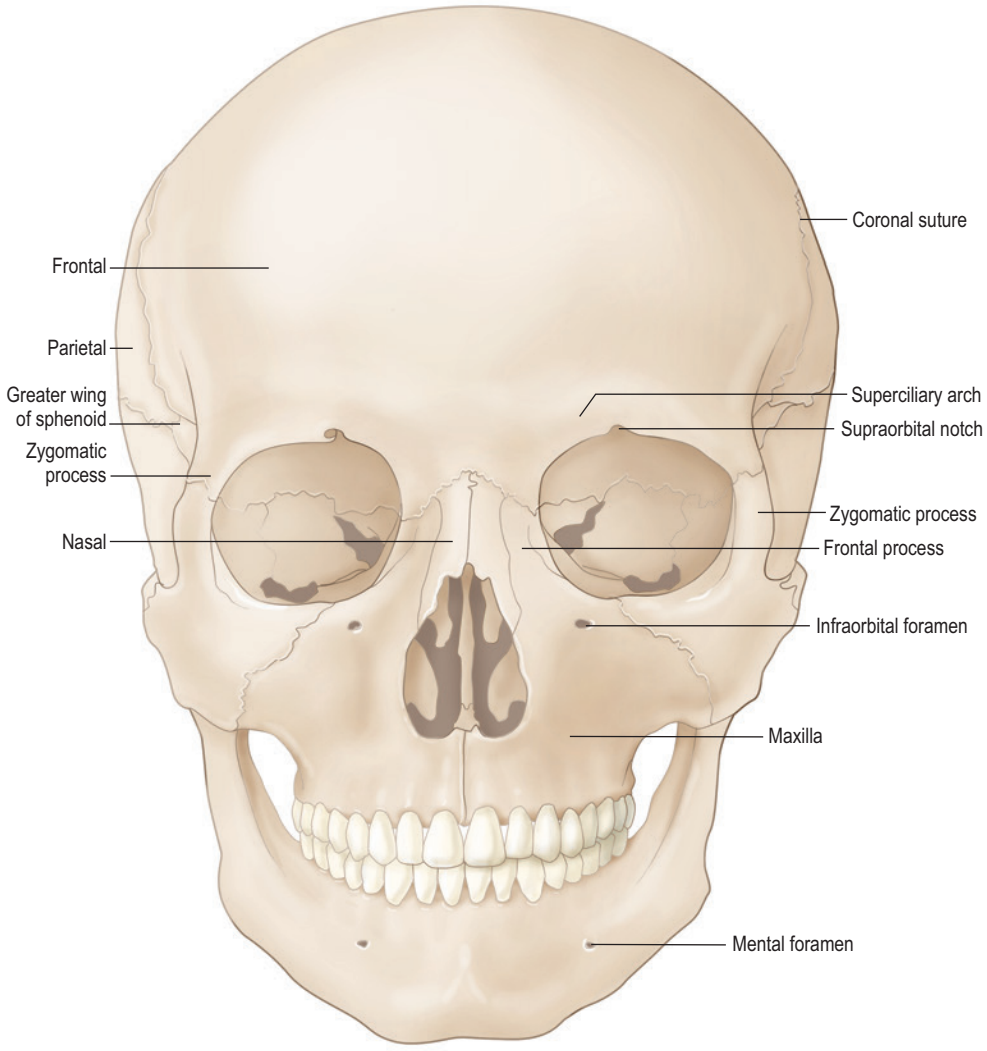
Supporting these facial structures are several short, strong, fibrous retaining ligaments (1.7) which arise from specific sites in the facial skeleton and insert into the overlying tissues and the skin. Progressive laxity in the retaining ligaments and loss of elasticity in the skin are responsible for many of the aging changes which prompt referral for cosmetic or functional advice.

1.1 The bony orbit

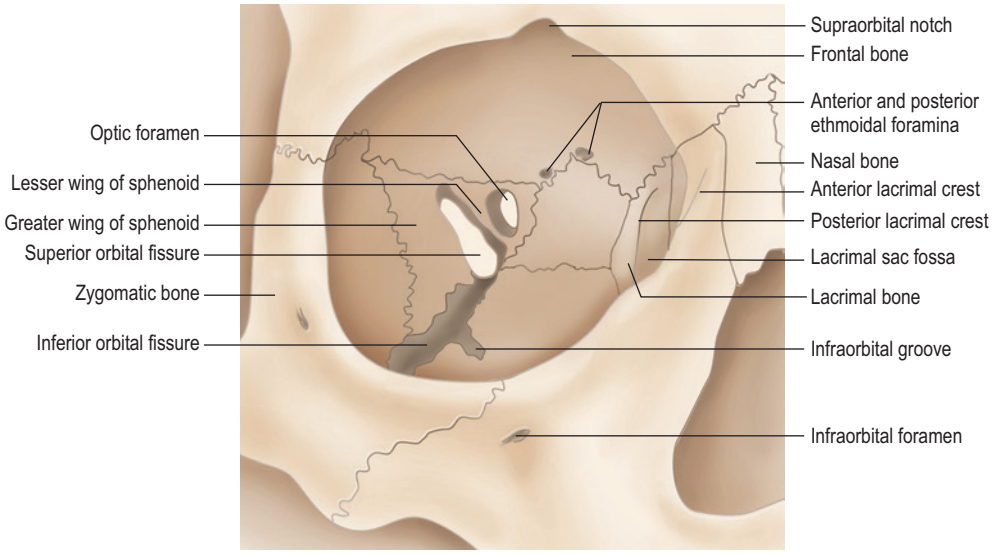
(Diags 1.1–1.3)

The bony orbit is a roughly pyramidal space with its base anteriorly; in cross-section it is rectangular anteriorly and triangular posteriorly. Each orbit is about 4 cm deep and has a volume of about 30 mL. The apex is the optic foramen, enclosed between the two roots of the lesser wing of the sphenoid. The inferior root, a thin bar of bone, separates the optic canal from the superior orbital fissure laterally. The inferior orbital fissure extends inferiorly and laterally from just below the optic foramen. About midway along its length the infraorbital groove branches anteriorly.

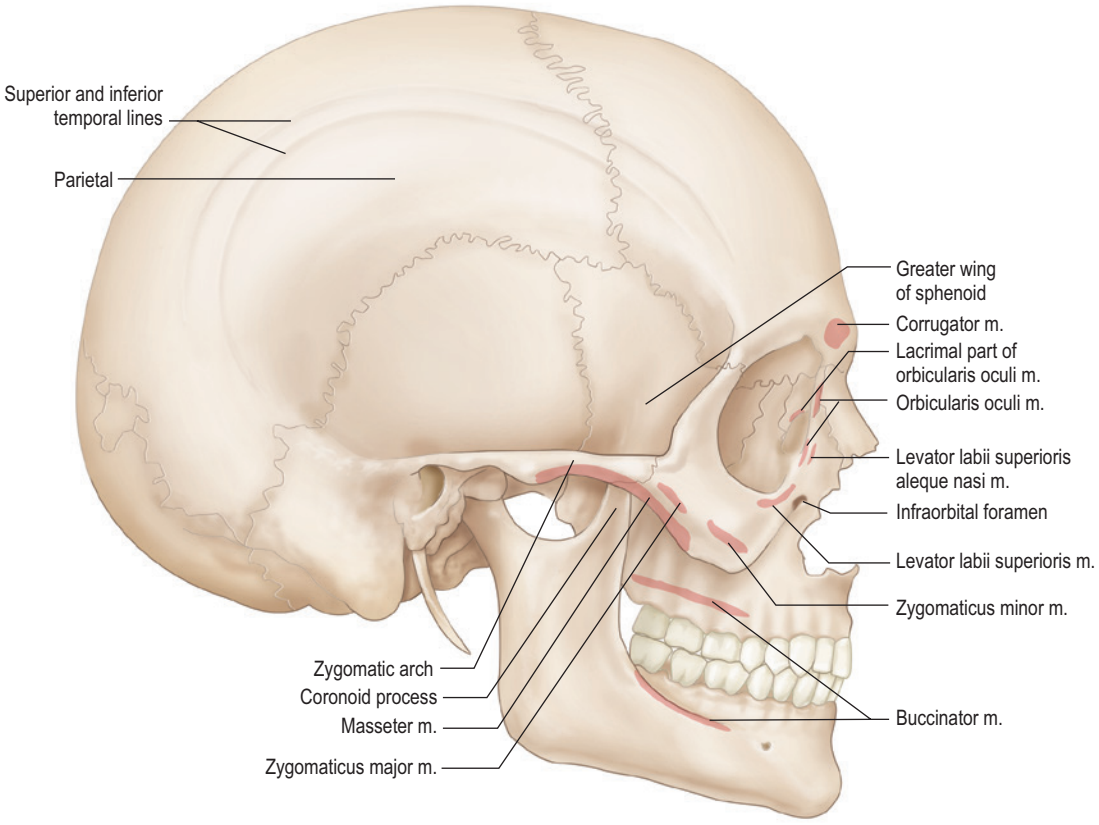
The medial walls of the orbits are parallel to each other. The lateral orbital walls are at 45 degrees to the medial walls and 90 degrees to each other. The floor, narrow at the apex, broadens as it slopes down and laterally. It is separated from the lateral wall by the inferior orbital fissure and it is continuous with the medial wall. The



