

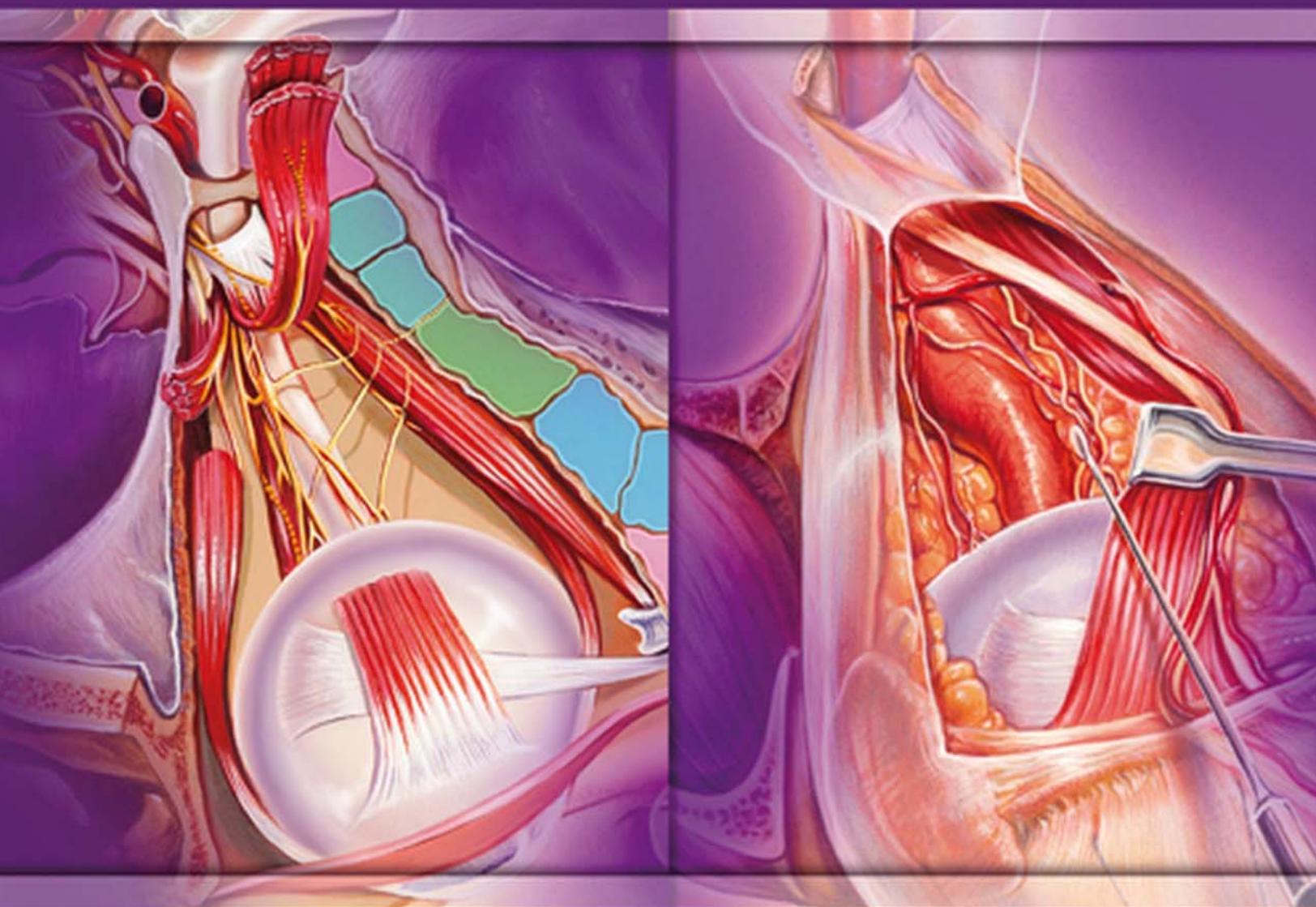
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# ORBITAL SURGERY

SECOND  
EDITION

A CONCEPTUAL APPROACH



Wolters Kluwer | Lippincott Williams & Wilkins  
Health



# **ORBITAL** SURGERY

SECOND  
EDITION

A CONCEPTUAL APPROACH



# ORBITAL SURGERY

SECOND  
EDITION

A CONCEPTUAL APPROACH



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## DEDICATION

*To my teachers, colleagues, students, patients, and family;  
my wife, Jenny, and our children Russell, Kate, and Daniel.*

