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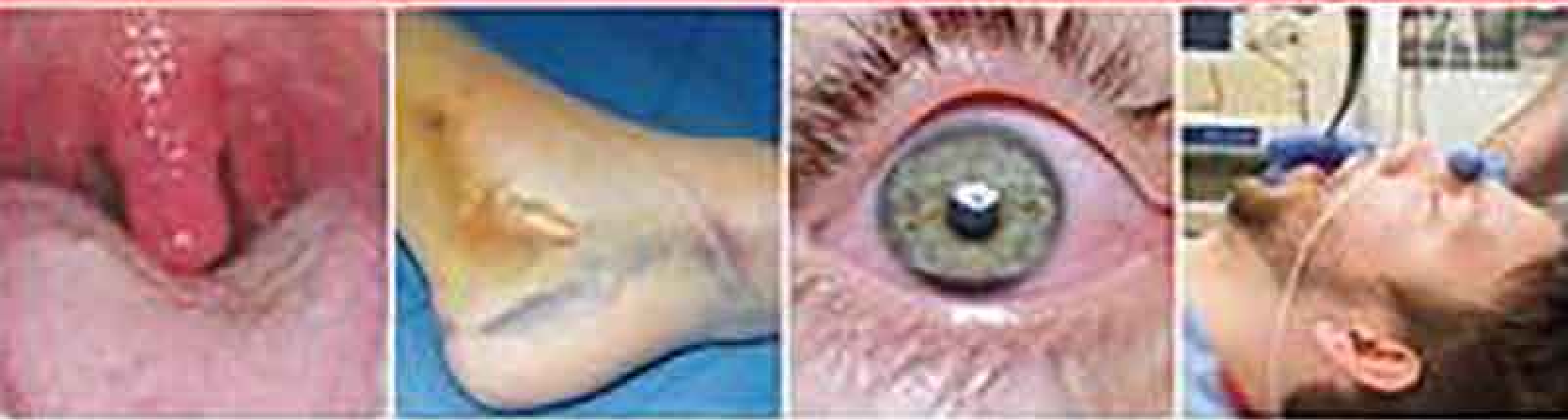
THE ATLAS OF EMERGENCY MEDICINE



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The Atlas of Emergency Medicine

FOURTH EDITION

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To MJ, Mimi and Stephen for your love and support of this and all life's endeavors. To the providers who deliver emergency care 24/7 throughout the world for inspiring me to be a lifelong learner. To our patients for sharing their malady for others to learn and then use in improving care.

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To the patients and families who have allowed us to photography their examination findings of themselves and their family members — I pray for God's grace and blessing on you for allowing others to learn from your illness and injuries for the benefit of caring for others.

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To my wife Lauren, and children Kate and Ben: You are the greatest blessings of my life. To all those who have generously provided mentoring over the years, especially Drs. Knoop, Stack, and Storrow: I am deeply honored and humbled to have had the opportunity to work alongside each of you.

RJT

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FOREWORD

Within a given medical specialty, typically two or three major textbooks help define the breadth and depth of a discipline. This Atlas of Emergency Medicine, for the field of emergency care, is one of these defining works. First appearing in 1997, the 4th Edition of the Atlas is now published in multiple foreign languages and available electronically, which makes it universally available and important for patient care across the globe. As many acute diagnoses are made visually, and many physicians are visual learners, the Atlas of Emergency Medicine serves as an outstanding educational and reference tool for the medical student, resident, and particularly the practicing emergency physician. It is a useful adjunct in preparation for the pictorial section of certification tests. This Atlas also serves as a valuable resource for other ambulatory care specialties such as pediatricians, general internists, family physicians, physician assistants, and nurse practitioners, by providing an approach designed by emergency physicians for patients with emergent conditions.

The 4th Edition of the Atlas of Emergency Medicine has been completely revised by the four editors as well as expert emergency physician contributors from across the specialty. It now contains 1500 full color photographs, electrocardiograms, and radiographs, 500 newly chosen for this 4th Edition. The chapters are arranged logically by organ system, special populations, and clinical problems. Environmental conditions, toxicology, electrocardiographic abnormalities, forensic medicine, airway procedures, tropical medicine, microscopic diagnoses, and emergency ultrasound are some of the special sections that greatly expand the usefulness of this Atlas for the practicing clinician caring for patients with emergencies. A clinical summary, management and disposition approaches, and pearls for photographic stimuli of a particular diagnosis make this text a full purpose reference. The impressive Table of Contents and exhaustive Index of the 4th Edition provides a comprehensive ability to access the important photographs, diagrams, and radiographs necessary to quickly help care for the patient presenting with an emergent condition. This expansion of topics and diagnoses has made this textbook a major resource in multiple medical environments for clinicians worldwide.

This 4th edition of the Atlas, for the first time, also provides access to videos to help improve the diagnostic capabilities of the clinician and complement the static photographic images. The editors are to be congratulated for continuing to expand the scope and media of this major work, while continuing to search for better photographic representations of disease processes for this latest edition.