Diag. 1.1
Anterior view of the skull.



Diag. 1.2
Oblique view of the bony orbit.



Diag. 1.3
Lateral view of the skull.

junction of the medial wall and the roof is marked by the anterior and posterior ethmoidal foramina.

The lacrimal gland fossa is just posterior to the superolateral orbital rim. The lacrimal sac fossa is just posterior to the inferomedial orbital rim, bounded anteriorly by the anterior lacrimal crest, a continuation of the inferior orbital rim, and posteriorly by the posterior lacrimal crest, a continuation of the superior orbital rim.

Each orbital margin measures approximately 40 mm, although the horizontal margins are usually greater than the vertical. The lateral and inferior rims are posterior to the medial and superior rims (Diags 1.3, 1.5) and this is more marked in children. The lateral rim is approximately 20 mm posterior to the medial and the plane between them has almost one-third of the eye in front of it. The superior orbital rim protrudes about 10 to 15 mm beyond the inferior rim. The adult corneal apex is 8 to 10 mm posterior to the superior rim and 2 to 3 mm anterior to the inferior rim and just reaches the plane between the two. Measured from the lateral orbital rim the corneal apex is about 13 mm in a child and up to 22 mm in an adult.

Just within the midpoint of the lateral rim, Whitnall's (lateral orbital) tubercle may be palpated. The trochlea is palpable just within the superomedial rim. The supraorbital notch is at the junction of the medial third and the lateral two-thirds of the superior rim and the infraorbital foramen is about 5 mm below the midpoint of the inferior rim or just medial to this.

The orbits are lined by periosteum (periorbita) which can be lifted easily (see Figs 12.3c, 13.7c) except at the orbital margins, at the sutures, fissures and foramina and at the margins of the lacrimal sac fossa. At the posterior lacrimal crest the periosteum splits to enclose the lacrimal sac and reunites at the anterior lacrimal crest.

The orbits offer protection and support for the eyes and they transmit nerves and vessels to the face.

1.2 Surface anatomy of the eyelids (Figs 1.1–1.5)

The upper and lower lids enclose the palpebral aperture and they join at the medial and lateral canthi. The lateral canthus is acute; the medial canthus is rounded and separated from the eye by a small bay, the tear lake (lacus lacrimalis), in which are a rounded elevation, the caruncle, and a vertical fold, the plica semilunaris.

The average size of the palpebral aperture in an adult is 30 mm horizontally and 10 mm vertically between the centres of the lids. The point of maximum concavity is different in the two lids. In the upper lid it is just medial to the pupil. In the lower lid it is just lateral. With the eye in the primary position the upper lid covers 1 to 3 mm of the upper cornea and the lower lid is at or close to the lower limbus. Scleral show of up to 2 mm between the lower lid and the limbus can be considered a normal variation but excessive scleral show may indicate lower lid retraction, proptosis or anomalies of the midfacial skeleton.

The lateral canthus is higher than the medial canthus – a line drawn between the canthi is elevated about 0 to 7 degrees laterally, a mean of about 3.5 degrees. The distance between the medial canthi is approximately half the interpupillary distance (Table 1.1).

Variations in children may reflect anomalies of facial development. The final dimensions of the palpebral apertures are achieved toward the late teens.

In the upper lid the delicate preseptal skin (inferior to the brow) and the pretarsal skin (superior to the lashes) meet at the level of the skin crease, a transverse crease 6 to 10 mm from the lash line in an adult, lower in a child. The skin crease is formed by the insertion of the levator aponeurosis into the orbicularis muscle at this level (see Diag. 1.16). It is occasionally twice this size.

Table 1.1
Periocular measurements 0–16 years; mean and 2 standard deviations

	Birth	8 years	16 years
Inner intercanthal distance	20 (15–25)	30 (24–34)	32 (26–36)
Outer intercanthal distance	67 (62–72)	96 (86–106)	105 (95–115)
Interpupillary distance	39 (33–45)	53 (46–60)	59 (52–66)
Palpebral fissure length	19 (17–21)	28 (25–31)	31 (28–33)
Angle IC to OC		3.5 deg (0–7)	3.5 deg (0–7)
Globe protrusion	13–22 children and adults		

Source: Hall JG, Froster-Iskenius UG, Allanson JE 1989 Handbook of normal physical measurements. Oxford University Press.

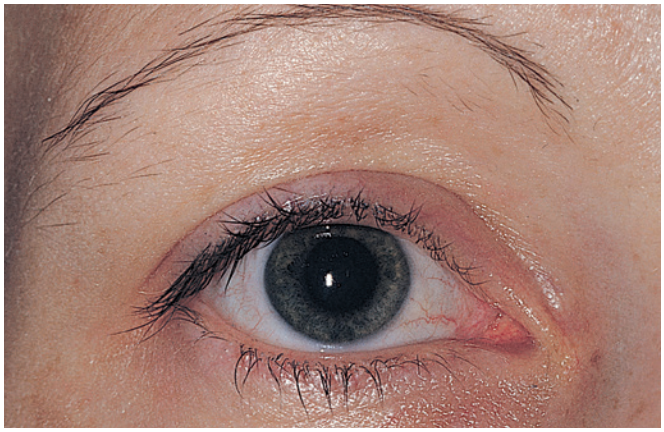
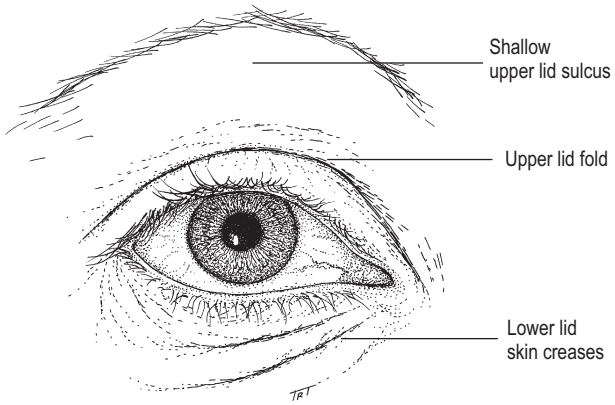
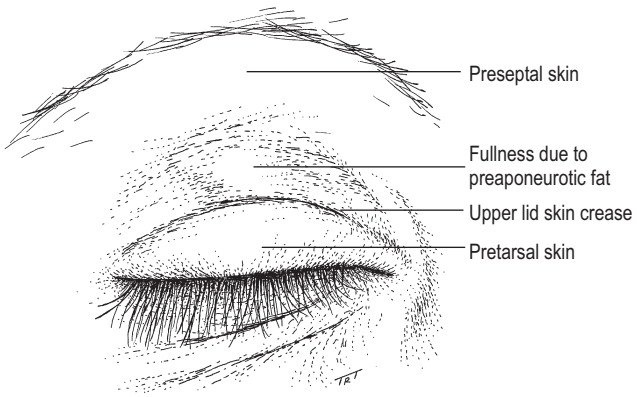


Fig. 1.1
Surface anatomy of the open eyelids.

