

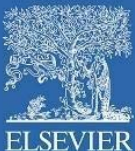


Enhanced  
**DIGITAL  
VERSION**  
Included

THE MASSACHUSETTS  
EYE AND EAR INFIRMARY  
ILLUSTRATED MANUAL OF

# OPHTHALMOLOGY

NEIL J. FRIEDMAN | PETER K. KAISER  
ROBERTO PINEDA II



FIFTH EDITION

# Any screen. Any time. Anywhere.

Activate the eBook version  
of this title at no additional charge.



Expert Consult eBooks give you the power to browse and find content, view enhanced images, share notes and highlights—both online and offline.

## Unlock your eBook today.

- 1 Visit [expertconsult.inkling.com/redeem](http://expertconsult.inkling.com/redeem)
- 2 Scratch off your code
- 3 Type code into “Enter Code” box
- 4 Click “Redeem”
- 5 Log in or Sign up
- 6 Go to “My Library”

It’s that easy!

Scan this QR code to redeem your  
eBook through your mobile device:



Place Peel Off  
Sticker Here

For technical assistance:  
email [expertconsult.help@elsevier.com](mailto:expertconsult.help@elsevier.com)  
call 1-800-401-9962 (inside the US)  
call +1-314-447-8200 (outside the US)

ELSEVIER

**THE MASSACHUSETTS  
EYE AND EAR INFIRMARY**  
ILLUSTRATED MANUAL OF

# **OPHTHALMOLOGY**



THE MASSACHUSETTS  
EYE AND EAR INFIRMARY  
ILLUSTRATED MANUAL OF

# OPHTHALMOLOGY

FIFTH EDITION

**NEIL J. FRIEDMAN, MD**

Adjunct Clinical Professor  
Department of Ophthalmology  
Stanford University School of Medicine  
Stanford, CA, USA  
Partner  
Mid-Peninsula Ophthalmology Medical  
Group  
Menlo Park, CA, USA

**PETER K. KAISER, MD**

Chaney Family Endowed Chair in  
Ophthalmology Research  
Professor of Ophthalmology  
Cleveland Clinic Lerner College of  
Medicine  
Cole Eye Institute  
Cleveland, OH, USA

*Associate author*

**ROBERTO PINEDA II, MD**

Thomas Y. and Clara W. Butler Chair in Ophthalmology  
Associate Professor of Ophthalmology  
Harvard Medical School  
Cornea and Refractive Surgery Service  
Massachusetts Eye and Ear Infirmary  
Boston, MA, USA

For additional online content visit [ExpertConsult.com](http://ExpertConsult.com)



ELSEVIER

Edinburgh London New York Oxford Philadelphia St. Louis Sydney 2021

Elsevier  
3251 Riverport Lane  
St. Louis, Missouri 63043

THE MASSACHUSETTS EYE AND EAR INFIRMARY  
ILLUSTRATED MANUAL OF OPHTHALMOLOGY, Fifth Edition

ISBN: 978-0-323-61332-3  
e-Book ISBN: 978-0-323-61333-0

© 2021, Elsevier Inc. All rights reserved.

Videos for Chapter 2: Ocular Motility and Cranial Nerves and Chapter 3: Lids, Lashes, and Lacrimal System Y. Joyce Liao retains copyright to her original videos.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: [www.elsevier.com/permissions](http://www.elsevier.com/permissions).

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

#### Notices

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds or experiments described herein. Because of rapid advances in the medical sciences, in particular, independent verification of diagnoses and drug dosages should be made. To the fullest extent of the law, no responsibility is assumed by Elsevier, authors, editors or contributors for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Previous editions copyrighted 2014, 2009, 2004, and 1998.

**International Standard Book Number: 978-0-323-61332-3**

*Content Strategist:* Kayla Wolfe  
*Content Development Specialist:* Nani Clansey  
*Publishing Services Manager:* Deepthi Unni  
*Project Manager:* Radjan Lourde Selvanadin  
*Design:* Renee Duenow  
*Illustration Manager:* Teresa McBryan  
*Marketing Manager:* Claire McKenzie

Printed in China

Last digit is the print number: 9 8 7 6 5 4 3 2 1



# Contents

Video Table of Contents ix  
Preface xi  
Contributors xii  
Acknowledgements xiii  
Figure Courtesy Lines xiv  
Introduction xvii

## CHAPTER 1

### Orbit 1

Trauma 1  
Globe Subluxation 7  
Carotid–Cavernous and Dural  
Sinus Fistulas 8  
Infections 10  
Inflammation 13  
Congenital Anomalies 17  
Pediatric Orbital Tumors 19  
Adult Orbital Tumors 24  
Acquired Anophthalmia 29  
Atrophia Bulbi and Phthisis  
Bulbi 30

## CHAPTER 2

### Ocular Motility and Cranial Nerves 33

Strabismus 33  
Horizontal Strabismus 35  
Vertical Strabismus 40  
Miscellaneous Strabismus 43  
Nystagmus 45  
Third Cranial Nerve Palsy 48  
Fourth Cranial Nerve Palsy 51  
Sixth Cranial Nerve Palsy 54  
Multiple Cranial Nerve Palsies 56  
Chronic Progressive External  
Ophthalmoplegia 59  
Horizontal Motility Disorders 61

Vertical Motility Disorders 63  
Myasthenia Gravis 65

## CHAPTER 3

### Lids, Lashes, and Lacrimal System 69

Eyelid Trauma 69  
Eyelid Infections 73  
Eyelid Inflammations 80  
Eyelid Malpositions 86  
Blepharospasm 94  
Bell's Palsy 95  
Floppy Eyelid Syndrome 97  
Trichiasis 98  
Congenital Eyelid Anomalies 99  
Benign Eyelid Tumors 103  
Malignant Eyelid Tumors 110  
Systemic Diseases 116  
Canaliculitis 120  
Nasolacrimal Duct Obstruction 123  
Dacryoadenitis 125  
Lacrimal Gland Tumors 128

## CHAPTER 4

### Conjunctiva and Sclera 131

Trauma 131  
Telangiectasia 135  
Microaneurysm 136  
Dry Eye Disease (Dry Eye  
Syndrome, Keratoconjunctivitis  
Sicca) 136  
Inflammation 142  
Conjunctivitis 145  
Degenerations 154  
Ocular Cicatricial Pemphigoid 156  
Stevens–Johnson Syndrome (Erythema  
Multiforme Major) 158

Graft-versus-Host Disease 160  
 Tumors 161  
 Episcleritis 170  
 Scleritis 171  
 Scleral Discoloration 173

## CHAPTER 5

### Cornea 177

Trauma 177  
 Limbal Stem Cell Deficiency 182  
 Peripheral Ulcerative Keratitis 184  
 Contact Lens–Related Problems 187  
 Miscellaneous 193  
 Corneal Edema 198  
 Graft Rejection and Failure 199  
 Infectious Keratitis (Corneal Ulcer) 201  
 Interstitial Keratitis 210  
 Pannus 212  
 Degenerations 213  
 Ectasias 217  
 Congenital Anomalies 220  
 Dystrophies 224  
 Metabolic Diseases 233  
 Deposits 235  
 Enlarged Corneal Nerves 240  
 Tumors 240