For me personally, this Atlas of Emergency Medicine **4th Edition** represents the incredibly successful germination of an idea started as a conversation between an emergency medicine attending physician and a very talented emergency medicine resident (the senior editor of this Atlas, Dr. Knoop) during an overnight shift in the University of Cincinnati Medical Center emergency department, now over 20 years ago. The critical gap in the Emergency Medicine textbooks of the early 1990's was the lack of a comprehensive and practical pictorial atlas available for real-time diagnosis of patients presenting to emergent care settings. This book has not only bridged this gap, but also now provides the concise diagnostic and treatment information necessary for the emergency physician or other practitioners to manage the patient and carefully disposition them in real time, at the bedside. I believe this important Atlas of Emergency Medicine, now a classic in its 4th Edition, will remain a mainstay for the hospital emergency department and outpatient clinic libraries, as well as have a major presence in the savvy clinician's personal reference collection long into the future.

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PREFACE

The Atlas of Emergency Medicine, 4th Edition Preface
“The life so short, the craft so long to learn”
Hippocrates

We have a passion for improving patient care. Our journey with The Atlas of Emergency Medicine began with superb mentors who instilled in us a drive to become excellent clinicians and educators. We discovered imaging was a powerful tool to take the learner “to the bedside” and establish permanence, in a fashion unlike any other didactic technique. In 1994, much by chance, collegial networking brought three of us together to pursue an aggressive goal of producing the most comprehensive source of high-quality emergency care images available. While there were some initial detractors, our first three editions received widespread praise and have been translated into three foreign languages, flash cards, and electronic versions. We are deeply humbled and honored to present our fourth iteration.

Emergency care is defined by time and the emergency department is the most diverse melting pot of acute conditions in the hospital. Diagnostic accuracy, prognostic prediction, and the treatment pathways rely heavily on visual clues. We desire to maximize this skill for the benefit of our patients. We also strongly believe the visual experience, while sometimes downplayed within the hectic and time-pressured environment of modern medicine, is critical to ideal education. Images can teach faster and with greater impact than many pages of text or hours of lecture.

We continue our pursuit of these goals with a substantially updated, expanded, and improved fourth edition of The Atlas of Emergency Medicine. Nearly all of our changes and additions come from reader suggestions and criticisms, all received with sincere gratitude.

First, we have changed the format to greatly reduce text and allow for more images. Hence, the text is more concise, providing essential information. Each chapter item is now organized into: **Clinical Summary**, including a differential diagnosis where appropriate, followed by **Management and Disposition,** and, finally, **Pearls**. We have, as in the past, endeavored to provide relevant “pearls” representing tips for diagnosis, management, or unique aspects of a condition difficult to find in a typical text.

Second, after extensive review and critique, hundreds of new and replacement images have been added. We have been fortunate to draw upon new sources of photographs available on the Internet or through electronic channels unavailable to us previously. This has substantially strengthened the content and is a reminder of how much the world of media has changed. Gone are the days of manually sorting through thousands of slides or prints. There have been radical changes in the way we access medical knowledge over the past two decades. Regardless of the form, however, an image maintains a potent means to teach and learn.

Third, we are making an initial move into video. Many chapters include links to short videos further elucidating findings and providing a powerful medium to expand upon static images.

The audience for this text is all who provide emergency medical care, including clinicians, educators, residents, nurses, prehospital caregivers, and medical students. Many have also found it extremely useful as a review for written board examinations containing pictorial questions. Other healthcare workers, such as internists, family physicians, pediatricians, nurse practitioners, and physician assistants will find the Atlas a useful guide in identifying and treating many acute conditions, where visual clues significantly guide, improve, and expedite diagnosis as well as treatment.

We thank the many contributors and readers who have helped make this edition possible. We are especially grateful for the many contributions from two great educators in emergency medicine who share our passion: David Effron, MD, and Larry Mellick, MD. Also, special thanks to Anne Sydor, PhD, our McGraw-Hill editor for her tireless commitment, organizational ability and focus. Lastly, and most importantly, we express our deepest gratitude to our patients who were willing to be a “great case” in the Atlas, thus ultimately paving the way for improved emergency care.