Fig. 1.2
Surface anatomy of the closed eyelids.



Key diag. 1.1



Key diag. 1.2

There is often redundant skin superior to the skin crease in the upper lid so that a fold of skin, the upper lid skin fold, is created which covers the skin crease (Fig. 1.1). Superior to the skin crease the 'fullness' in the upper lid (Fig. 1.2) is due to orbital fat. The lacrimal gland lies laterally. Immediately below the brow there may be some hollowing of the upper lid – the upper lid sulcus (see Fig. 1.1). This is often marked in the elderly, especially if there is a ptosis (see Fig. 9.1 Pre B). If a skin crease is present in the lower lid, it is usually less obvious than the upper lid crease. It is formed approximately at the level of the lower border of the inferior tarsal plate, 4 to 5 mm from the lash line (see Diag. 1.15).

In the lower lid the junction of the lid and the root of the nose, the naso-jugal fold, may develop a shallow linear depression, the 'tear trough', which extends down and laterally from below the inner canthus (Figs. 10.1g,l). It deepens with age.

The brow position and profile are different in males and females. The brow lies just above the superior orbital rim in females and it tends to be slightly arched. In males the brow is flatter and deeper and it lies at a lower level, along the anterior aspect of the superior orbital rim. As the orbital rim descends laterally the downward curve of the brow is gentler. In contrast to the thin skin of the upper lid, brow skin is thick (see Fig. 10.7d). It bears numerous hairs whose follicles are directed laterally at about 30 degrees, except at the medial end of the brow where they are directed upwards. Deep to the brow is a fat pad – the retro-orbicularis oculi fat or ROOF – which is variable in volume. It is more prominent in males but in both males and females the brow fat may spread inferiorly, especially laterally, causing a fullness in the upper lid which some find unaesthetic.

In profile view (Fig. 1.3), the anterior surface of the adult cornea is approximately in line with the malar eminence

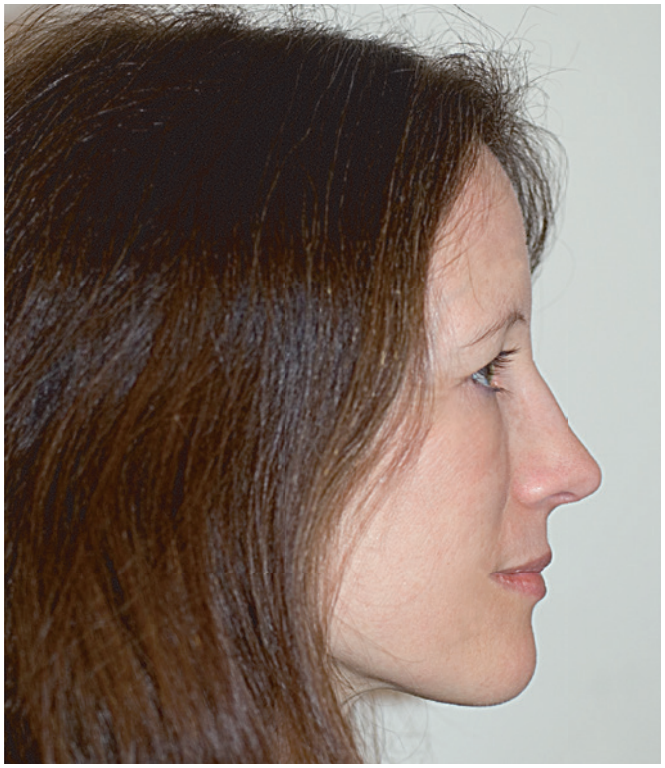


Fig. 1.3
Profile of face.

or slightly posterior to it. If the cornea is anterior to the malar eminence the intrinsic support for the lower lid is weaker; this is known as a 'negative vector'.

In upgaze (Fig. 1.4) the action of the levator and Müller's muscles lifts the upper eyelid. The action of the frontalis lifts the brow. The elevation of the brow contributes about 2 mm to the elevation of the upper lid. The lateral canthus rises slightly. The upper lid fold is accentuated.

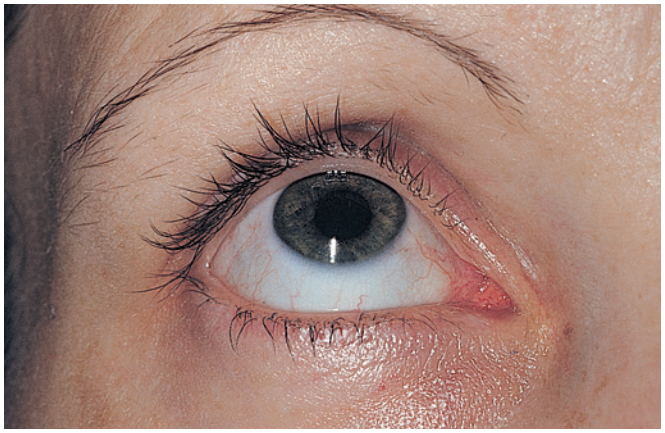


Fig. 1.4
Eyelid features in upgaze.

In downgaze (Fig. 1.5) the lower lid level is depressed by the pull of the lower lid retractors and the lower lid skin crease is accentuated. The lateral canthus moves down slightly. The upper lid fold is reduced, revealing the previously covered skin crease.

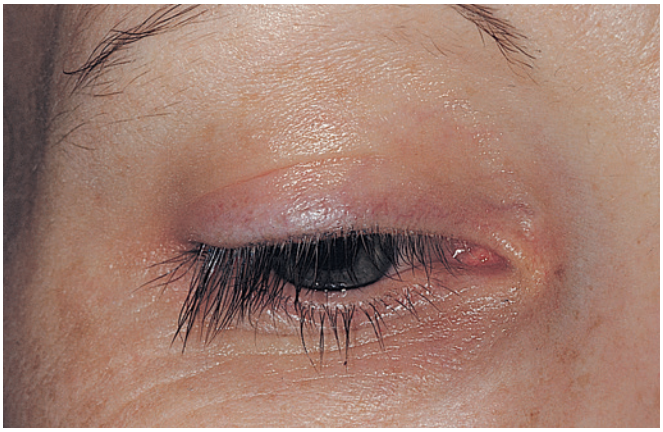


Fig. 1.5
Eyelid features in downgaze.

1.3 Eyelid skin

The skin of the eyelids is the thinnest in the body, less than 1 mm thick and almost transparent in places. It is attached quite loosely to the orbicularis muscle and more firmly to the region of the canthal tendons – especially the medial.

Apart from the lashes, the skin hairs are very fine. The sweat glands of Moll secrete between the lashes or into the ducts of the glands of Zeis. The sebaceous glands of Zeis secrete into the lash follicles.

Deep to the skin is a thin layer of loose connective tissue which contains no fat and which lies on the orbicularis muscle.