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# Foreword

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I have been blessed in life to have many memorable teachers. I remember many good ones, a smaller number of great ones, and just a few transcendent master teachers. Jack Rootman is a master teacher. It is not simply that he has encyclopedic knowledge of orbital anatomy, orbital disease, and orbital pathology. Nor is it simply that he is a gifted surgeon, with remarkable creativity, dexterity, and ability to orient in three dimensions. Rather, Jack's great ability in teaching stems from his ability to crystallize a conceptual framework for orbital diagnosis and orbital surgery. Twenty-five years after my fellowship, I still find myself remembering his specific lessons when I evaluate a difficult patient or face a challenging surgery in the operating room. I smile to find myself using the same words with my students that he used with me.

This newest version of Jack's orbital textbook captures his unique style of thinking about and teaching conceptual approaches to orbital disease and surgery. I note that his paradigm for evaluation of orbital disease has been reframed as the CLOSE system. To me, the underlying principle is the same: Jack stresses a logical, organized, stepwise approach to orbital diagnosis that is firmly based on solid knowledge of orbital differential diagnosis, combined with appreciation for the nuances of disease presentation based on the biology of the underlying process. Orbital diagnosis can be confusing; the stakes are high; and I find myself using and teaching Jack's organized approach every day.

Surgery, of course, is fundamentally an exercise in applied anatomy. Jack is a consummate anatomist, not only in the bookkeeping sense of cataloguing all structures but in the practical sense of understanding the three-dimensional relationships and how they affect the presentation of orbital disease (and the requirements for safe surgery). I watched him work very hard with Bruce Stewart to try to capture this three-dimensional sense of orbital anatomy, and I believe that their teamwork has paid off richly. It will be hard for future authors to improve on the practical, conceptual, three-dimensional, and authentically artistic presentation of orbital anatomy in this textbook.

One of Jack's core teaching principles in orbit surgery, a principle that has defined and stimulated my own surgical odyssey, is that orbit surgery can never be rote. Every tumor or disease process is slightly different; variations in anatomy are unlimited; and so the surgeon must be prepared to individualize the approach for each patient. This individualization, of course, is what makes surgery so intellectually stimulating and technically rewarding. Imagination is richly rewarded. By showing examples of creative approaches, in a richly illustrated case-based format, this textbook teaches not only specific examples of useful approaches but more important, examples of how the surgeon can use this flexible, imaginative framework to design individualized approaches to orbital disease.

Another of Jack's core teaching principles is the requirement to be perceptive and flexible during surgery and prepared to change course based on the intraoperative findings. In the drawings, case selection, and didactic descriptions, Jack emphasizes and illustrates some of the nuances of gross surgical pathology, interpreting the biology of the process based on the appearance of the tumor and its interaction with the surrounding structures, and maintaining flexibility and intellectual stamina as the case progresses.

It is not an easy task to codify these critical conceptual principles into a textbook. I believe that Jack and Bruce have accomplished this in a stunning fashion. I hope the readers approach this book not only as a "music stand" step-by-step surgical instruction manual but even more importantly as a vehicle to start to understand Jack's unique philosophical approach to orbital disease and surgery. They, like me, will have inherited a great master teacher and a philosophy that will serve as a solid foundation for their own evolution as a thoughtful and imaginative orbital surgeon.

*Robert A. Goldberg, MD  
Chief, Orbital and Ophthalmic Plastic Surgery Division  
Jules Stein Eye Institute  
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David Geffen School of Medicine at UCLA*

# Foreword

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It is my great pleasure to write the foreword for *Orbital Surgery: A Conceptual Approach*. Why is this a fabulous book? The simple truth is that it is written by Jack Rootman, perhaps the most brilliant and scholarly orbital surgeon of our time. This book contains four decades of ideas, innovations, and techniques concerning orbital surgery. Those readers who know Jack will hear his enthusiasm, dedication, and personality spoken in the written words. The combined wisdom of clinician, researcher, teacher, administrator, and artist is evident. This book is a masterpiece and will be appreciated by orbital surgeons, novice, and masters alike, for years to come.

Jack Rootman received his ophthalmology training at the University of Alberta in Edmonton, Canada (1972). He did three fellowships: ocular pathology and experimental pathology (1973); ocular oncology and orbital disease (1974); and after 2 years of practice in Edmonton, orbital disease with John Wright at Moorfields Eye Hospital in London, England (1976), training ground of many of today's great orbital surgeons throughout the world.