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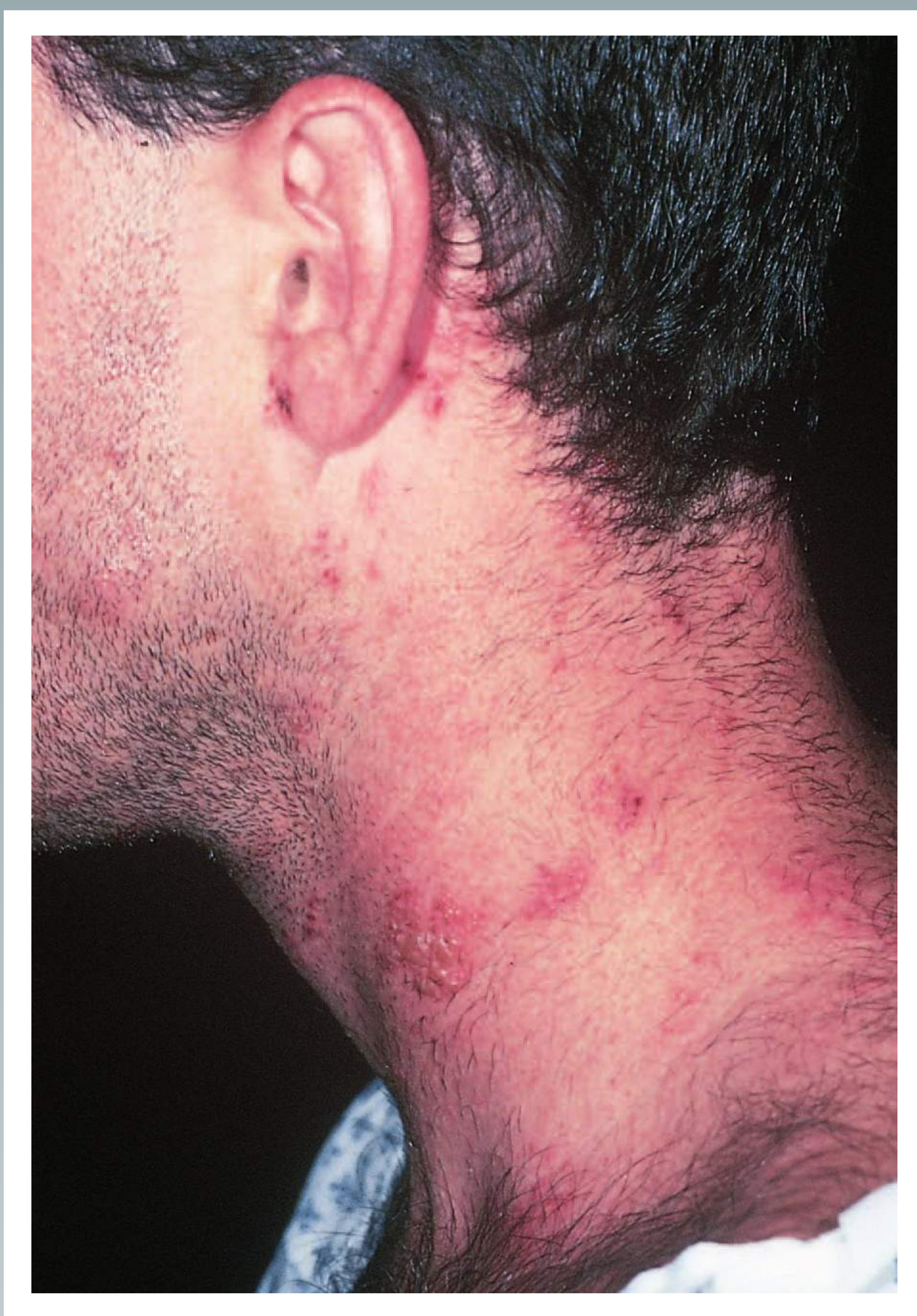