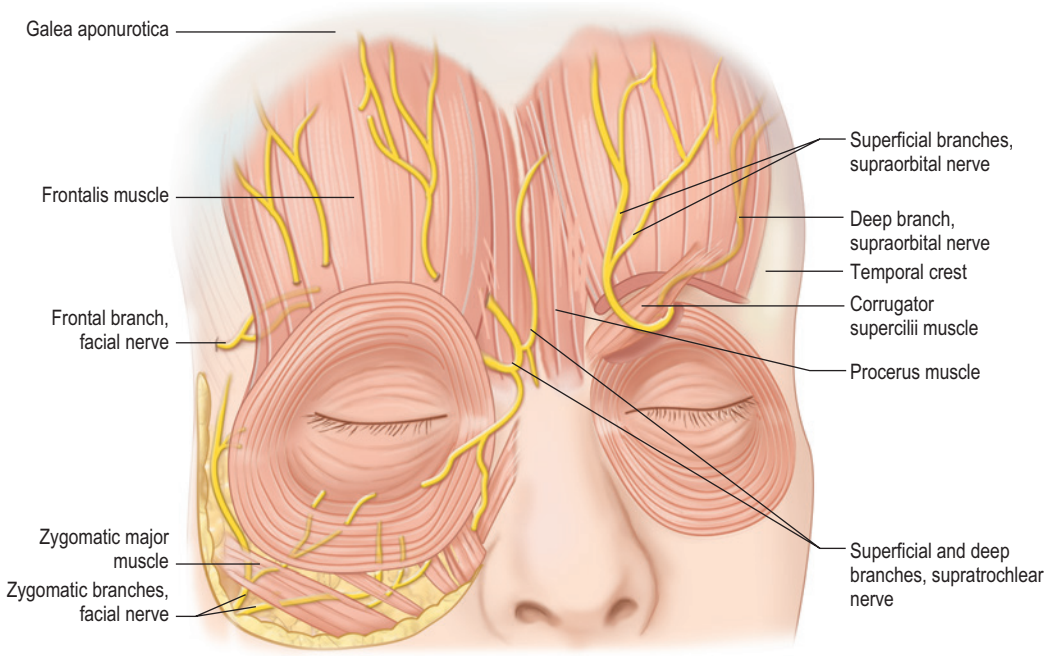
1.4 Eyelid structure

The eyelids are conveniently divided into two anatomical lamellae (see Diags 1.15, 1.16). The anterior lid lamella includes the skin and the orbicularis muscle. The posterior lamella is formed by the tarsal plate and the conjunctiva. A grey line, visible transversely along the middle of each lid margin, marks the junction of the anterior and posterior lamellae (see Fig. 3.16). These lamellae are very important in eyelid surgery. Between the lamellae there is a layer of connective tissue.

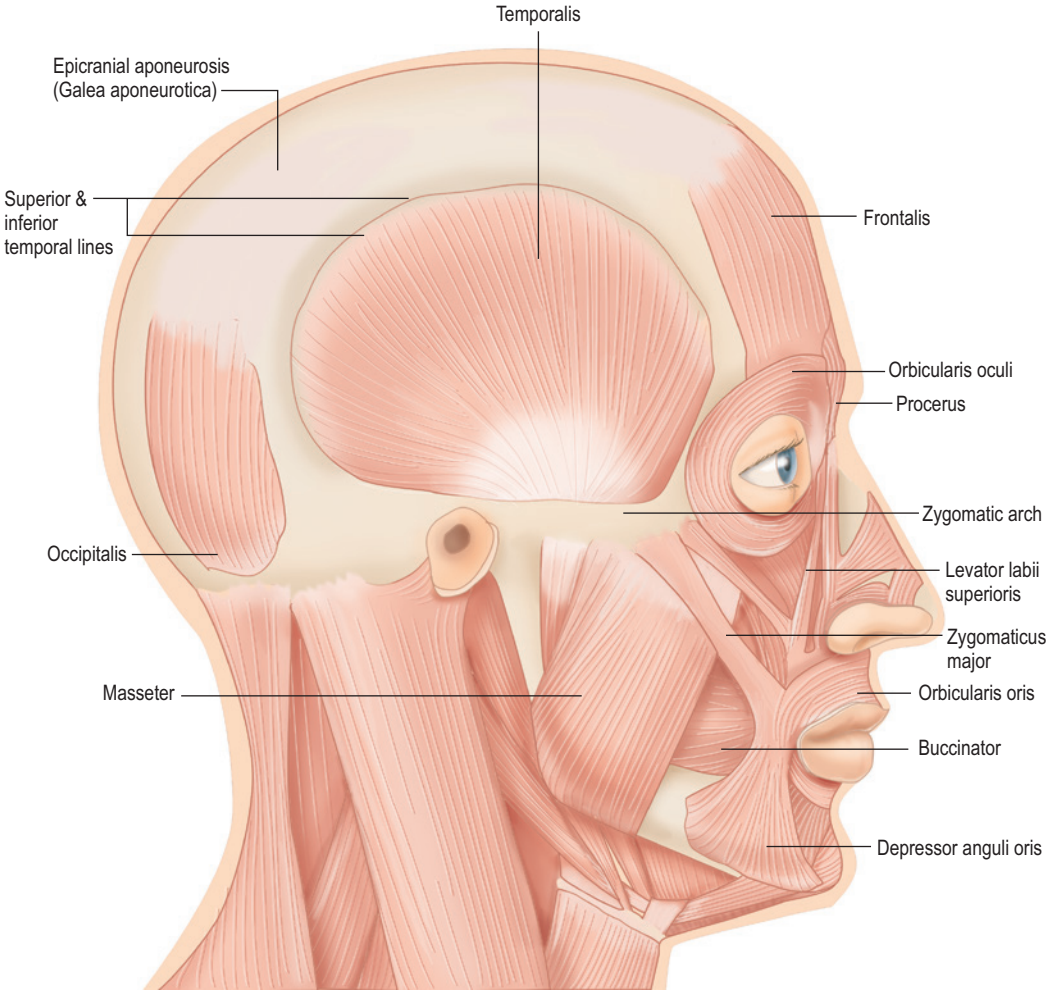
The margins of the eyelids are 2 mm wide. The posterior lid margin is sharp and applied to the globe. The anterior lid margin is rounded and holds the eyelashes. The mucocutaneous junction is at the Meibomian gland openings, just posterior to the grey line at the margin of the lid.

1.5 Muscles of facial expression, the mimetic muscles (Diags 1.4, 1.5)

These muscles are derived from the second branchial arch and they are innervated by the seventh cranial nerve.



Diag. 1.4
Anterior view of muscles of facial expression and their relationship with local nerves.



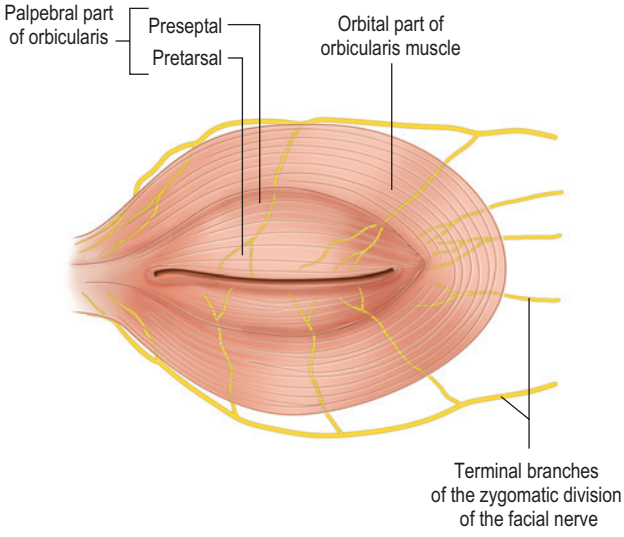
Diag. 1.5
Lateral view of muscles of facial expression and muscles of mastication.