## CHAPTER 6

### Anterior Chamber 243

Primary Angle-Closure Glaucoma 243  
 Secondary Angle-Closure Glaucoma 245  
 Hypotony 248  
 Hyphema 250  
 Cells and Flare 251  
 Hypopyon 253  
 Endophthalmitis 254  
 Anterior Uveitis (Iritis, Iridocyclitis) 258  
 Uveitis–Glaucoma–Hyphema  
 Syndrome 265

## CHAPTER 7

### Iris and Pupils 267

Trauma 267  
 Corectopia 271  
 Seclusio Pupillae 272

Peripheral Anterior Synechiae 273  
 Rubeosis Iridis 275  
 Neovascular Glaucoma 276  
 Pigment Dispersion Syndrome 277  
 Pigmentary Glaucoma 278  
 Iris Heterochromia 279  
 Anisocoria 281  
 Adie’s Tonic Pupil 283  
 Argyll Robertson Pupil 284  
 Horner’s Syndrome 285  
 Relative Afferent Pupillary Defect  
 (Marcus Gunn Pupil) 287  
 Leukocoria 289  
 Congenital Anomalies 290  
 Mesodermal Dysgenesis Syndromes 292  
 Iridocorneal Endothelial Syndromes 295  
 Tumors 297

## CHAPTER 8

### Lens 303

Congenital Anomalies 303  
 Congenital Cataract 306  
 Acquired Cataract 310  
 Posterior Capsular Opacification 316  
 Aphakia 318  
 Pseudophakia 319  
 Exfoliation 320  
 Pseudoexfoliation Syndrome 321  
 Pseudoexfoliation Glaucoma 322  
 Lens-Induced Glaucoma 324  
 Dislocated Lens (Ectopia Lentis) 325

## CHAPTER 9

### Vitreous 329

Amyloidosis 329  
 Asteroid Hyalosis 330  
 Persistent Hyperplastic Primary Vitreous  
 (Persistent Fetal Vasculature  
 Syndrome) 331  
 Posterior Vitreous Detachment 332  
 Synchysis Scintillans 334  
 Vitreous Hemorrhage 334  
 Vitritis 335



**CHAPTER 10****Retina and Choroid 337**

Trauma 338  
 Hemorrhages 342  
 Cotton-Wool Spot 344  
 Terson Syndrome 345  
 Branch Retinal Artery Occlusion 345  
 Central Retinal Artery Occlusion 347  
 Ophthalmic Artery Occlusion 350  
 Branch Retinal Vein Occlusion 351  
 Central or Hemiretinal Vein Occlusion 354  
 Venous Stasis Retinopathy 358  
 Ocular Ischemic Syndrome 358  
 Retinopathy of Prematurity 360  
 Coats Disease and Leber's Miliary Aneurysms 362  
 Familial Exudative Vitreoretinopathy and Norrie Disease 364  
 Incontinentia Pigmenti 364  
 Eales Disease 364  
 Macular Telangiectasia (MacTel, Idiopathic Juxtafoveal, and Perifoveal Telangiectasia) 365  
 Retinopathies Associated with Blood Abnormalities 367  
 Diabetic Retinopathy 370  
 Hypertensive Retinopathy 377  
 Toxemia of Pregnancy 378  
 Acquired Retinal Arterial Macroaneurysm 379  
 Radiation Retinopathy 380  
 Age-Related Macular Degeneration 381  
 Retinal Angiomatous Proliferation 388  
 Polypoidal Choroidal Vasculopathy 390  
 Age-Related Choroidal Atrophy 392  
 Myopic Degeneration and Pathologic Myopia 393  
 Angioid Streaks 395  
 Central Serous Chorioretinopathy 396  
 Cystoid Macular Edema 399  
 Macular Hole 401  
 Vitreomacular Adhesion and Traction 404  
 Epiretinal Membrane and Macular Pucker 404  
 Myelinated Nerve Fibers 407

Solar and Photic Retinopathy 407  
 Toxic (Drug) Maculopathies 408  
 Lipid Storage Diseases 417  
 Peripheral Retinal Degenerations 418  
 Retinoschisis 420  
 Retinal Detachment 423  
 Choroidal Detachment 427  
 Chorioretinal Folds 428  
 Chorioretinal Coloboma 429  
 Proliferative Vitreoretinopathy 430  
 Intermediate Uveitis and Pars Planitis 430  
 Neuroretinitis (Leber's Idiopathic Stellate Neuroretinitis) 432  
 Posterior Uveitis: Infections 433  
 Posterior Uveitis: White Dot Syndromes 447  
 Posterior Uveitis: Other Inflammatory Disorders 455  
 Posterior Uveitis: Evaluation and Management 464  
 Hereditary Chorioretinal Dystrophies 466  
 Hereditary Macular Dystrophies 476  
 Hereditary Vitreoretinal Degenerations 484  
 Leber Congenital Amaurosis 490  
 Retinitis Pigmentosa 493  
 Albinism 501  
 Phakomatoses 503  
 Tumors 509  
 Paraneoplastic Syndromes 523

**CHAPTER 11****Optic Nerve and Glaucoma 525**

Papilledema 525  
 Idiopathic Intracranial Hypertension and Pseudotumor Cerebri 527  
 Optic Neuritis 529  
 Anterior Ischemic Optic Neuropathy 530  
 Traumatic Optic Neuropathy 533  
 Other Optic Neuropathies 535  
 Congenital Anomalies 539  
 Tumors 544  
 Chiasmal Syndromes 548  
 Congenital Glaucoma 551  
 Primary Open-Angle Glaucoma 552

Secondary Open-Angle Glaucoma	561
Normal (Low)-Tension Glaucoma	564

## CHAPTER 12

### Visual Acuity, Refractive Procedures, and Sudden Vision Loss 567

Refractive Error	567
Refractive Surgery Complications	570
Refractive Surgery Complications: Evaluation and Management	579
Vertebrobasilar Insufficiency (Vertebrobasilar Atherothrombotic Disease)	581
Migraine	582
Convergence Insufficiency	586
Accommodative Excess (Accommodative Spasm)	586
Functional Visual Loss	586
Transient Visual Loss (Amaurosis Fugax)	587
Amblyopia	588
Cortical Blindness (Cortical Visual Impairment)	590
Visual Pathway Lesions	591

## APPENDIX 595

Ophthalmic History and Examination	595
American Academy of Ophthalmology Suggested Routine Eye Examination Guidelines	622
Differential Diagnosis of Common Ocular Symptoms	622
Common Ophthalmic Medications	625
Color Codes for Topical Ocular Medication Caps	632
Ocular Toxicology	633
List of Important Ocular Measurements	634
List of Eponyms	635
Common Ophthalmic Abbreviations (How to Read an Ophthalmology Chart)	638
Common Spanish Phrases	640