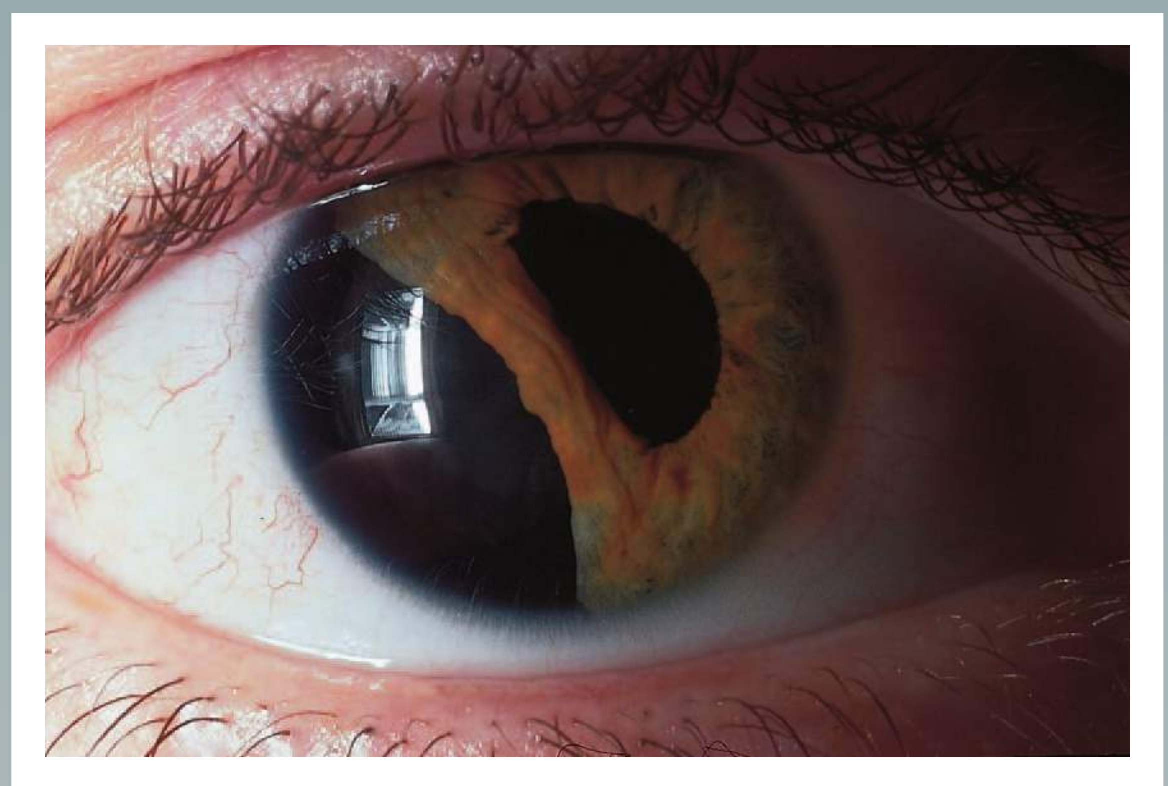
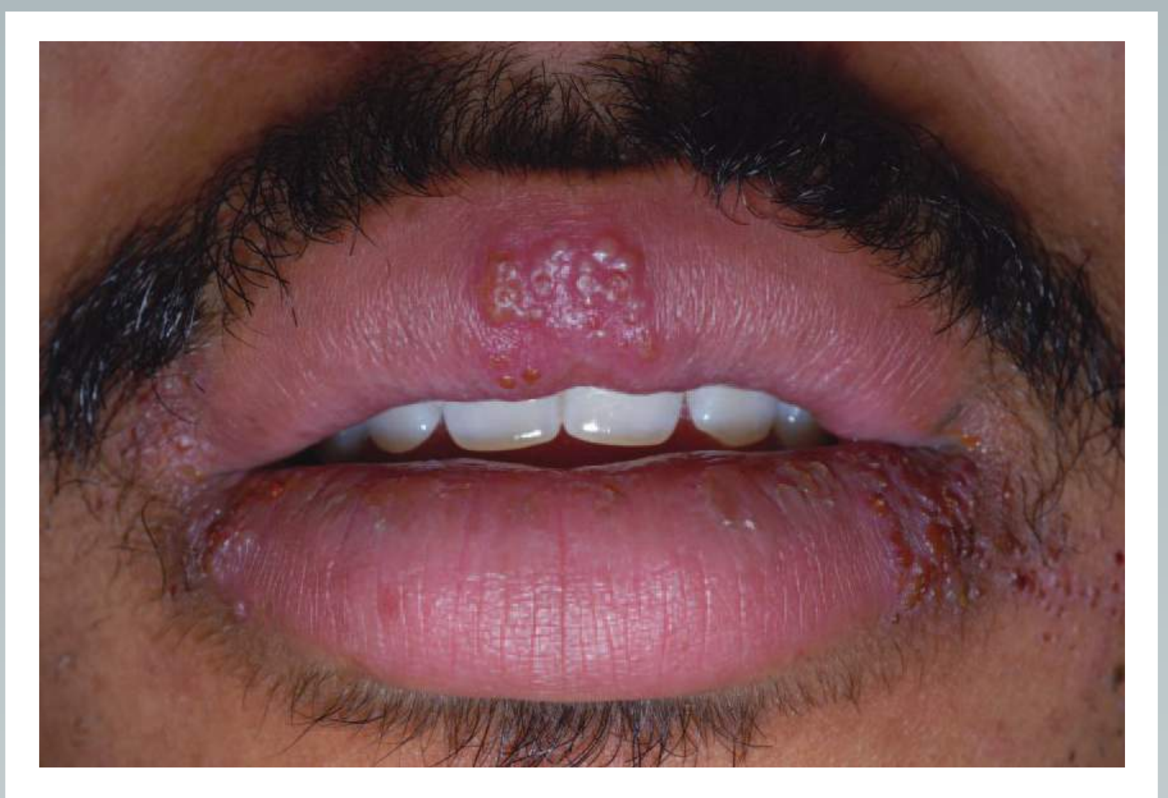
PART 1