In 1976, Dr. Rootman started at the University of British Columbia, attaining the rank of professor in the Departments of Ophthalmology and Pathology in 1985. He also served as chairman of the Departments of Ophthalmology for the University of British Columbia and the Vancouver General Hospital and Health Sciences Center from 1990 to 2001.

During Dr. Rootman's nearly 40 years of practice, the discipline of orbital surgery has dramatically expanded. Jack has been a major contributor to the progress of our field.

In 1981, the orbital disease and surgery textbook most of us studied was *Orbital Disease: A Practical Approach*, written by Krohel, Stewart, and Chavis. This "authoritative" source was 160 pages, including all of orbital disease and surgery. The little orange textbook, so prized, in our early careers was the clinical guide for our practice. The first half of the book, the emphasis of the text, introduced the six Ps of orbital disease (Pain, Progression, Proptosis, Palpation, Pulsation, Periocular, and Ocular changes) that are familiar to orbital surgeons today. The book was illustrated with black and white clinical photos and line drawings. The text included a nine-page section on computed

tomography scan of orbit, still in its infancy. Some of the latest other innovations in imaging included ultrasonography, basal tomography of the optic canals, and orbital venography. What amazing changes in our field since that time, and many contributions are from Jack Rootman.

Jack has written two textbooks, one on orbital disease (second edition published in 2003) and the other on surgery of the orbit (1995). He has published 214 clinical and basic science research papers. Much of the information in these articles and books is compiled from probably the most extensive and complete orbital case log in world. A third book is the edited proceedings from an international symposium on orbital disease, which Jack organized for the Orbital Society in 2002. Dr. Rootman has had 38 grants and 49 awards and distinctions. He has given papers at over 350 meetings. Jack has trained 92 national and international fellows.

There are several aspects unique to Jack's training, experience, and personality that contribute to his conceptual approach to orbital surgery and his thinking "style." His extensive experience in pathology and oncology is a factor. Among a group of orbital surgeons, Jack is the one who wants to "see the slides." This histopathologic approach to the study of orbital disease is the basis of his teaching and thought process in understanding orbital disease. This background is unique among many orbital surgeons, including me, who operate from a reconstructive background. This approach perhaps lends itself to a more global or systemic approach to disease, as Jack is known for. This is evidenced in Jack's extensive collaborations with physicians and scientists outside of ophthalmology. Again among a group of orbital surgeons, Jack is the doctor who discusses the latest developments that he has learned from his rheumatology, radiology, pathology, and other colleagues outside the narrow reach of ophthalmology. This approach is exemplified in his interdisciplinary approach discussed throughout the text, and especially in the section on multidisciplinary surgery and in the chapter on vascular lesions of the orbit. Perhaps most importantly, it is Jack's passion for learning throughout his life, especially from those around him. I have always been impressed with the thoughtful attentiveness that Jack gives to comments from his colleagues, often less

experienced than him. This is not to say that Jack is one to accept nonsense without an appropriate comment, or at least an almost imperceptible turn of the head and roll of the eyes with a small smile communicating to all present his thoughts. In that same room, the discussion is usually not complete until Jack offers his last words. As you read the book, written in the first-person narrative, you will appreciate bits of this style of learning and teaching as though you are listening to Jack in that same room of orbital surgeons.

In 1995, Dr. Rootman took an “art sabbatical” to New York City, where he attended the Art Students’ League along with other courses offered by several art masters. Jack’s artistic work centers around painting. He has had 9 one-man shows and has participated in 29 group-artist shows. I am pleased to have several pieces of his work grace my home. You will be impressed by the illustrations in this text. Are these beautiful renderings (over 250 of them) a coincidence of a well thought-out publishing project? No, rather, I think, each condenses Jack’s understanding of an aspect of orbital disease enveloped in his personal aesthetic.

Since Jack’s “retirement” from full-time medicine, he is concentrating on his art, but continues to work

as a Visiting Professor at the University of California. Jack also reviews some 50 orbit cases sent to him via the Internet per year.

Outside Jack’s professional life, he and his wife, Jenny, are a wonderful couple of 48 years. They share much of their individual lives together as well as the joy and responsibility raising three great, successful, and happy children, Russell, Kate, and Daniel. The latest generation includes four grandchildren, Solly, Jordy, Ira, and Eden.