## Index 645

# Video Contents

Video 2.1	Torsional nystagmus.
Video 2.2	Acquired pendular nystagmus.
Video 2.3	Down-beating nystagmus.
Video 2.4	Up-beating nystagmus.
Video 2.5	Fixation instability.
Video 2.6	Fixation instability, episodic.
Video 2.7	Ataxia of saccades.
Video 2.8	Saccadic pursuit.
Video 2.9	Cranial nerve 3 palsy, left.
Video 2.10	Cranial nerve 4 palsy, right.
Video 2.11	Cranial nerve 6 palsy, left.
Video 2.12	Internuclear ophthalmoplegia, right.
Video 2.13	Bilateral ophthalmoplegia (one-and-a-half syndrome, left, and vertical gaze palsy in both eyes).
Video 2.14	Spasm of near reflex.
Video 2.15	Ocular myasthenia.
Video 3.1	Blepharospasm.
Video A.1	Ocular motility testing (cranial nerve 4 palsy, right).

Videos are courtesy of Y. Joyce Liao, MD, PhD, with special thanks to Dr. Thomas Hwang, Angela Oh, and Ali Shariati for their assistance.

Available on [www.expertconsult.com](http://www.expertconsult.com)



# Preface

We started this process more than two decades ago when the first edition was published, and now we are excited to share the fifth edition of this book with you. Our goal remains the same: to produce a concise manual that covers a broad variety of ophthalmic disorders and present it in a user-friendly diagnostic atlas. With each update, we strive to improve on the previous version. We believe that this edition continues to set the bar higher.

We have expanded many chapters by adding new sections and figures, we have completely revised various sections, and we have updated numerous evaluation and management algorithms to incorporate the most up-to-date diagnostic and treatment options. Current residents, fellows, and attending physicians have reviewed and contributed to the book to ensure that the text is relevant to all ophthalmologists. The new figures include more clinical photos and images of various tests (i.e., fluorescein angiography, spectral domain optical coherence tomography, fundus autofluorescence, and visual fields) as well as updating some of the older images.

In addition, the fifth edition contains newer classification systems for various entities and updated epidemiology information. In the companion online material, we have added more videos of motility disturbances.

We believe that the new and improved fifth edition retains its previous attributes and incorporates important updates to keep pace with all the recent changes in our specialty. We hope you enjoy it.

Neil J. Friedman, MD  
Peter K. Kaiser, MD  
Roberto Pineda II, MD



# Contributors

We are most appreciative of the contribution of the following colleagues who helped review and edit various chapters of this text:

**Daniel Youngjun Choi, MD**

Partner, Central Valley Eye Medical Group  
Stockton, CA, USA

**Yaping Joyce Liao, MD, PhD**

Associate Professor  
Director, Neuro-Ophthalmology  
Department of Ophthalmology and Department of Neurology  
Stanford University School of Medicine  
Palo Alto, CA, USA

# Acknowledgments

This book would not be possible without the help of numerous people to whom we are grateful. We thank the faculty, staff, fellows, residents, colleagues, and peers at our training programs, including the Bascom Palmer Eye Institute, the Cole Eye Institute, the Cullen Eye Institute, the Massachusetts Eye and Ear Infirmary, the New York Eye and Ear Infirmary, and Stanford University, for their teaching, guidance, and support of this project. We are indebted to the individuals who contributed valuable suggestions and revisions to the text.

We especially acknowledge our editorial and publishing staff at Elsevier—Russell Gabbedy, Kayla Wolfe, Nani Clansey, Radjan Selvanadin, and the members of their department—for their expertise and assistance in once again producing a work that we are excited to share with you.

In addition, we owe a debt of gratitude to Tami Fecko, Nicole Brugnoli, Anne Pinter, Shawn Perry, Louise Carr-Holden, Ditte Hesse, Kit Johnson, Bob Masini, Audrey Melacan, Jim Shigley, Huynh Van, and their photography departments for the wonderful images that truly set this book apart from other texts. We also appreciate the contributions of the numerous physicians whose photographs complete the vast array of ophthalmic disorders represented herein.

Finally, we acknowledge our families, including Mae, Jake, Alan, Diane, Peter (PJ), Stephanie, Dawn, Peter, Anafu, Christine, Roberto, Anne, Gabriela, and Nicole, for all their love and support.

Neil J. Friedman, MD  
Peter K. Kaiser, MD  
Roberto Pineda II, MD

## Figure Courtesy Lines

The following figures are reproduced from *Essentials of Ophthalmology*, Friedman and Kaiser, 2007, Saunders: 2.3, 2.15, 2.22, 4.1, 4.2, 4.31, 4.45, 7.9, 7.20, 7.21, 10.144, 11.30, 12.19, Figure A.7, A.10, A.19, A.20, A.23, A.27, A.28, A.30, A.31, A.32, A.43, Table A.2, and Table A.3.

The following figures are reproduced from *Review of Ophthalmology*, Friedman, Kaiser, and Trattler, 2007, Saunders: 2.25, 2.26, 7.1, 7.6, A.14, A.16, A.17, A.21, and A.29.

The following figures are courtesy of the Bascom Palmer Eye Institute: 3.10, 4.3, 4.43, 4.53, 4.66, 5.8, 5.13, 5.26, 5.34, 5.40, 5.47, 5.64, 5.65, 5.71, 5.76, 5.78, 5.87, 6.10, 6.11, 6.12, 7.8, 7.14, 7.22, 7.23, 8.6, 8.37, 8.39, 8.41, 9.7, 10.1, 10.7, 10.8, 10.13, 10.32, 10.34, 10.41, 10.42, 10.43, 10.47, 10.56, 10.57, 10.64, 10.66, 10.96, 10.99, 10.100, 10.110, 10.117, 10.134, 10.148, 10.149, 10.152, 10.153, 10.154, 10.155, 10.163, 10.169, 10.204, 10.205, 10.208, 10.210, 10.222, 10.223, 10.237, 10.239, 10.244, 10.246, 10.247, 10.248, 10.251, 10.260, 10.262, 10.263, 10.264, 10.265, 10.266, 10.267, 10.272, 10.273, 10.274, 10.276, 10.277, 11.15, 11.18, and 11.21.