1.5.1 Muscles and tendons of the eyelids

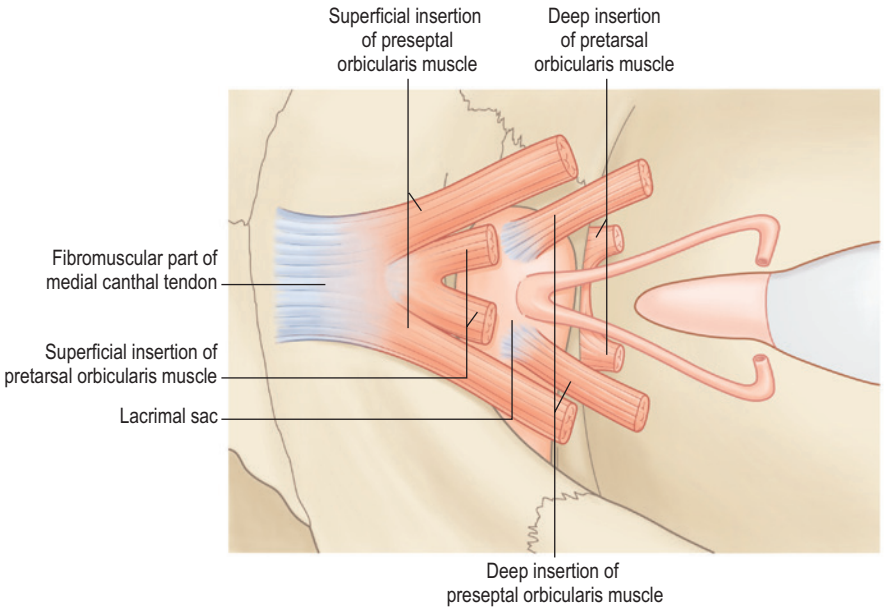
(a) The muscles – orbicularis oculi
(Diags 1.6, 1.7)

The orbicularis oculi muscle closes the eyelids. The muscle is a flat sheet of fibres which encircles the palpebral aperture spreading out beyond the orbital rim. It is divided into two concentric zones – orbital (overlying the orbital rims) and palpebral (overlying the lids). The palpebral part is further divided into a preseptal part (anterior to the orbital septum) and a pretarsal part (anterior to the tarsal plate).

The orbital part arises from the medial orbital rim and its fibres sweep laterally in concentric bands to join at the lateral orbital rim. The palpebral part arises from the lateral canthal tendon and inserts medially. At the lid margins the pretarsal muscle extends posteriorly as far as the Meibomian gland openings and the muscle of Riolan (see Diags 1.15, 1.16).



Diag. 1.6
Orbicularis oculi muscle and the terminal branches of the facial nerve.



Diag. 1.7
The medial canthus.

The medial attachments of the palpebral part of the orbicularis oculi muscle are complex (Diag. 1.7).

The pretarsal muscles, firmly attached to the tarsal plates, insert medially by a superficial head and a deep head. The superficial head from each lid blends with a fibrous component to form the anterior part of the medial canthal tendon. The deep head from each lid is also known as the pars lacrimalis, or Horner's muscle. Its fibres begin at the medial ends of the tarsal plates and insert into the posterior lacrimal crest a few millimetres behind the lacrimal sac. Contraction of the deep head pulls the lid medially and posteriorly.

The preseptal muscles, less firmly attached to the orbital septum, also insert medially by a superficial head and by a deep head. The superficial head from each lid inserts into the superficial part of the medial canthal tendon. The deep heads insert into the fascia overlying the lacrimal sac and on the medial orbital wall above and below Horner's muscle. Contraction of the deep heads pulls the lacrimal fascia laterally.

There is some discussion about the detailed anatomy of the medial canthus. In practice the individual muscle insertions described previously are not usually identified at operation.

At the lateral canthus the pretarsal muscles join and insert by a common tendon into Whitnall's tubercle. The preseptal muscles join laterally to form a lateral raphe which is connected to the underlying tendon.

(b) The canthal tendons (also known as palpebral ligaments)

(i) The lateral canthal tendon (Diag. 1.8)

Deep to the muscle insertions described above a Y-shaped fibrous thickening in the orbital septum joins the lateral ends of the tarsal plates to Whitnall's tubercle. These muscular and fibrous structures together form the lateral canthal tendon.

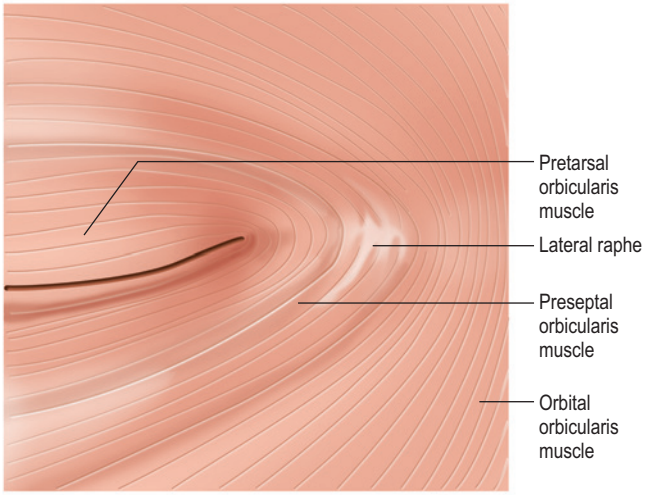
(ii) The medial canthal tendon (Diag. 1.7)

The medial canthal tendon also has a fibrous and a muscular component. The muscular component was described in detail previously.

The fibrous component is attached laterally to the medial ends of the tarsal plates as two limbs of a Y. It has a superficial and a deep component. The superficial component inserts medially on the frontal process of the maxilla just anterior to the anterior lacrimal crest, level with the upper part of the lacrimal sac. It has a definite inferior border but the superior border blends with the periosteum. The deep component leaves the deep surface just lateral to the anterior lacrimal crest and inserts into the posterior lacrimal crest behind the lacrimal sac. This deep component of the tendon is the main medial anchor of the lids.

(c) The lacrimal pump

During blinking the deep heads of the pretarsal muscles (Horner's muscle) pull the medial ends of the eyelids



Diag. 1.8
The lateral canthus.

medially, shortening the canaliculi, while the lacrimal fascia and sac wall are pulled laterally by contraction of the deep heads of the preseptal muscle. The puncta close and the tears in the ampullae of the canaliculi are forced medially and are sucked into the sac. As the deep insertions of the orbicularis muscle relax at the end of the blink the lacrimal fascia and sac wall move medially again, the medial ends of the lids move laterally, the puncta reopen and the ampullae refill with tears. Drainage of tears from the lacrimal sac into the nasolacrimal duct is not influenced directly by the lacrimal pump mechanism and is mainly due to gravity.

1.5.2 Muscles of the forehead and scalp (Diags 1.4, 1.5)

The occipitalis muscle posteriorly and the frontalis muscle anteriorly are joined by an aponeurosis, the galea aponeurotica or epicranial aponeurosis. Laterally, it blends with the temporoparietal (superficial temporal) fascia which together form part of the superficial musculo-aponeurotic system (SMAS, see 1.7.1 and Diag. 1.9). The frontalis muscle fibres insert into the orbicularis muscle and the skin of the brows. The occipitalis arises from the occipital bone.

The corrugator supercilii muscle (Diag. 1.4) arises from the medial end of the superciliary ridge, lateral to the origin of the procerus muscle, and passes upwards and laterally through both frontalis and orbicularis muscles to insert into the skin of the middle of the brow. It draws the brow in and down. The superficial and deep branches of the supraorbital nerve pass either side of the muscle, approximately at its midpoint, as they ascend into the forehead.

The procerus muscle arises on the nasal bones and inserts into the skin of the lower forehead and bridge of the nose. It wrinkles the nose.

These muscles are all innervated by the frontal branch of the facial nerve.

1.5.3 Muscles of the mouth (Diags 1.5, 1.11)

Several small muscles deep within the cheek arise from the facial skeleton below and lateral to the eye and converge on the angle of the mouth. They and their anatomical relationships are important in any surgery in the mid face. The zygomaticus major and minor muscles arise from the zygomatic bone. The levator labii superioris and the levator anguli oris respectively arise from above and below the infraorbital foramen. A number of other smaller muscles in the mid face are less relevant surgically. They include the levator labii superioris alequae nasi which arises from the frontal process of the maxilla just anterior to the orbicularis oculi.

1.6 Muscles of mastication (Diag. 1.5)

These muscles are derived from the first branchial arch and they are innervated by the motor fibres in the mandibular division of the fifth cranial nerve.