*Orbital Surgery: A Conceptual Approach* is more than a great book. It is the essence of Jack’s person. What more could one want more from life than the passion for one’s profession, his outside interests, and his family? We are privileged to share in that passion. I am happy to have Jack as a mentor, colleague, and friend. As orbital surgery matures, medicine changes, and we each move through our lives, and we are most fortunate to have the experience of Dr. Rootman to draw upon. Thank you, Jack.

Jeffrey A. Nerad, MD

Cincinnati Eye Institute

Professor of Ophthalmology, University of Cincinnati

# Foreword

---

One day in 1974, while a resident in anatomic pathology following an eye residency at the Edward S. Harkness Eye Institute, I ambled into the library at the Edward S. Harkness Eye Institute of the Columbia Presbyterian Medical Center, and I saw a young man my own age pouring over notes at a long table. I introduced myself and discovered it was Jack Rootman. Jack told me he was doing a fellowship to study intraocular tumors with Dr. Robert Ellsworth, who was unquestionably the world's greatest authority on retinoblastoma, and also with Ira Snow Jones, who had inherited the mantle of orbital diseases and surgeries from Algernon Beverly Reese, the founder of American ophthalmic oncology, with whom he had been in practice.

Jack had just arrived from a fellowship in ocular and experimental pathology with Professor Norman Ashton at the University of London Institute of Ophthalmology, with whom he studied in 1973. Ashton was the premiere experimentalist in eye pathology of the middle-third of the 20th century. After a 1-hour conversation, I discovered that Jack and I shared many interests, including orbital diseases, reinforced by our shared interest in a pathologic approach to understanding them. The thought quickly settled in my mind at that time that Jack was an intense, extremely bright, and focused individual who was "going places." He subsequently published several outstanding articles based on the material he had investigated from the Ellsworth retinoblastoma clinic and acquired an excellent grounding in orbital surgery from Ira Jones, with whom I later joined in practice for several years. From that point on in the library to the present, over a 40-year span, Jack and I have had a close, unspoiled, warm, and amicable relationship with many contacts and crossings of paths in our myriad endeavors.

Jack returned to Edmonton, Canada, where he had been trained. After 2 years in practice, he decided to return to London to study with Mr. John Wright, who, as the recipient of most orbital referrals in the British Health System, which were funneled to him as the Chief of the Orbital Service at the Moorefield's Eye Hospital in London, had acquired a vast experience that was the envy of many other specialists in orbital diseases. Wright could therefore offer an outstanding and unrivalled training experience.

From there, Jack went on to achieve many great things. Through his tenacity and insights, he has made monumental contributions to our understanding of orbital diseases and has also widened the purview of orbital surgery by refining the instruments and technologies that are applied to it. He established one of the most famous orbital training centers in the Western Hemisphere at the University of British Columbia, Vancouver, and has trained over 92 national and international fellows and observers, many of whom have become section chiefs and chairmen of departments. Jack's approach to his work has always been "eccentric," by which I mean approaching the center from various triangulating edges, thereby acquiring a different and original perspective with powerful new insights. He has not been satisfied just to do descriptive work but has always pursued pathogenetic mechanisms, an example being his approach to understanding orbital vascular tumors. There is, however, no subject within orbital pathology on which he has not had either an intellectual impact or hands-on clinical and surgical impact. His towering stature led to his service for two terms as the Chairman of Ophthalmology at the University of British Columbia in Vancouver. He took a department renowned for its glaucoma expertise to a new level by investing in the whole gamut of ophthalmic subspecialties and acquitting himself with distinction as an exceptional fundraiser for the department.

This new edition of Jack's textbook on orbital surgery is indeed his ontologic legacy in the form of a *summa ophthalmologica orbitalis*. It synthesizes Jack's incomparable and unmatched experiences with diagnostics, surgery, and ophthalmic pathology encompassing its experimental and investigative arms. It also bears witness to Jack's great artistic talents (he is a professional painter with many gallery showings and exhibitions of his work in his portfolio) by virtue of the quality of the illustrative artwork in this book that he himself has co-conceived over the last 30 years with Bruce Stewart. I am honored to have been personally and professionally associated in my career with Jack Rootman, whom I include in a pantheon of three or four individuals who number among my ophthalmic peers as the greatest exemplars of genuine

academic pursuits (not the mere bloviation we see all too often today), professional integrity, and intellectual achievement.