The following figures are courtesy of the Cole Eye Institute: 1.3, 1.28, 1.32, 1.33, 1.34, 1.35, 3.3, 3.11, 3.14, 3.19, 3.22, 3.23, 3.37, 3.49, 3.52, 3.56, 3.65, 4.8, 4.20, 4.25, 4.29, 4.32, 4.40, 4.41, 4.44, 4.50, 4.55, 4.56, 4.58, 4.65, 4.68, 5.5, 5.6, 5.12, 5.25, 5.35, 5.38, 5.39, 5.42, 5.43, 5.51, 5.57, 5.61, 5.68, 5.92, 5.99, 5.100, 5.101, 5.102, 6.13, 6.14, 7.17, 7.31, 7.39, 7.46, 8.4, 8.8, 8.9, 8.10, 8.11, 8.21, 8.24, 9.2, 9.6, 10.2, 10.14, 10.18, 10.19, 10.20, 10.21, 10.22, 10.23, 10.25, 10.28, 10.30, 10.31, 10.35, 10.36, 10.37, 10.38, 10.44, 10.46, 10.48, 10.49, 10.50, 10.52, 10.58, 10.59, 10.61, 10.62, 10.67, 10.73, 10.76, 10.77, 10.78, 10.79, 10.93, 10.95, 10.97, 10.98, 10.102, 10.103, 10.105, 10.106, 10.108, 10.115, 10.121, 10.123, 10.124, 10.125, 10.131, 10.132, 10.135, 10.137, 10.138, 10.139, 10.140, 10.141, 10.145, 10.146, 10.147, 10.151, 10.157, 10.159, 10.160, 10.161, 10.162, 10.164, 10.165, 10.166, 10.167, 10.168, 10.171, 10.172, 10.174, 10.175, 10.179, 10.181, 10.182, 10.185, 10.188, 10.189, 10.190, 10.191, 10.192, 10.193, 10.194, 10.197, 10.198, 10.199, 10.200, 10.201, 10.202, 10.203, 10.207, 10.211, 10.214, 10.215, 10.217, 10.218, 10.219, 10.220, 10.221, 10.226, 10.227, 10.228, 10.230, 10.231, 10.232, 10.236, 10.241, 10.249, 10.254, 10.257, 10.258, 10.261, 10.269, 10.270, 10.271, 10.275, 11.1, 11.2, 11.3, 11.4, 11.12, 11.16, 11.17, 11.23, 11.24, 11.34, 11.37, 12.5, 12.9, 12.12, 12.13, and 12.14.

The following figures are courtesy of the Massachusetts Eye and Ear Infirmary: 1.2, 1.8, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16, 1.21, 1.29, 1.36, 2.1, 2.2, 2.4, 2.7, 2.10, 2.11, 2.12, 2.20, 2.23, 2.24, 3.5, 3.8, 3.12, 3.13, 3.17, 3.20, 3.21, 3.24, 3.29, 3.41, 3.47, 3.48, 3.57, 3.63, 3.64, 3.68, 4.4, 4.5, 4.6, 4.9, 4.12, 4.13, 4.15, 4.16, 4.17, 4.18, 4.19, 4.26, 4.27, 4.30, 4.33, 4.34, 4.37, 4.38, 4.39, 4.49, 4.51, 4.52, 4.57, 4.59, 4.61, 4.62, 4.63, 5.2, 5.7, 5.15, 5.16, 5.17, 5.18, 5.21, 5.22, 5.23, 5.29, 5.30, 5.36, 5.37, 5.41, 5.44, 5.45, 5.52, 5.55, 5.56, 5.60, 5.62, 5.72, 5.74, 5.75, 5.78, 5.88, 5.89, 5.93, 6.1, 6.2, 6.5, 6.8, 6.15, 7.2, 7.4, 7.7, 7.10, 7.12, 7.16, 7.24, 7.27, 7.29, 7.30, 7.33, 7.36, 7.37, 7.38, 7.40, 7.42, 7.43, 7.44, 7.45, 7.48, 8.1, 8.3, 8.5, 8.7, 8.12, 8.13, 8.15, 8.16, 8.17, 8.18, 8.22, 8.23, 8.27, 8.40, 8.42, 8.45, 9.1, 9.3, 10.29, 10.45, 10.65, 10.68, 10.69, 10.71, 10.116, 10.127, 10.128, 10.129, 10.130, 10.142, 10.150, 10.158, 10.170, 10.173, 10.178, 10.179, 10.180, 10.184, 10.196, 10.206, 10.209, 10.225, 10.229, 10.238, 10.240, 10.242, 10.243, 10.245, 10.250, 11.5, 11.6, 11.7, 11.10, 11.13, 11.26, 11.29, and 11.35.



The following figures are courtesy of the New York Eye and Ear Infirmary: 3.7, 3.16, 3.34, 3.39, 3.59, 4.13, 4.21, 4.35, 4.37, 4.46, 4.47, 4.48, 4.54, 4.60, 4.64, 5.14, 5.46, 5.48, 5.49, 5.50, 5.53, 5.54, 5.59, 5.73, 5.95, 5.98, 7.3, 7.9, 7.11, 7.13, 7.26, 8.14, 8.28, 8.36, 8.38, 8.44, 9.5, 9.10, 10.3, 10.10, 10.11, 10.12, 10.17, 10.24, 10.30, 10.33, 10.51, 10.63, 10.92, 10.114, 10.156, 10.186, 10.187, 10.195, 10.206, 10.212, 10.224, 10.233, 10.234, 10.235, 11.11, and 11.20.

The following figure is courtesy of Shamik Barfna, MD: 12.16.

The following figures are courtesy of Michael Blair, MD: 10.279 and 10.280.

The following figure is courtesy of Robert Chang, MD: 5.97.

The following figures are courtesy of Warren Chang, MD: 2.8 and 2.9.

The following figure is courtesy of Netan Choudhry, MD: 10.133.

The following figures are courtesy of Cullen Eye Institute: 1.7, 5.82, and 11.14.

The following figure is courtesy of Eric D. Donnenfeld, MD: 3.6.

The following figures are courtesy of Jay Duker, MD: 10.176 and 10.177.

The following figure is courtesy of Chris Engelman, MD: 11.38.

The following figures are courtesy of Neil J. Friedman, MD: 1.6, 1.9, 4.10, 4.11, 4.69, 5.3, 5.4, 5.11, 5.19, 5.28, 5.31, 5.66, 5.67, 5.77, 5.86, 6.3, 7.5, 7.15, 7.47, 8.19, 8.25, 8.26, 8.30, 8.31, 10.9, 11.22, 11.27, 11.31, 11.32, 11.33, 11.36, 12.4, 12.6, 12.7, 12.8, 12.15, 12.20, A.34, A.35, A.42, A.44, and A.45.

The following figures are courtesy of Ronald L. Gross, MD: 5.70, 6.4, 6.7, 6.9, 7.25, 7.28, 7.34, and 11.23.

The following figures are courtesy of M. Bowes Hamill, MD: 4.7, 4.25, 4.27, 4.41, 4.66, 5.9, 5.10, 5.81, 7.32, and 7.35.

The following figures are courtesy of Allen Ho, MD: 10.163, 10.183, and 10.255, 10.256.

The following figure is courtesy of Thomas N. Hwang, MD, PhD: 11.9.

The following figures are courtesy of J. Michael Jumper, MD: 10.128 and 10.129.

The following figures are courtesy of ATul Jain, MD: 6.6, 9.4, 10.15, and 10.16.