1.6.1 Temporalis muscle

This fan-shaped muscle arises from a wide origin on the side of the skull – the inferior temporal line. It also has attachments to the strong overlying temporal fascia which inserts into the superior temporal line. The temporalis muscle fibres descend and converge to insert on the coronoid process and anterior part of the ramus of the mandible.

1.6.2 Masseter muscle

The masseter muscle, which can be easily palpated in the cheek when the teeth are clenched, arises from the lower border of the zygomatic arch and inserts on the angle and ramus of the mandible. The anterior border of the parotid gland wraps around the posterior border of the masseter. The parotid duct passes forward across the middle of the muscle and winds around its anterior border to pierce the buccinator muscle and enter the mouth at the level of the second upper molar tooth.

1.7 Facial fat and fascia

Subcutaneous fat throughout the body is separated into a superficial, continuous layer of fat, just deep to the dermis and of variable thickness, and a deeper, discontinuous layer which is formed of collections of fat between the muscles.

The superficial fat layer is thickened in the cheek where it is known as the malar fat pad. It also has a deep component between the facial muscles.

Of the deep fat pads in the face, a number are important during surgery in the periocular region.

These superficial and deep fat layers are separated by a layer of thin superficial fascia.

Fascia is also found at a deeper level where it is of variable thickness. It invests the muscles of facial expression (the mimetic muscles), binds the deeper structures together, forms intermuscular septa between muscles or groups of muscles and binds muscles or tendons to deeper structures.

This system of superficial and deep layers of fascia is the superficial musculo-aponeurotic system, or SMAS. The facial nerve pierces the deep layer of the SMAS in the mid cheek to innervate the enclosed muscles of facial expression.

1.7.1 The superficial musculo-aponeurotic system (SMAS) (Diags 1.9, 1.10)

The multilayered sheet of fascial tissue which forms the SMAS extends from the galea aponeurotica (epicranial aponeurosis) in the scalp to the platysma muscle in the neck. It splits, en route, to enclose the muscles of facial expression, binding them together so that their action is disseminated and their effect is smoothly coordinated.

There has been some discussion about the extent and continuity of the SMAS. The following is a summary of the main features.

In the scalp the SMAS is represented by the galea aponeurotica. Here it splits to enclose the frontalis muscle (Diag. 1.10). The superficial part covers the anterior surface of the frontalis and orbicularis muscles. The deep part, lying on the periosteum, splits again into anterior and posterior layers to enclose the fat pad of the brow – the retro-orbicularis oculi fat pad or ROOF (see 1.7.4). The anterior layer of the deep galea covers the posterior surface of the orbicularis muscle. It is thickened laterally as part of the orbital retaining ligament (1.7.5). The posterior layer of the deep galea becomes the orbital septum.

The superficial and deep layers of the deep galea continue their descent into the upper lid and ultimately reunite on the surface of the levator aponeurosis (Diag. 1.10). The superficial and deep galea, lying superficial and deep to the orbicularis muscle respectively, become attenuated within the lid and unite close to the lid margin. Laterally, within the lid, the layers of the galea pass around the canthi into the mid face to unite with the facial SMAS to lie superficial and deep to the other facial muscles.

Laterally from the scalp the SMAS descends into the temple as the temporoparietal (superficial temporal) fascia, a sheet lying on the surface of the (deep) temporal fascia (see 1.7.2). It continues down superficial to the zygomatic arch and masseter muscle (Diag. 1.9). Within the temporoparietal fascia the frontal branch of the facial nerve passes superiorly across the midpoint of the zygomatic arch where it is particularly vulnerable to injury during face and brow lift surgery. Inferior to the zygomatic arch the temporoparietal fascia splits into a superficial layer and a deep layer to enclose the muscles of facial expression in the mid face and neck – the zygomatic, orbicularis oculi and platysma muscles and other small muscles in the mid face.

The SMAS is a well-formed layer in the scalp (the galea aponeurotica) and the temporal region (the temporoparietal fascia) but it becomes thin and variable elsewhere, including most of the mid face. In the parotid-masseteric region, it is also thin but it is adherent to the parotid fascia which results in a uniform sheet overlying the parotid gland and extending some way into the mid face. Attenuated anterior and posterior layers envelop the orbicularis muscle of the lower lid.

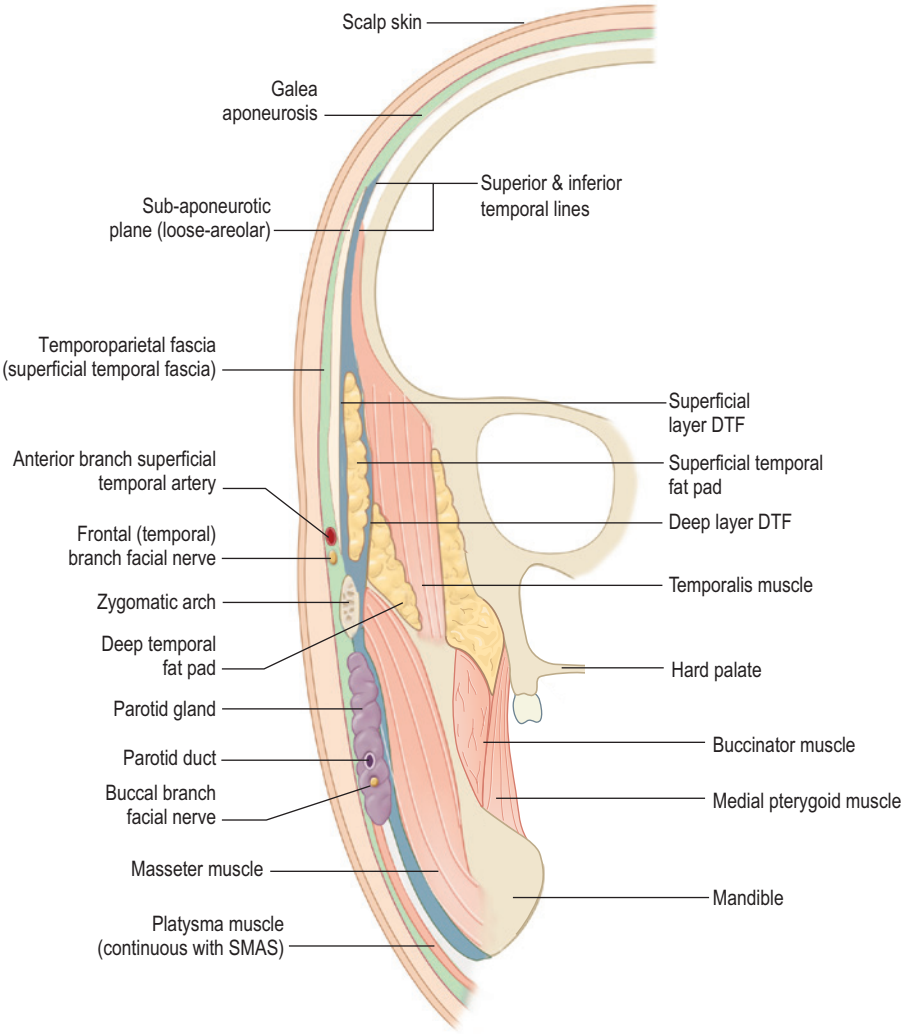
1.7.2 Temporal fascia and fat pads (Diag. 1.9)

The terminology of the temporal fascial layers can be confusing.

The temporoparietal fascia, the SMAS in the temporal region, is sometimes known as the superficial temporal fascia. It is described above (1.7.1).

The temporal fascia, also known as the deep temporal fascia, is a strong membrane stretching over the temporal fossa and covering the temporalis muscle. It has superficial and deep layers (Diag. 1.9). It arises above, along the superior temporal line (also known as the temporal fusion line or temporal line of fusion) (Diag. 1.3), just superior to the origin of the temporalis muscle which arises from the inferior temporal line. Along the superior temporal line the temporal fascia fuses with the periosteum and the bone. As it descends toward the zygomatic arch the temporal fascia splits. The superficial layer inserts along the superior border of the zygomatic arch. The deep layer descends on the surface of the temporalis muscle, deep to the zygomatic arch, then on the surface of the masseter muscle down to its insertion on the mandible.