These trademarks have flowed from Jack's remarkable character, coruscating intellectual endowments, passionate concentration on subject matter, practicality, and stamina to see complex projects through to a successful completion. Fortunately, this textbook is not certifying the final swan song of a great personage of our field. Jack will be going to the Jules Stein Eye Institute at the University of California in Los Angeles as a visiting scholar, where he will mentor an orbital program in the clinic and in the operating room, as well as conduct research in bioengineering and medical instrumentation for advancing novel surgeries that

more effectively cope with the challenges of orbital diseases. Jack never quits. He just moves on to the next phase. Lucky us.

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Massachusetts Eye and Ear Infirmary*

*Henry Willard Williams Professor Emeritus of  
Ophthalmology and Pathology*

*Harvard Medical School*

*Former Chief of Ophthalmology*

*Massachusetts Eye and Ear Infirmary*

*Former Chairman of the Department of Ophthalmology*

*Harvard Medical School*

# Preface and Acknowledgments

It has been a pleasure to have the opportunity to revise this book in a contemplative fashion. It is a legacy project that culminates 40 years of academic practice in orbital disease, ocular pathology, and ocular oncology. It also represents more than 30 years of mindful collaboration between two careers in the visual arts, Bruce Stewart's and mine. The philosophy of construction has been based on experience in teaching, patient care, and interaction with committed colleagues who provided insights into how they wish to use a book meant to teach surgery. We have been meticulous in using the latest means of developing transviews, drawings, diagrams, and three-dimensional illustrations to convey the surgical engram that is the basis of visual motor skills necessary to operate in a confined space. Thousands of hours were spent developing and reimagining images that convey the essence of an anatomic and surgical space from a surgeon's and artist's viewpoint. We believe the drawings that may have been based on anatomic dissection, operative experience, and in some instances on accurate photos and videos convey the character of surgery in a more meaningful and complete way.

The book has an expanded scope in response to a survey by our publisher to include chapters on endoscopic surgery, enucleation, evisceration and socket reconstruction, orbital trauma, and vascular lesions. More and different case examples and surgical approaches have been added to reflect changes in the modern setting and the diversity of options now available.

We and the publisher have endeavored to make the visuals closely related to the text as much as possible, to avoid the disconnect that page-turning has always created. This is supported by the notion that good practitioners store visual memories, which are the basis of excellence in diagnosis and surgery. We had a vast source of visual and recorded material based on over 6,000 orbital cases to draw upon, which we hope has been rationalized well into the text and visuals.

In addition, all of the coauthors have been students of mine who in their own right have achieved distinction. In particular, I want to acknowledge that the visual collaboration was supported by access to the dissection laboratory of the University of California, Los Angeles,

and the surgical knowledge of Robert Goldberg. I also want to acknowledge my colleagues at the Singapore National Eye Centre, particularly Professor Seah Lay Leng, for allowing me to help in the development of their considerable expertise.

The book also represents a special collaboration with Daniela Ciucci, who organized my clinical life and knew and cared about every patient. I also want to thank the operating room staff who put up with the long hours, difficult requests, experiments, and tension of the operating room. The Department of Ophthalmology and Visual Sciences at the University of British Columbia, the Vancouver Coastal Health Research Institute, and the University of British Columbia Brain Research Centre contributed to the intellectual and financial environment that made this text possible.

During my career, I have had the opportunity to work with a remarkable research assistant, Wilma Chang, whose diverse skills in organization, multimedia, editing, and research have made an immeasurable contribution to the construction of my academic publications, textbooks, and training program. Her work always exceeded my expectations as does her commitment to life-long learning.

I come from and am supported by a peoplehood and a large family with a history of generations of scholarship and care of others, and I hope my endeavors have added to that distinction. Finally, as always, thanks to my nuclear family, especially my wife, Jenny, for the love and forbearance.

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# Artist Statement

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In an attempt to clarify the great complex of structures of and surrounding the orbit, we have adopted a number of artistic devices in our drawings. Some of those we used are noted and may be of interest to the reader.

In the chapter on Orbital Anatomy, we have chosen operative viewpoints in three surgical planes, namely, lateral, anterior, and superolateral. These and their variations are used throughout the surgical sections as well.