The following figures are courtesy of Peter K. Kaiser, MD: 2.13, 2.16, 2.19, 2.21, 9.8, 9.9, 10.4, 10.5, 10.6, 10.26, 10.27, 10.39, 10.40, 10.53, 10.54, 10.55, 10.70, 10.74, 10.75, 10.80, 10.81, 10.82, 10.83, 10.84, 10.85, 10.86, 10.87, 10.88, 10.94, 10.101, 10.104, 10.107, 10.109, 10.111, 10.112, 10.113, 10.116, 10.118, 10.119, 10.120, 10.136, 10.143, 10.212,

10.216, 10.268, 11.16, 11.19, A.1, A.2, A.3, A.4, A.6, A.8, A.9, A.11, A.12, A.13, A.15, A.18, A.22, A.24, A.25, A.26, A.38, A.39, A.40, and A.41.

The following figures are courtesy of Robert Kersten, MD: 3.51, 3.62, and 3.66.

The following figures are courtesy of Jonathan W. Kim, MD: 1.25, 1.26, and 3.43.

The following figure is courtesy of John Kitchens, MD: 10.60.

The following figures are courtesy of Douglas D. Koch, MD: 5.33, 5.69, 8.2, 8.20, 8.29, 8.32, 8.33, 8.34, 8.35, 8.43, 12.11, and 12.18.

The following figures are courtesy of Andrew G. Lee, MD: 2.14, 2.17, 2.27, 7.18, 11.1, and 11.8.

The following figures are courtesy of Peter S. Levin, MD: 1.23, 3.9, 3.30, 3.38, 3.58, 3.60, 3.61, and 3.67.

The following figure is courtesy of Thomas Loarie: 12.17.

The following figure is courtesy of Edward E. Manche, MD: 12.10.

The following figure is courtesy of Samuel Masket, MD: 12.2.

The following figures are courtesy of Timothy J. McCulley, MD: 1.1, 1.5, 1.18, 1.20, 1.21, 1.22, 1.24, 1.30, 1.31, 3.2, 3.4, 3.25, 3.44, 3.45, and 11.25.

The following figure is courtesy of George J. Nakano, MD: 5.94.

The following figures are courtesy of James R. Patrinely, MD: 1.17, 1.27, 3.18, 3.28, 3.31, 3.32, 3.33, 3.35, 3.36, 3.40, 3.42, 3.50, 3.53, 3.54, and 3.55.

The following figures are courtesy of Julian Perry, MD: 3.1 and 3.46.

The following figures are courtesy of Roberto Pineda II, MD: 5.20, 5.27, 5.32, 5.90, 5.91, 5.96, A.33, A.36, and A.37.

The following figures are courtesy of David Sarraf, MD, and ATul Jain, MD: 10.122, 10.126, 10.260, 10.261, and 10.262.

The following figures are courtesy of Richard Spaide, MD: 10.89, 10.90, and 10.91.

The following figures are courtesy of Paul G. Steinkuller, MD: 1.19, 2.5, 2.6, and 12.1.

The following figures are courtesy of Christopher N. Ta, MD: 3.15, 3.26, 3.27, 4.21, 4.22, 4.23, 5.1, 5.24, 5.58, 5.63, 5.85, 7.41, and 12.3.

# Introduction

Given the visual nature of ophthalmology, an illustrated manual is of utmost importance to our specialty. Continuing in the tradition of excellence forged by Drs. Friedman, Kaiser, and Pineda in the first four editions, the fifth edition of the *MEEI Illustrated Manual of Ophthalmology* continues to provide us with an accessible and portable yet comprehensive compendium that optimizes its availability for use by the practitioner.

Reflecting recent advances in ophthalmic care and understanding, the fifth edition contains a number of new diagnoses, new photos, updated treatment regimens, and major updates to many of the sections within the manual. New sections in this edition cover infectious uveitis, limbal stem cell deficiency, graft-versus-host disease, neurotrophic keratitis, hereditary color blindness, and refractive surgery procedures. The fifth edition continues to highlight the importance of our most sophisticated imaging technologies with optical coherence tomography angiography, wide-field angiography, and wide-field fundus photography. It serves as both a valuable teaching tool and a standard reference for practicing ophthalmologists.

The authors—all of whom trained at Harvard Medical School as students, residents, or fellows—continue to embody the best of the clinician–teacher paradigm. While advances in research (basic, translational, and clinical) drive our practice forward, it is a critical to share this knowledge to successive generations of ophthalmologists. We are especially grateful for their commitment, wisdom, and diligence in updating this classic text.

Joan W. Miller, MD  
Chief of Ophthalmology,  
Massachusetts Eye and Ear and Massachusetts General Hospital  
David Glendenning Cogan Professor of Ophthalmology and Chair,  
Harvard Medical School  
Boston, MA, USA



# Orbit

# 1

Trauma	1	Congenital Anomalies	17
Globe Subluxation	7	Pediatric Orbital Tumors	19
Carotid–Cavernous and Dural Sinus Fistulas	8	Adult Orbital Tumors	24
Infections	10	Acquired Anophthalmia	29
Inflammation	13	Atrophia Bulbi and Phthisis Bulbi	30

## Trauma

### Blunt Trauma

#### Orbital Contusion

Periocular bruising caused by blunt trauma; often with injury to the globe, paranasal sinuses, and bony socket; traumatic optic neuropathy or orbital hemorrhage may be present. Patients report pain and may have decreased vision. Signs include eyelid edema and ecchymosis, as well as ptosis. Isolated contusion is a preseptal (eyelid) injury and typically resolves without sequelae. Traumatic ptosis secondary to levator muscle contusion may take up to 3 months to resolve; most oculoplastic surgeons observe for 6 months before surgical repair.

**Fig 1.1** • Orbital contusion demonstrating severe eyelid ecchymosis and edema, subconjunctival hemorrhage, and conjunctival chemosis.



- In the absence of orbital signs (afferent pupillary defect, visual field defect, limited extra-ocular motility, and proptosis), imaging studies are not necessarily required but should be considered with more serious mechanisms of injury (e.g., motor vehicle accident [MVA], massive trauma, or loss of consciousness) even in the absence of orbital signs. When indicated, orbital computed tomography (CT) scan is the imaging study of choice.

- When the globe is intact and vision is unaffected, ice compresses can be used every hour for 20 minutes during the first 48 hours to decrease swelling.
- Concomitant injuries should be treated accordingly.

### Orbital Hemorrhage and Orbital Compartment Syndrome

Accumulation of blood throughout the intraorbital tissues caused by surgery or trauma (retrobulbar hemorrhage) may cause proptosis, distortion of the globe, and optic nerve stretching and compression (orbital compartment syndrome). Patients may report pain and decreased vision. Signs include bullous, subconjunctival hemorrhage, tense orbit, proptosis, resistance to retropulsion of globe, limitation of ocular movements, lid ecchymosis, and increased intraocular pressure (IOP). Immediate recognition and treatment are critical in determining outcome. Urgent treatment measures may include canthotomy and cantholysis. Evacuation of focal hematomas or bony decompression is reserved for the most severe cases with an associated optic neuropathy.