Regional Anatomy





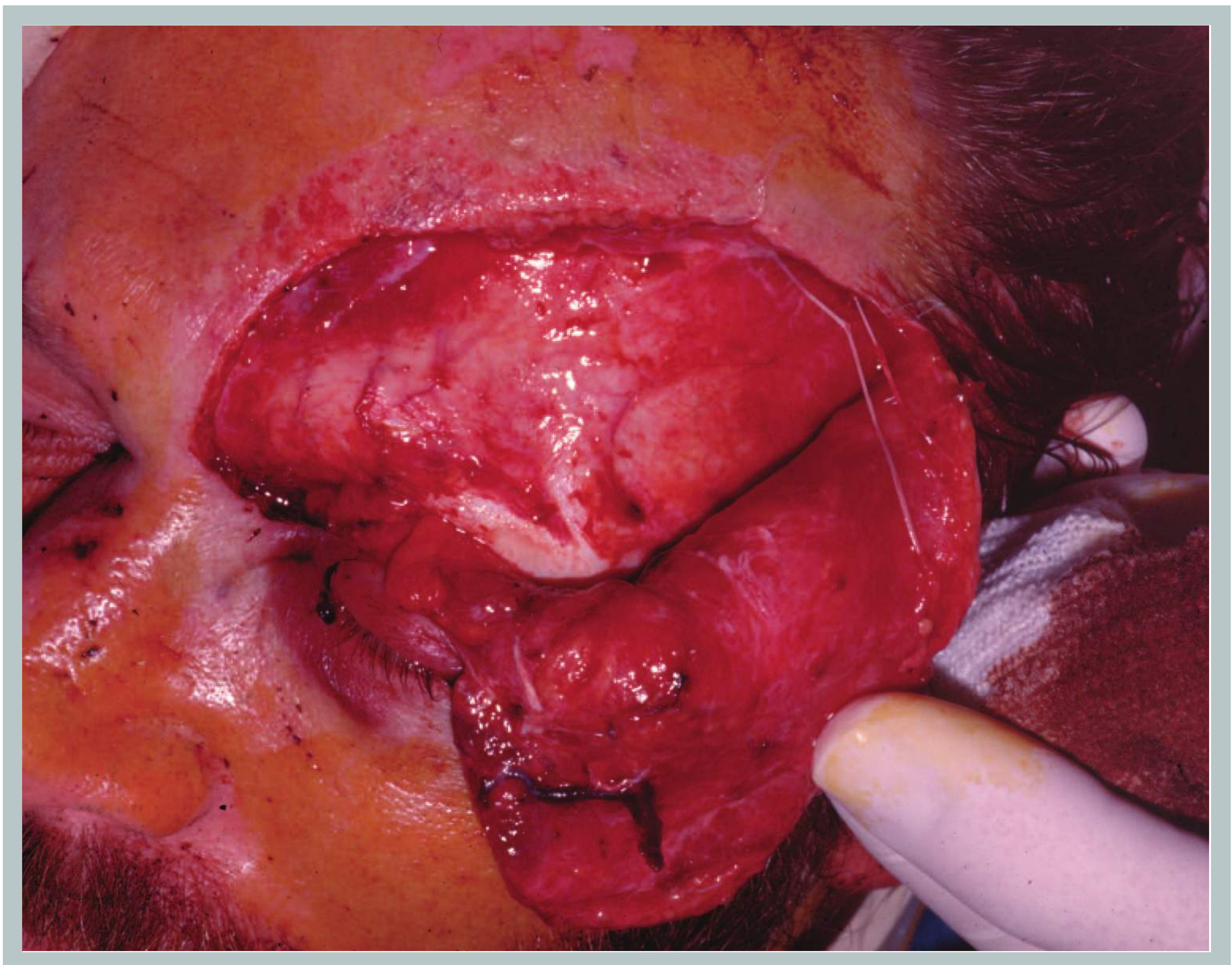


Chapter 1

HEAD AND FACIAL TRAUMA

Scan QR code or go to www.ematlas.com for video related to chapter

David W. Munter



Exposed Galea. Partial forehead degloving injury after a motor vehicle crash. Galea overlying the frontal bone is demonstrated just prior to repair. (Photo contributor: Lawrence B. Stack MD)

Clinical Summary

The skull "base" comprises the frontal bone, occiput, occipital condyles, clivus, carotid canals, petrous portion of the temporal bones, and the posterior sphenoid wall. A basilar skull fracture is basically a linear fracture of the skull base. Trauma resulting in fractures to this area typically does not have localizing symptoms. Indirect signs of the injury may include visible evidence of bleeding from the fracture into surrounding soft tissue, such as a Battle sign or "raccoon eyes." Bleeding into other structures—including hemotympanum or blood in the sphenoid sinus seen as an air-fluid level on computed tomography (CT)—may also be seen. Cerebrospinal fluid (CSF) leaks may also be evident and noted as clear or pink rhinorrhea. If CSF is present, a dextrose stick test may be positive. The fluid can be placed on filter paper and a "halo" or double ring may be seen.

Management and Disposition

Identify underlying brain injury, which is best accomplished by CT. CT is also the best diagnostic tool for identifying the fracture site, but fractures may not always be evident. Evidence of open communication, such as a CSF leak, mandates neurosurgical consultation and admission. Otherwise, the decision for admission is based on the patient's clinical condition, other associated injuries, and evidence of underlying brain injury as seen on CT. The use of antibiotics in the presence of a CSF leak is controversial because of the possibility of selecting resistant organisms.