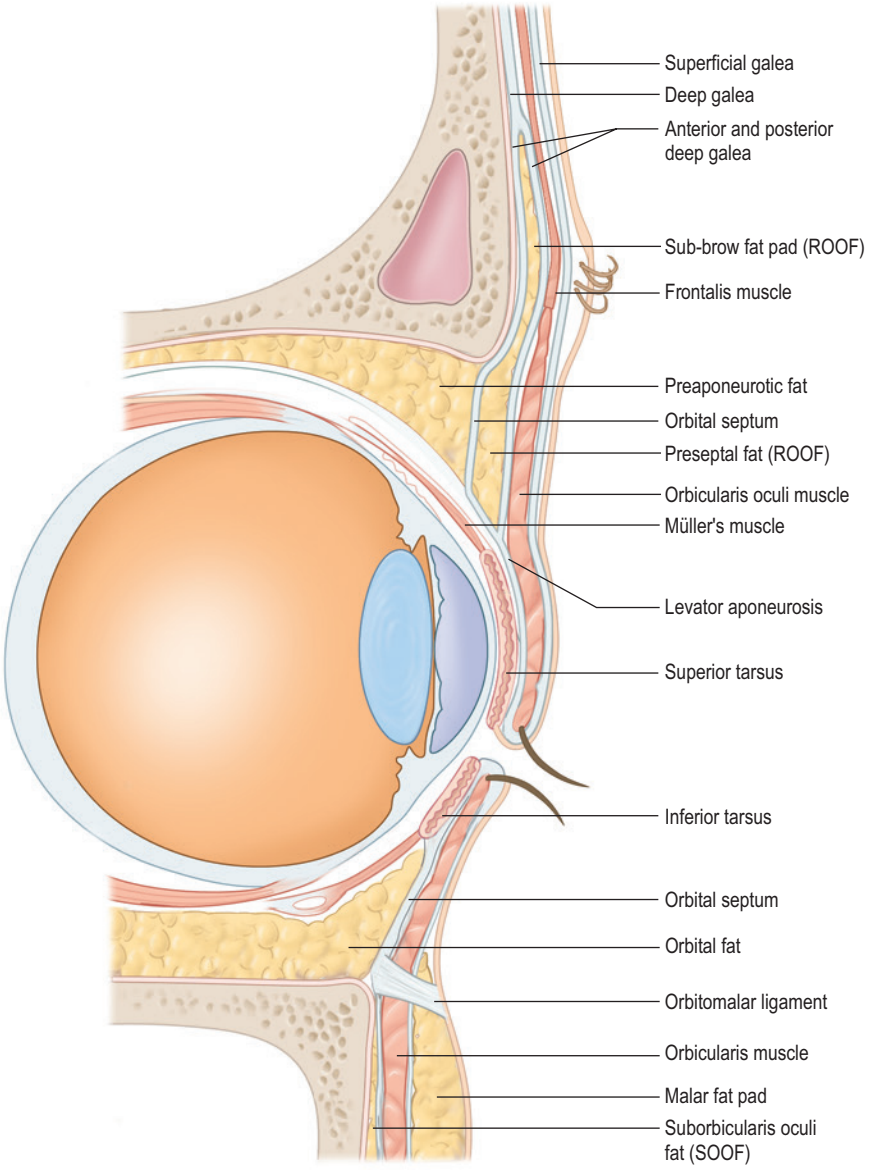
Between the superficial and deep layers of the (deep) temporal fascia lies the superficial temporal fat pad – often termed simply the temporal fat pad. It is situated just above the posterior half of the zygomatic arch. Between the deep layer of the (deep) temporal fascia and the temporalis muscle lies the deep temporal fat pad; this is the temporal extension of a pad of fat extending up from the cheek – the fat pad of Bichat. It is situated more anteriorly, between the zygomatic arch and the lateral orbital rim.



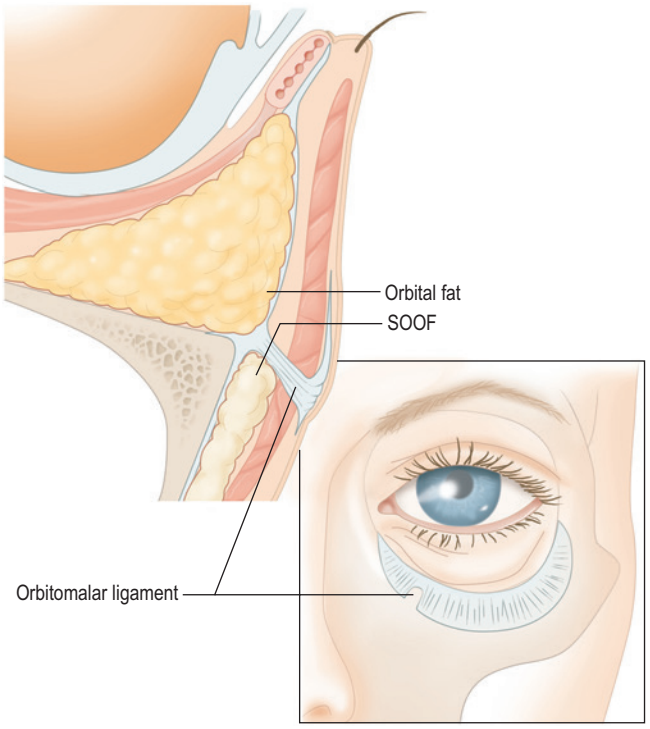
Diag. 1.9
Coronal section through the SMAS, temporal fascia and muscles on the lateral side of the face.

1.7.3 Sub-orbicularis oculi fat pad – SOOF (Diags 1.10–1.12)

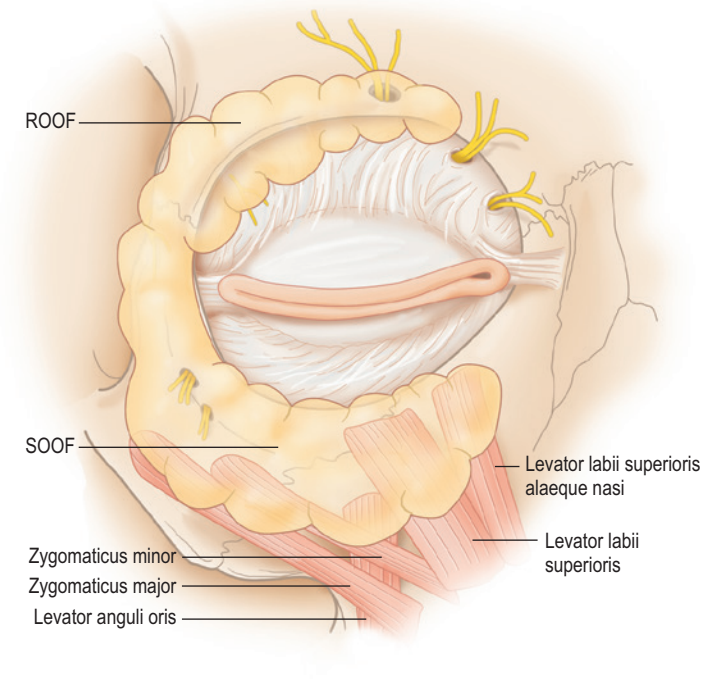
This fad pad lies just below the lateral half of the inferior orbital rim and extends over the lower part of the body of the zygoma. It is in contact with the periosteum but its lower border overlaps the origins of the zygomatic, levator labii and levator anguli oris muscles, deep to the lower part of the orbicularis oculi muscle in the upper cheek. It is posterior to the deep layer of the SMAS lining the deep surface of the orbicularis muscle. As the SMAS descends from the lower lid tissues, it is thickened into a supporting sheet, the orbitomalar ligament (also known as the orbicularis retaining ligament), which has attachment also to the inferior orbital rim periosteum. This has to be cut to expose the SOOF from above (Diag. 1.10).