Conjunctival chemosis

Lid edema

**Fig 1.2** • Retrobulbar hemorrhage of the left eye demonstrating proptosis, lid swelling, chemosis, and restricted extraocular motility on upgaze.

### OPHTHALMIC EMERGENCY

- If orbital compartment syndrome is suspected, lateral canthotomy and cantholysis should be performed emergently.
- **Lateral canthotomy:** This procedure is performed by compressing the lateral canthus with a hemostat, and Stevens scissors are then used to make a full-thickness incision from the lateral commissure (lateral angle of the eyelids) posterolaterally to the lateral orbital rim. Some advocate compression of the lateral canthal tendon before incision. The inferior crus of the lateral canthal tendon is then transected by elevating the lateral lower lid margin away from the face, placing the scissors between the cut edges of lower lid conjunctiva and lower lid skin, palpating the tendon with the tips of the scissors, and transecting it. If the inferior eyelid is not extremely mobile, the inferior crus has not been transected adequately, and the procedure should be repeated. If the IOP remains elevated and the orbit remains tense, the superior

## OPHTHALMIC EMERGENCY—cont'd

crus of the lateral canthal tendon may be cut. Septolysis, blunt dissection through the orbital septum at the base of the cantholysis incision, may be performed when pressure is not adequately relieved with lysis of the canthal tendon.

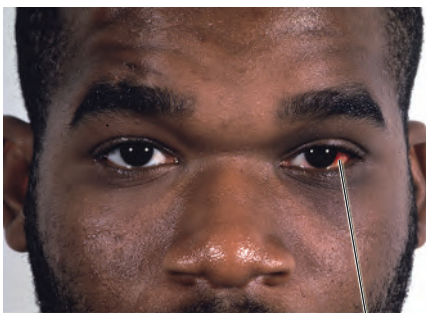
- Emergent inferior orbital floor fracture, although advocated by some, is fraught with complications and is not advised for surgeons with little experience in orbital surgery; however, it should be considered in emergent situations with risk of blindness.
- Canthoplasty can be scheduled electively ~1 week after the hemorrhage.
- Orbital CT scan (without contrast, direct coronal and axial views, 3 mm slices) after visual status has been determined and emergent treatment (if necessary) administered (i.e., after canthotomy and cantholysis). Magnetic resonance imaging (MRI) is contraindicated in acute trauma.
- If vision is stable and IOP is elevated (>25 mm Hg), topical hypotensive agents may be administered (brimonidine 0.15% [Alphagan P] 1 gtt tid, timolol 0.5% 1 gtt bid, and/or dorzolamide 2% [Trusopt] 1 gtt tid).

### Orbital Fractures

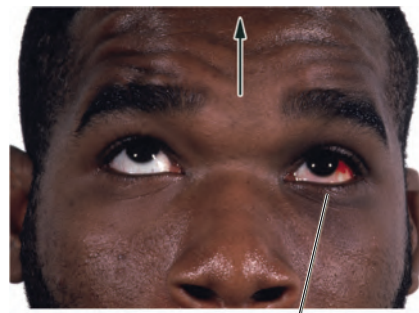
Fracture of the orbital walls may occur in isolation (e.g., blow-out fracture) or with displaced or nondisplaced orbital-rim fractures. There may be concomitant ocular, optic nerve, maxillary, mandibular, or intracranial injuries.

#### *Orbital floor (blow-out) fracture*

This is the most common orbital fracture requiring repair and usually involves the maxillary bone in the posterior medial floor (weakest point) and may extend laterally to the infraorbital canal. Orbital contents may prolapse or become entrapped in maxillary sinus. Signs and symptoms include diplopia on upgaze (anterior fracture) or downgaze (posterior fracture), enophthalmos, globe ptosis, and infraorbital nerve hypesthesia. Orbital and lid emphysema is often present and may become extensive with nose blowing.



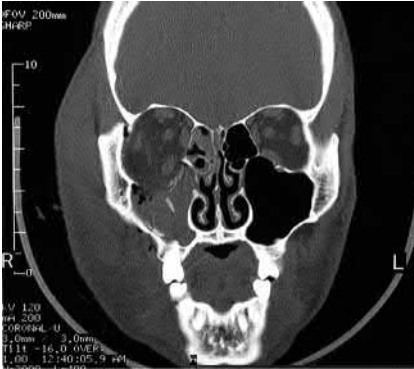
Subconjunctival hemorrhage



Orbital floor fracture with entrapment

**Fig 1.3** • Orbital floor blow-out fracture with enophthalmos and globe dystopia and ptosis of the left eye.

**Fig 1.4** • Same patient as in Fig. 1.3 demonstrating entrapment of the left inferior rectus and inability to look up.



**Fig 1.5** • Orbital computed tomography scan demonstrating large right orbital floor fracture.

- For mild trauma, orbital CT scan need not be obtained in the absence of orbital signs.
- Orbital surgery consultation should be considered, especially in the setting of diplopia, large floor fractures (>50% of orbital floor surface area), trismus, facial asymmetry, inferior rectus entrapment, and enophthalmos. Consider surgical repair after 1 week to allow for reduction of swelling except in cases of pediatric trapdoor-type fractures with extraocular muscle entrapment, in which emergent repair is advocated.

#### *Pediatric floor fracture*

This differs significantly from an adult fracture because the bones are pliable rather than brittle. A “trapdoor” phenomenon is created in which the inferior rectus muscle or perimuscular tissue can be entrapped in the fracture site. In this case, enophthalmos is unlikely, but ocular motility is limited dramatically. The globe halts abruptly with ductions opposite the entrapped muscle (most often on upgaze with inferior rectus involvement) as if it is “rethered.” Forced ductions are positive; nausea and bradycardia (oculocardiac reflex) are common. Despite the severity of the underlying injury, the eye is typically quiet, hence the nickname “white eyed blowout fracture.”

- Urgent surgery (<24 hours) is indicated in pediatric cases with entrapment.

#### *Medial wall (nasoethmoidal) fracture*

This involves the lacrimal and ethmoid (lamina papyracea) bones. It is occasionally associated with depressed nasal fracture, traumatic telecanthus (in severe cases), and orbital floor fracture. Complications include nasolacrimal duct injury, severe epistaxis caused by anterior ethmoidal artery damage, and orbit and lid emphysema. Medial rectus entrapment is rare, and enophthalmos caused by isolated medial wall fractures is extremely uncommon.

- Fractures extending through the nasolacrimal duct should be reduced with stenting of the drainage system. If not repaired primarily, persistent obstruction requiring dacryocystorhinostomy may result.
- Otolaryngology consultation is indicated in the presence of nasal fractures.



### *Orbital roof fracture*

This is an uncommon fracture usually secondary to blunt or projectile injuries. It may involve the frontal sinus, cribriform plate, and brain. It may be associated with cerebrospinal fluid (CSF) rhinorrhea or pneumocephalus.