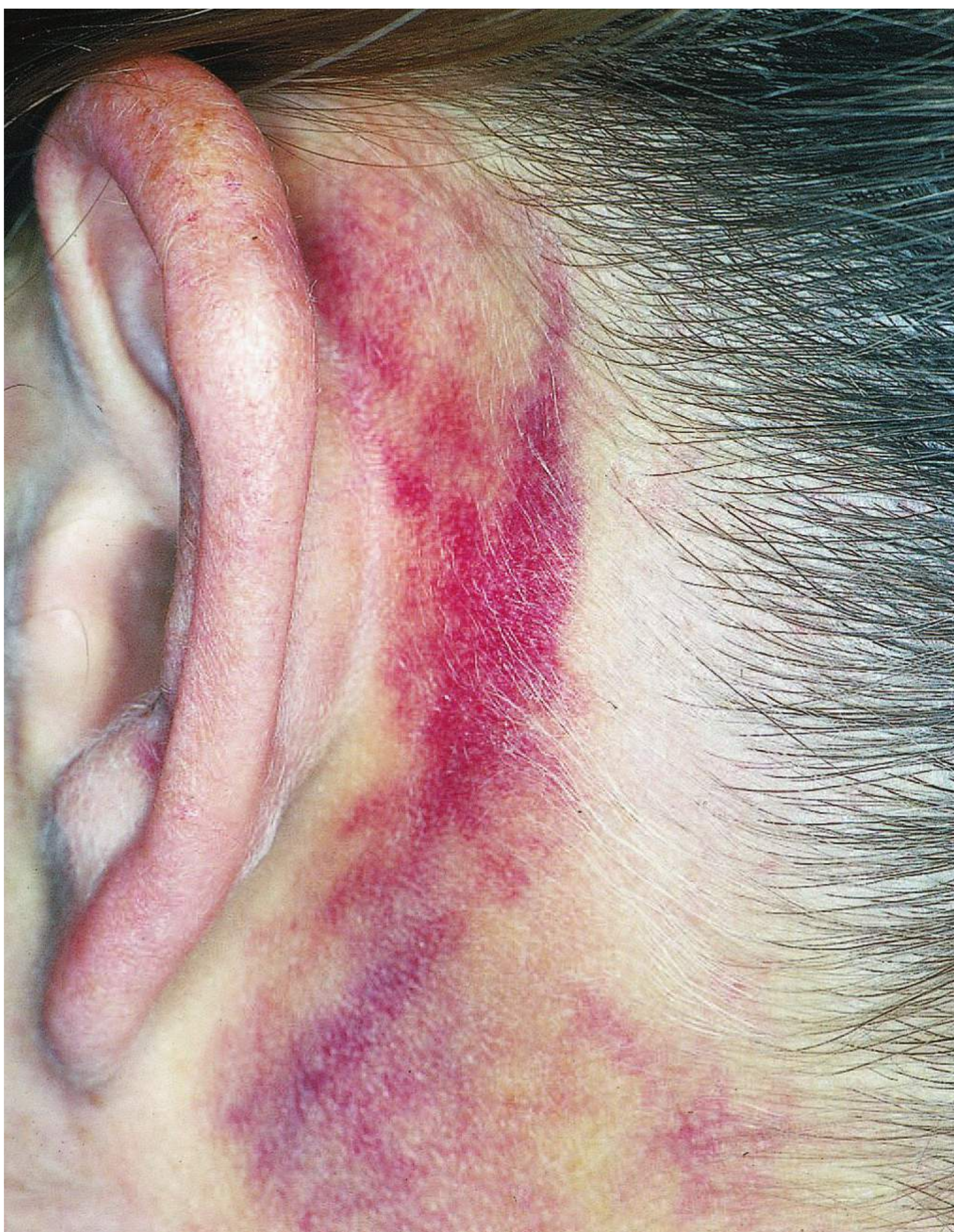


FIGURE 1.1 ■ **Battle Sign.** Ecchymosis in the postauricular area develops when the fracture line communicates with the mastoid air cells, resulting in blood accumulating in the cutaneous tissue. This patient had sustained injuries several days prior to presentation. (Photo contributor: Frank Birinyi, MD.)