In order to help clarify an illustration, a see-through or transview approach was taken, thus preserving a more true-to-life surgical configuration. Structures in transview have a generally bluish purple treatment to distinguish them from direct-view structures. For example, periorbital or orbital lesions seen through skin or deep lesions are treated with this so-called atmospheric perspective, first popularized in the Italian Renaissance.

Windows or sectional cuts are employed to distinguish tissue planes such as those used to detail upper lid structures in the drawings of orbital septa in the Anatomy chapter.

Assigned colors for neurovascular structures employ the traditional red and blue for vessels and yellow and orange for sensory and motor nerves, respectively.

In an attempt to soften the illustrations for the surgical sections, we have used more pastel colors with

a “skin” color predominating throughout. Bony landmarks are used to orientate the viewer where subtle changes in viewpoint facilitate a better view of a procedure. An example would be in orbital decompression, where one looks down the medial wall to the apex and then returns to a more oblique view to show the extent and configuration of removal of bone from the floor.

In this second edition, we are now able to offer more detail by combining traditional watercolor and acrylic painting methods with augmentation by digital painting. This allows for a more subtle and effective way of portraying the orbit and its structures in three-dimension by more easily altering directional light sources and the resultant shadows upon structures. Also, see-through structures such as the paranasal sinuses can be made much more subliminally to act as orientation in decompression for Graves orbitopathy.

We tried for a more didactic completeness in the Anatomy chapter and somewhat greater simplification of structures where they occur in the surgical field. Because the orbit and related structures are complex in their integral components, a more dramatic sense of foreshortening was used to depict certain structures in a wide-angle view in order to improve a sense of three-dimension.

*Bruce Stewart, BFA*

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# Section One

## Principles of Analysis, Planning, and Surgical Management

- CHAPTER 1** Introduction to the Analysis of Orbital Disorders
- CHAPTER 2** Disease-specific Indications for Orbital Surgery
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# Introduction to the Analysis of Orbital Disorders

Jack Rootman

1

Although the purpose of this book is to explore surgical approaches and methods, it is equally important to have a firm grasp of the breadth of orbital disorders and how they relate to the purpose of surgery, disease processes, and a particular patient's profile. I have chosen to introduce the concepts of surgery in the context of a contemplative evaluation of patients' needs derived from a fundamental and a largely clinical analysis of disease. This is based on clinicopathologic knowledge that takes us virtually to the door of the operating room. Surgery remains in essence a controlled violent intrusion; therefore, one has to be convinced that it is the appropriate course of management since it is inevitably fraught with some degree of doubt and concern, for both the patient and surgeon who are bound to each other during the journey. This section discusses a clinical pathway for analysis, clinical pathologic features of disease, indications, preoperative planning, operative principles, and lesion-specific surgical management.

## The CLOSE Analysis of Orbital Disease

---

The diagnosis of orbital disease may be a significant challenge because of the diversity of disorders that can affect the tissues. We have developed a simple algorithm to analyze the clinical encounter, which will result in a limited or focused differential diagnosis, and a logical investigative approach to management. The basis for a logical differential diagnosis is a confluence of observations and knowledge constructed from careful examination of the patient's history and physical features.

As a general overview, it is possible in most instances to come up with a plausible diagnosis after an accurate history and physical examination. Commonly, investigations are required, based on either imaging or laboratory evaluation, to support a diagnosis. Primary investigations may require secondary or tertiary studies to achieve an accurate diagnosis and further characterize a disorder for management. The development of a case-specific differential diagnosis therefore follows a diminishing algorithm based on information from history, clinical examination, analysis of the implied pathophysiology, application of epidemiologic knowledge, imaging, biopsy, and laboratory investigations. The differential diagnosis is, or should be, a short list of possibilities after following this analytical pathway.

The overall picture can be seen as an encounter with a clinical problem through history and physical examination that leads to a better understanding of the location and extent of disease and the clinical physiology. Once these are obtained, the clinician can develop a differential diagnosis based on five factors, which we have called the "CLOSE" analysis. These five factors are clinical process, location, onset, symptoms and signs, and epidemiology. In order to demonstrate this approach, I will go through each subset of the CLOSE mnemonic.

### Clinical Process

---

The clinical processes that one can elucidate from a direct patient encounter include mass effect, inflammatory effect, infiltrative effect, vascular effect, and functional or neurosensory effect.