- Neurosurgery and otolaryngology consultations are advised, especially in the presence of CSF rhinorrhea or pneumocephalus.

### *Orbital apex fracture*

This may be associated with other facial fractures and involve optic canal and superior orbital fissure. Direct traumatic optic neuropathy is likely. Complications include carotid–cavernous fistula and fragments impinging on optic nerve. These are difficult to manage because of proximity of multiple cranial nerves and vessels.

- Obvious impingement by a displaced fracture on the optic nerve may require immediate surgical intervention by an oculoplastic surgeon or neurosurgeon. High-dose systemic steroids may be given for traumatic optic neuropathy (see Chapter 11).

### *Tripod fracture*

This involves three fracture sites: the inferior orbital rim (maxilla), lateral orbital rim (often at the zygomaticofrontal suture), and zygomatic arch. The fracture invariably extends through the orbit floor. Patients may report pain, tenderness, binocular diplopia, and trismus (pain on opening mouth or chewing). Signs include orbital rim discontinuity or palpable “step off,” malar flattening, enophthalmos, infraorbital nerve hypesthesia, emphysema (orbital, conjunctival, or lid), limitation of ocular movements, epistaxis, rhinorrhea, ecchymosis, and ptosis. Enophthalmos may not be appreciated on exophthalmometry caused by a retrodisplaced lateral orbital rim.

### *Le Fort fractures*

These are severe maxillary fractures with the common feature of extension through the pterygoid plates:

*Le Fort I:* low transverse maxillary bone; no orbital involvement

*Le Fort II:* nasal, lacrimal, and maxillary bones (medial orbital wall), as well as bones of the orbital floor and rim; may involve the nasolacrimal duct

*Le Fort III:* extends through the medial wall; traverses the orbital floor and through the lateral wall (craniofacial dysjunction); may involve the optic canal

- Orbital CT scan (without contrast, direct axial and coronal views, 3 mm slices) is indicated in the presence of orbital signs (afferent papillary defect, diplopia, limited extraocular motility, proptosis, and enophthalmos) or ominous mechanism of injury (e.g., MVA, massive facial trauma). MRI is of limited usefulness in the evaluation of fractures because bones appear dark.
- Otolaryngology consultation is indicated in the presence of mandibular fracture.
- Orbital surgery consultation is indicated in the presence of isolated orbital and trimalar fractures.
- Instruct the patient to avoid blowing the nose. A “suck-and-spit” technique should be used to clear nasal secretions.
- Nasal decongestant (oxymetazoline hydrochloride [Afrin nasal spray] bid as needed for 3 days. *Note:* This may cause urinary retention in men with prostatic hypertrophy).

- Ice compresses for the first 48 hours
- Systemic oral antibiotics (amoxicillin–clavulanate [Augmentin] 250–500 mg po tid for 10 days) are advocated by some.
- Nondisplaced zygomatic fractures may become displaced after initial evaluation because of masseter and temporalis contraction. Orbital or otolaryngology consultation is indicated for evaluation of such patients.

## Penetrating Trauma

These may result from either a projectile (e.g., pellet gun) or stab (e.g., knife, tree branch) injury. A foreign body should be suspected even in the absence of significant external wounds.

### Intraorbital Foreign Body

Retained orbital foreign body with or without associated ocular and optic nerve involvement. Inert foreign body (e.g., glass, lead, BB, plastics) may be well tolerated and should be evaluated by an oculoplastic surgeon in a controlled setting. Organic matter carries significant risk of infection and should be removed surgically. A long-standing iron foreign body can produce iron toxicity (siderosis), including retinopathy.

Patients may be asymptomatic or may report pain or decreased vision. Critical signs include eyelid or conjunctival laceration. Other signs may include ecchymosis, lid edema and erythema, conjunctival hemorrhage or chemosis, proptosis, limitation of ocular movements, and chorioretinitis sclopetaria (see Fig. 10.9). A relative afferent pupillary defect (RAPD) may be present. The prognosis is generally good if the globe and optic nerve are not affected.



Intraorbital foreign body

**Fig 1.6** • Orbital computed tomography scan demonstrating a foreign body at the orbital apex.

- Precise history (may be necessary to isolate a minor child from the parents while obtaining history) is critical in determining the nature of any potential foreign body.
- **Lab tests:** Culture entry wound for bacteria and fungus. Serum lead levels should be monitored in patients with a retained lead foreign body.
- Orbital CT scan (without contrast, direct coronal and axial views). The best protocol is to obtain thin-section axial CT scans (0.625–1.25 mm, depending on the capabilities of the scanner) and then to perform multiplanar reformation to determine character and position of foreign body. MRI is *contraindicated* if the foreign body is metallic.
- If there is no ocular or optic nerve injury, small inert foreign bodies posterior to the equator of the globe usually are not removed but observed.
- Patients are placed on systemic oral antibiotic (amoxicillin–clavulanate [Augmentin] 500 mg po tid for 10 days) and are followed up the next day.

- Tetanus booster (tetanus toxoid 0.5 mL IM) if necessary for prophylaxis (>7 years since last tetanus shot or if status is unknown).
- Indications for surgical removal include fistula formation, infection, optic nerve compression, large foreign body, or easily removable foreign body (usually anterior to the equator of the globe). Surgery should be performed by an oculoplastic surgeon. Organic material should be removed more urgently.

## Globe Subluxation

**Definition** Spontaneous forward displacement of the eye so that the equator of the globe protrudes in front of the eyelids, which retract behind the eye.

**Etiology** Most often spontaneous in patients with proptosis (e.g., Graves' disease) but may be voluntary or traumatic.

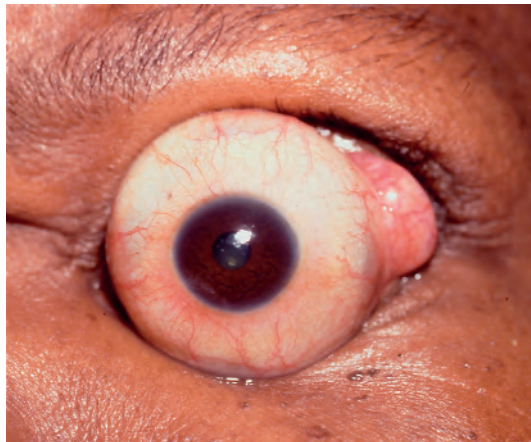
**Mechanism** Pressure against the globe, typically from spreading the eyelids, causes the eye to move forward, and then when a blink occurs, the eyelids contract behind the eye, locking the globe in a subluxed position.

**Epidemiology** Occurs in individuals of any age (range, 11 months to 73 years) and has no sex or race predilection. Risk factors include eyelid manipulation, exophthalmos, severe eyelid retraction, floppy eyelid syndrome, thyroid eye disease (TED), and shallow orbits (i.e., Crouzon's or Apert's syndrome).