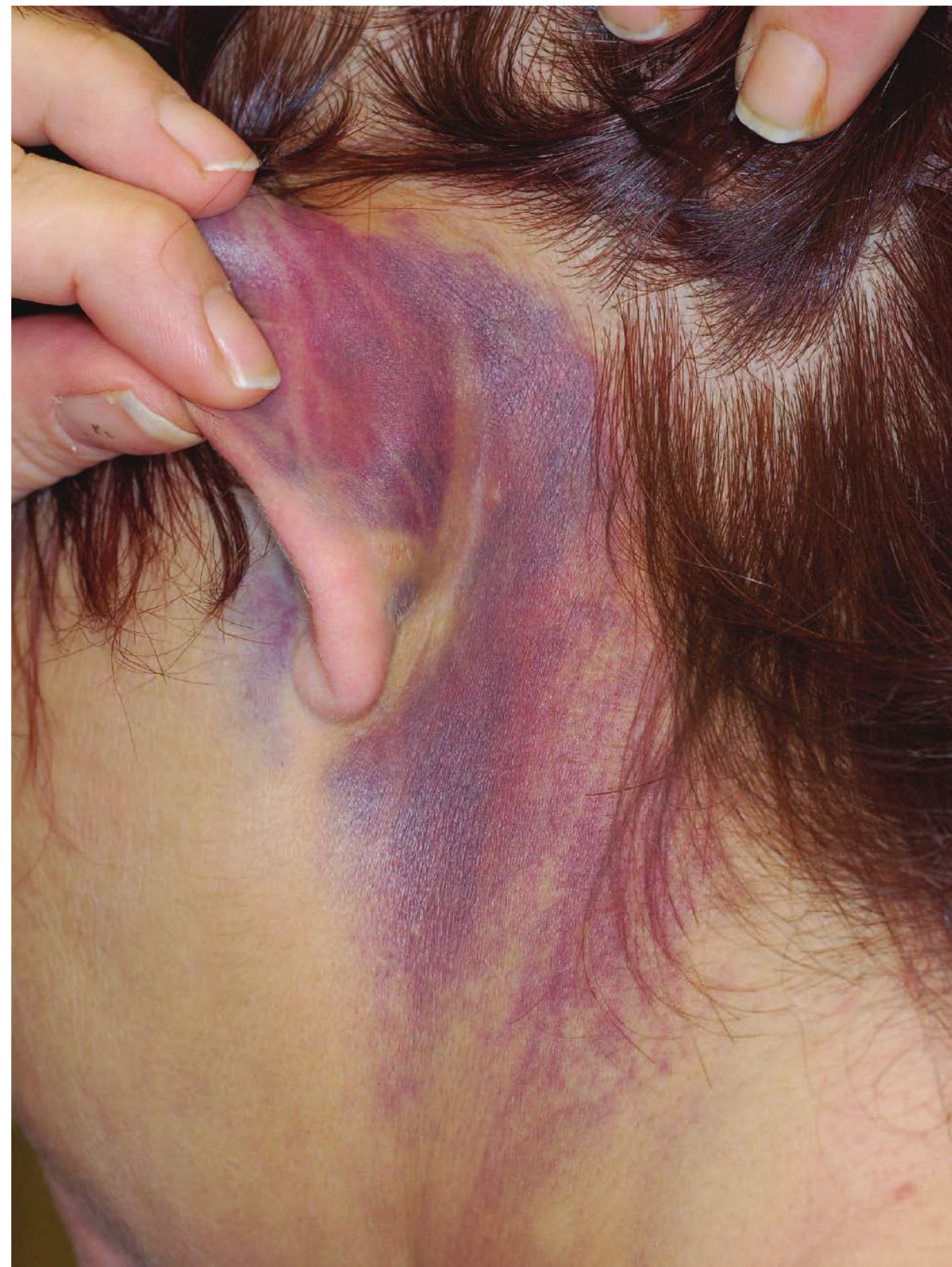


FIGURE 1.2 ■ **Battle Sign.** A striking Battle sign is seen in this patient with head trauma. This finding may take hours to days to develop. (Photo contributor: David Effron, MD.)

Pearls

1. Clinical manifestations of basilar skull fracture may take several hours to fully develop.
2. There should be a low threshold for head CT in any patient with head trauma, loss of consciousness, change in mental status, severe headache, visual changes, or nausea or vomiting.
3. The use of filter paper or a dextrose stick test to determine if CSF is present in rhinorrhea is not 100% reliable.