Diag. 1.10
Sagittal section through the fascia, muscles and fat of the eyelids, forehead and upper cheek.



Diag. 1.10, cont'd

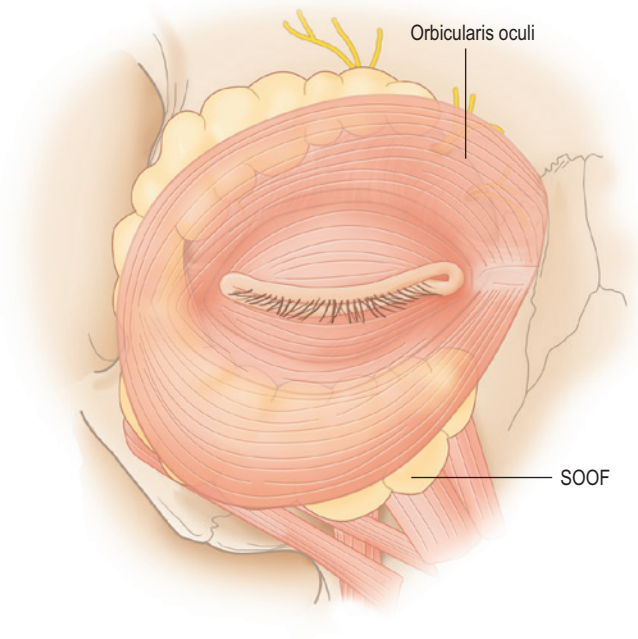


Diag. 1.11
Mimetic muscles of the cheek with the SOOF and ROOF fat layers.

1.7.4 The retro-orbicularis oculi fat pad – ROOF (Diags 1.10–1.12)

This fat pad, which is generally more prominent in males, lies deep to the hair-bearing skin and thin subcutaneous fat layer of the brow, the orbital part of the orbicularis muscle and the lower fibres of the frontalis muscle. It is enclosed between the superficial and deep layers of the deep galea aponeurotica as these descend into the upper lid. An additional deep attachment of the brow fat to the supraorbital periosteum is more secure medially than laterally. The brow fat may extend inferiorly on the anterior surface of the orbital septum where it can be confused with the preaponeurotic fat pad which is posterior to the septum at the same level. The supraorbital nerve and vessels emerge from the supraorbital foramen at the junction of the central and medial thirds of the superior orbital rim. The supratrochlear nerve emerges medially (see Diags 1.4, 1.23, 1.24). These sensory nerves pass superiorly between the periosteum and the overlying ROOF and then pierce the frontalis muscle to reach the skin of the scalp.

The SOOF and ROOF pads communicate at their lateral ends through fat overlying the lateral orbital rim and the lateral canthal tendon. These fat pads are separated from the orbital fat pads by the orbital septum and, in the lower lid, also by the layers of the SMAS (orbitomalar ligament) at the orbital rim.

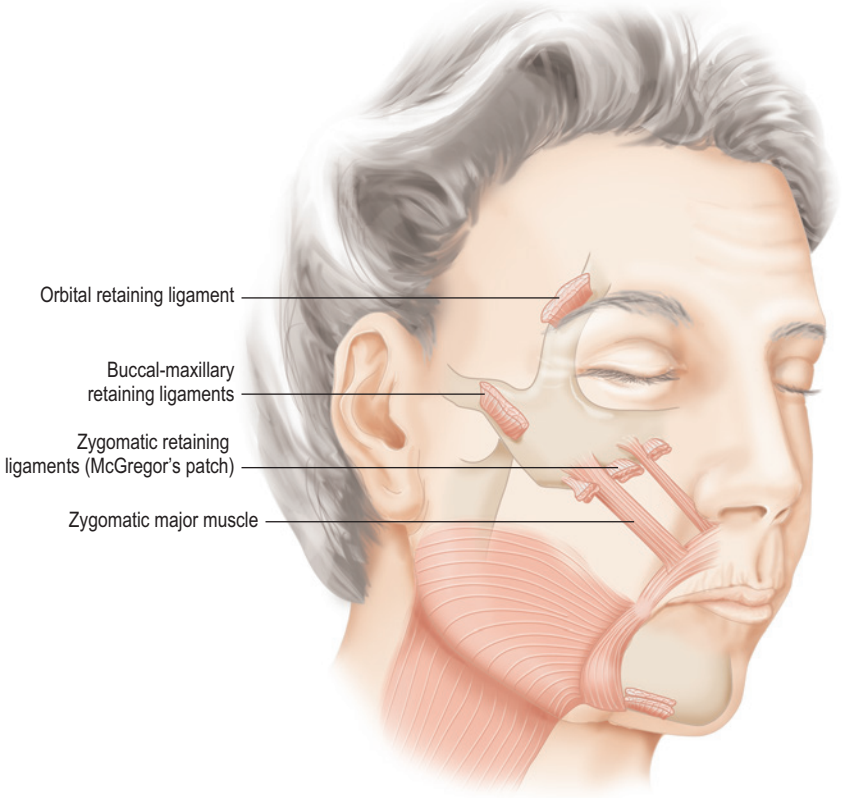


Diag. 1.12
Orbicularis oculi muscle and its relationship to the underlying muscles and fat of the cheek.

1.7.5 The retaining ligaments (Diag. 1.13)

The retaining ligaments of the face are fibrous connective tissue condensations that originate on the bones of the facial skeleton and support the overlying soft tissues. There are three retaining ligaments in the orbital region; each arises from one of the bony sutures of the zygoma. In addition, the orbitomalar ligament (also known as the orbicularis retaining ligament) supports the cheek (see 1.7.3).

The orbital retaining ligament lies at the anterior end of the superior temporal line (temporal fusion line) and bridges the zygomatico-frontal suture. It inserts into the overlying muscles and skin close to the tail of the brow. The zygomatic retaining ligament, also known as McGregor's patch, is centred on the zygomatico-temporal suture at the anterior end of the zygomatic arch. This ligament supports the tissues of the upper lateral cheek. One of the rami of the zygomatic branch of the facial nerve passes inferiorly and deep to it. The buccal-maxillary retaining ligament covers most of the zygomatico-maxillary suture and inserts as a line into the tissues of the mid cheek above the nasolabial fold.



Diag. 1.13
Retaining ligaments of the periocular region and cheek.

1.8 Orbital fat and fascia

(Diags 1.14, 1.23)

The muscle cone divides the orbital fat into two parts, the intraconal and extraconal fat, which are separated by fascia anteriorly, between the rectus muscles, but communicate posteriorly as the fascia becomes thinner. The fat is supported by a complex meshwork of delicate connective tissue septa elaborated, by Koornneef (1976, 1979). This system of interlocking septa, which effectively links the various orbital components, is well formed in the anterior orbit but is weaker posteriorly.

The intraconal fat is exposed by enucleation of the eye or by surgery in the intraconal space. The extraconal fat is frequently seen in lid surgery and is divided into four lobes or fat pads.

In the upper lid, there are two extraconal fat pads: a smaller medial fat pad and a larger central fat pad, the preaponeurotic fat pad (see Figs 9.3e,f, 10.2c,d). These fat pads are separated by a fascial septum in the region of the trochlea. Lateral to the preaponeurotic fat pad lies the lacrimal gland (see Fig. 10.3a).

In the lower lid, there are also two fat pads (see Fig. 6.4c). The larger medial fat pad is often subdivided into two smaller collections – the medial and central fat pads – separated by the inferior oblique muscle and a fine fascial septum in the region of the inferior oblique muscle origin. Care must be taken not to damage the inferior oblique muscle during reduction of this fat pad at blepharoplasty (see 10.4c). The smaller lateral fat pad is separated from the medial fat pad(s) by a fascial septum.