**Symptoms** Asymptomatic; may have pain, blurred vision, and anxiety.

**Signs** Dramatic proptosis of the eye beyond the eyelids. Depending on the length of time the globe has been subluxed, may have exposure keratopathy, corneal abrasions, blepharospasm, and optic neuropathy.

**Fig 1.7** • Globe subluxation with equator of globe and lacrimal gland in front of the eyelids.



### Evaluation

- Complete ophthalmic history with attention to previous episodes and potential triggers.
- Complete eye exam (after the eye has been repositioned) with attention to visual acuity, pupils, motility, exophthalmometry, lids, cornea, and ophthalmoscopy.

## Management

- Immediately reposition the globe. Relax the patient, instill topical anesthetic, and digitally reduce the subluxation by one of the following methods:
  1. While the patient looks down, pull the upper eyelid up and depress the globe.
  2. Place a retractor under the center of the upper eyelid, push the globe downward, and advance the eyelid forward. When the eyelid is past the equator of the globe, have the patient look up to pull the eyelid over the eye.
- May require a facial nerve block, sedation, or general anesthesia.
- Instruct the patient to avoid triggers and how to reduce a subluxation.
- Treat any underlying condition.
- Surgical options include partial tarsorrhaphy and orbital decompression.

**Prognosis** Good unless complications develop.

## Carotid–Cavernous and Dural Sinus Fistulas

### Definition

Arterial venous connection between the carotid artery and cavernous sinus; there are two types.

### High-Flow Fistula

Between the cavernous sinus and internal carotid artery (carotid–cavernous fistula).

### Low-Flow Fistula

Between small meningeal arterial branches and the dural walls of the cavernous sinus (dural sinus fistula).

### Etiology

#### High-Flow Fistula

Spontaneous; occurs in patients with atherosclerosis and hypertension with carotid aneurysms that rupture within the sinus or secondary to closed-head trauma (basal skull fracture).

#### Low-Flow Fistula

Slower onset compared with the carotid–cavernous variant; dural sinus fistula is more likely to present spontaneously.

**Symptoms** May hear a “swishing” noise (venous soufflé); may have a red “bulging” eye.

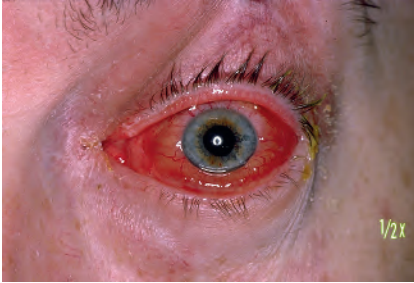
### Signs

#### High-Flow Fistula

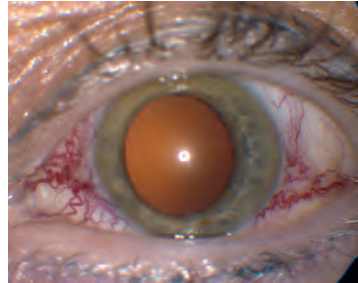
May have orbital bruit, pulsating proptosis, chemosis, epibulbar injection and vascular tortuosity (conjunctival corkscrew vessels), congested retinal vessels, and increased IOP.

### Low-Flow Fistula

Mild proptosis and orbital congestion. However, in more severe cases, findings are similar to those described for carotid–cavernous fistula may occur.



**Fig 1.8** • Carotid–cavernous fistula with conjunctival injection and chemosis.



**Fig 1.9** • Carotid–cavernous fistula with dilated, corkscrew, episcleral, and conjunctival vessels.

**Differential Diagnosis** Orbital varices that expand in a dependent position or during Valsalva maneuvers and may produce hemorrhage with minimal trauma. Carotid–cavernous fistulas may also be mistaken for orbital inflammatory syndrome and occasionally uveitis.

### Evaluation

- Complete history with attention to onset and duration of symptoms and history of trauma and systemic diseases (atherosclerosis, hypertension).
- Complete eye exam with attention to orbital auscultation, exophthalmometry, conjunctiva, tonometry, and ophthalmoscopy.
- **Orbital CT scan or MRI:** Enlargement of the superior ophthalmic vein.
- Arteriography usually is required to identify the fistula; CT angiography and magnetic resonance angiography have largely replaced conventional angiography.

### Management

- Consider treatment with selective embolization or ligation for severely symptomatic patients (uncontrolled increase in IOP, severe proptosis, retinal ischemia, optic neuropathy, severe bruit, involvement of the cortical veins).
- Treatment for all cases of carotid–cavernous fistula has been advocated but is controversial.

**Prognosis** Up to 70% of dural sinus fistulas may resolve spontaneously.

## Infections

### Preseptal Cellulitis

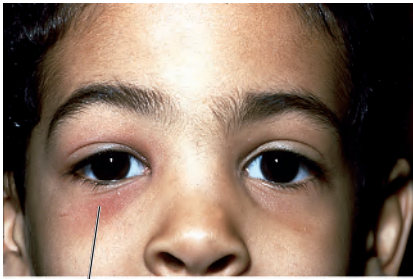
**Definition** Infection of the eyelids not extending posterior to the orbital septum. The globe and orbit are not involved.

**Etiology** Usually follows periorbital trauma or dermal infection. Suspect *Staphylococcus aureus* in traumatic cases and *Haemophilus influenzae* (nontypeable) in children <5 years old.

**Symptoms** Eyelid swelling, redness, ptosis, and pain; low-grade fever.

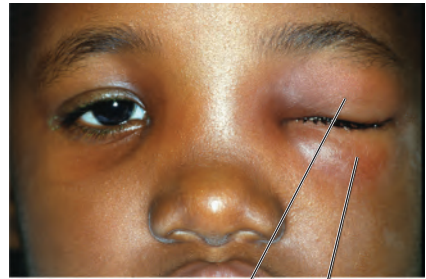
**Signs** Eyelid erythema, edema, ptosis, and warmth (may be quite dramatic); visual acuity is normal; full ocular motility without pain; no proptosis; the conjunctiva and sclera appear uninfamed; an inconspicuous lid wound may be visible; an abscess may be present.

**Differential Diagnosis** Orbital cellulitis, idiopathic orbital inflammation (IOI), dacryoadenitis, dacryocystitis, conjunctivitis, and trauma.



Lid erythema

**Fig 1.10** • Mild preseptal cellulitis with right eyelid erythema in a young child.



Lid edema Erythema

**Fig 1.11** • Moderate preseptal cellulitis with left eyelid edema and erythema.

### Evaluation

- Complete ophthalmic history with attention to trauma, sinus disease, recent dental work or infections, history of diabetes or immunosuppression.
- Complete eye exam with attention to visual acuity, color vision, pupils, motility, exophthalmometry, lids, conjunctiva, and sclera.
- Check vital signs, head and neck lymph nodes, meningeal signs (nuchal rigidity), and sensorium.
- **Lab tests:** Complete blood count (CBC) with differential, blood cultures; wound culture if present.
- Orbital and sinus CT scan in the absence of trauma or in the presence of orbital signs to look for orbital extension and paranasal sinus opacification.