*Mass effect* is characterized by the displacement of structures (up, down, in, out, axial, or combinations of

these) or compression of structures that lead to some sort of functional deficit (restricted movement, globe indentation, etc.). For example, a superiorly located orbital mass may cause downward displacement and distortion of the globe, while a downward, inward displacement caused by a solid lesion in the lacrimal fossa could be associated with temporal choroidal folds and globe indentation noted on indirect ophthalmoscopy.

Many lesions produce mass effect with proptosis and displacement of the globe, which helps with localization. In addition, an anterior lesion may provide palpable clues as to the type of process and its relationship to various orbital structures. For instance, a well-defined lesion that allows overlying structures to move freely on palpation would suggest a benign, relatively noninfiltrative process. On the other hand, a lesion that is firm and associated with phenomenologic changes in the skin overlying it, such as induration or brawny change, suggests more infiltrative and possibly chronically edematous lesions, either malignant or inflammatory. Other palpable and observable abnormalities include the classic ropiness, less common peau d'orange skin changes, and soft thickening associated with plexiform neurofibroma. Thinning of the skin and dermis is a feature that is sometimes secondary to either infiltrative lesions or degenerative or atrophic changes such as scleroderma. Lymphoma tends to have a rubbery, sometimes nodular surface. Granulomas, on the other hand, will likely have a relatively distinct edge and may be more attached and firm.

Even if the mass cannot be directly palpated because of a posterior location, feedback can be obtained by retro-pulsion of the globe. While gently pushing back on the globe, the clinician concentrates on the general compliance of the orbital tissue; a pliable retrobulbar mass tends to feel softer and more doughy than a solid mass, which may offer significant resistance to retro-pulsion.

One other aspect of palpation that relates to vascular lesions is worth noting. With increasing jugular venous pressure, a distensible venous lesion will engorge the orbit and will be relatively easily retro-placed after engorgement. The rapidity of engorgement and indeed that of deflation may reflect the inflow and outflow nature of these lesions. On the other hand, arterial-side lesions may pulsate and can be indented but feel more spongy and collapse incompletely or more slowly (see Chapter 14).

*Inflammatory effect* is characterized clinically by the classically described presence of pain, redness, warmth, and/or functional deficit. A mass effect can also be present as a result of associated tissue swelling. Inflammations can be different in character based on

whether they are acute (hours to days), subacute (days to weeks), or chronic (months) in onset. For example, acute dacryoadenitis leads to swelling of the superolateral part of the lid associated with injection, tenderness, tearing, and an S-shaped deformity, occasionally associated with pouting of the excretory ducts, noted in the superolateral fornix. Imaging would demonstrate an enlargement of the lacrimal gland sometimes with surrounding edema.

Acute inflammation can be caused by a limited number of processes. Catastrophic onset over minutes to hours suggests hemorrhage, in either a de novo or pre-existing lesion. Infections can also lead to rapidly progressive and fulminant inflammation in some instances.

Less dramatic but rapidly progressing subacute (over weeks) inflammation suggests infection, Graves' orbitopathy, idiopathic inflammatory disorders, or occasionally fulminant neoplasia. Specific inflammatory diseases such as sarcoidosis and Sjögren syndrome can have a subacute presentation but are more often chronic in character. Even an acute, aggressive lymphoma can have features of conjunctival injection, chemosis, and lid edema that appear like a subacute clinical inflammatory effect.

On the other hand, patients with orbital Wegener granulomatosis can develop diffuse or localized retrobulbar involvement in a chronic fashion, leading to protrusion of the eye associated with conjunctival and lid injection, scleritis, brawny induration, pressure, and tenderness as well as associated edema. Chronic inflammation presents a challenging differential diagnosis. This (weeks to months) onset is often characterized by low-grade dysfunctions and lesser intensity of symptoms, in contrast to acute inflammation. In addition, a desmoplastic response is much more common in chronic inflammatory processes.

Although abscesses are the result of inflammation, they are not necessarily always associated with inflammatory features; they can be localized or loculated and behave more like fairly rapidly developing masses. Even in these circumstances, there will likely be other clinical clues and investigative features that suggest an abscess, such as a cystic appearance on ultrasound and an enhancing capsule with contrast imaging. Fistulae most commonly are associated with chronic microbial infections or foreign bodies, and often remain fairly localized with intermittent drainage sometimes with granulomas at the mouth of the fistula, providing a clue to the nature of the lesion and its location to guide surgical intervention. Additional information can be obtained from probing or adjuvant investigations, such as fistulography.