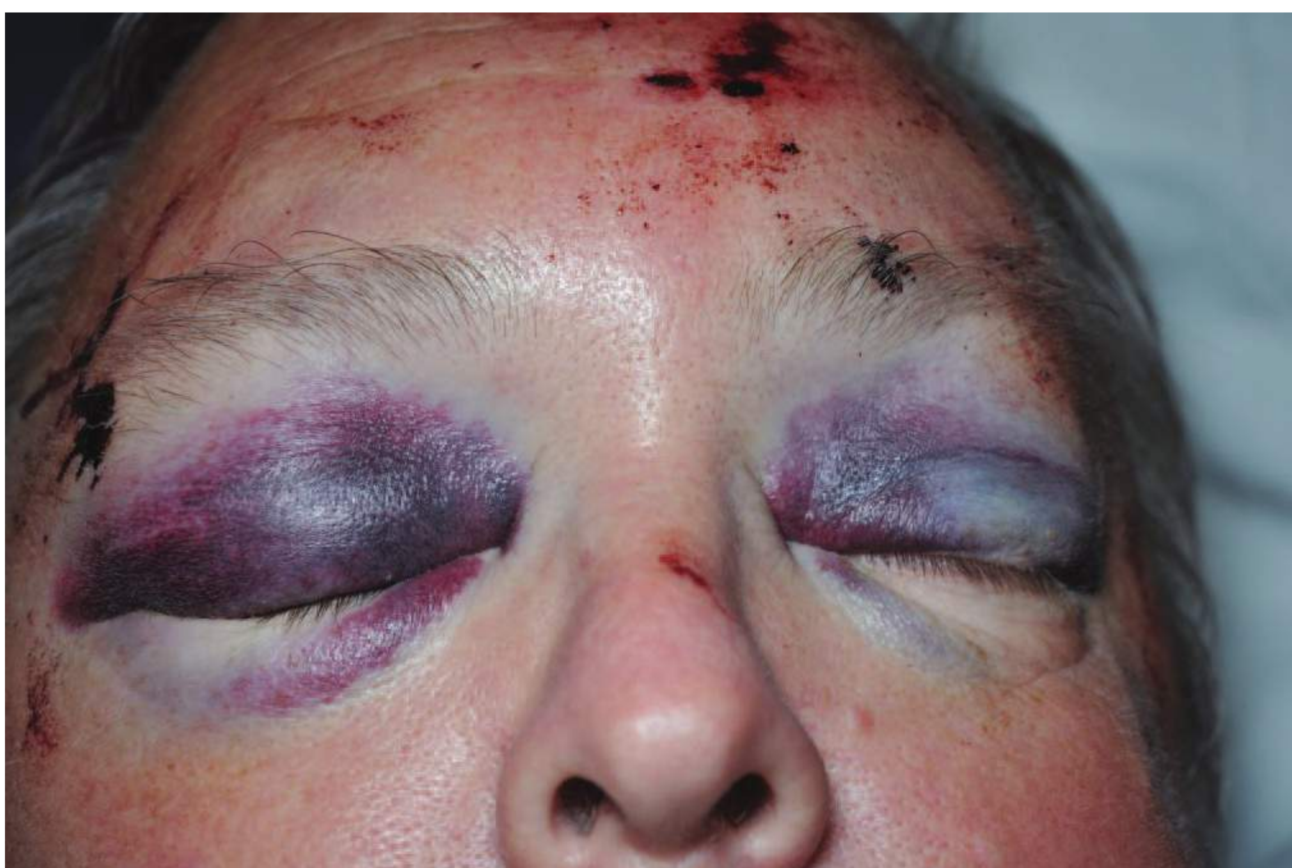


FIGURE 1.3 ■ **Raccoon Eyes.** Acute periorbital ecchymosis seen in this patient with a basilar skull fracture. These findings may also be caused by facial fractures. (Photo contributor: Shannon Koh, MD.)

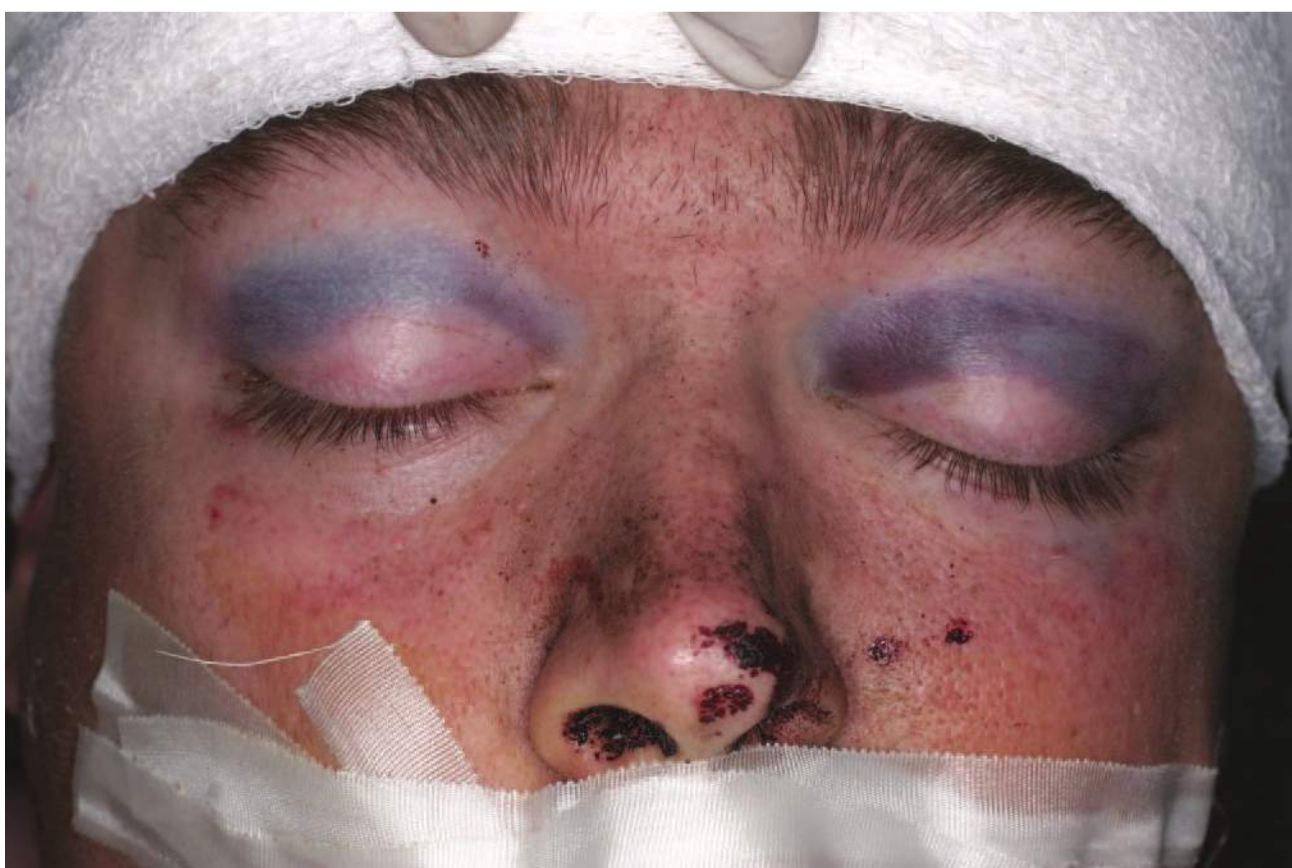


FIGURE 1.4 ■ **Early Raccoon Eyes.** Subtle periorbital ecchymosis manifests 1 hour after a blast injury. (Photo contributor: Kevin J. Knoop, MD, MS.)

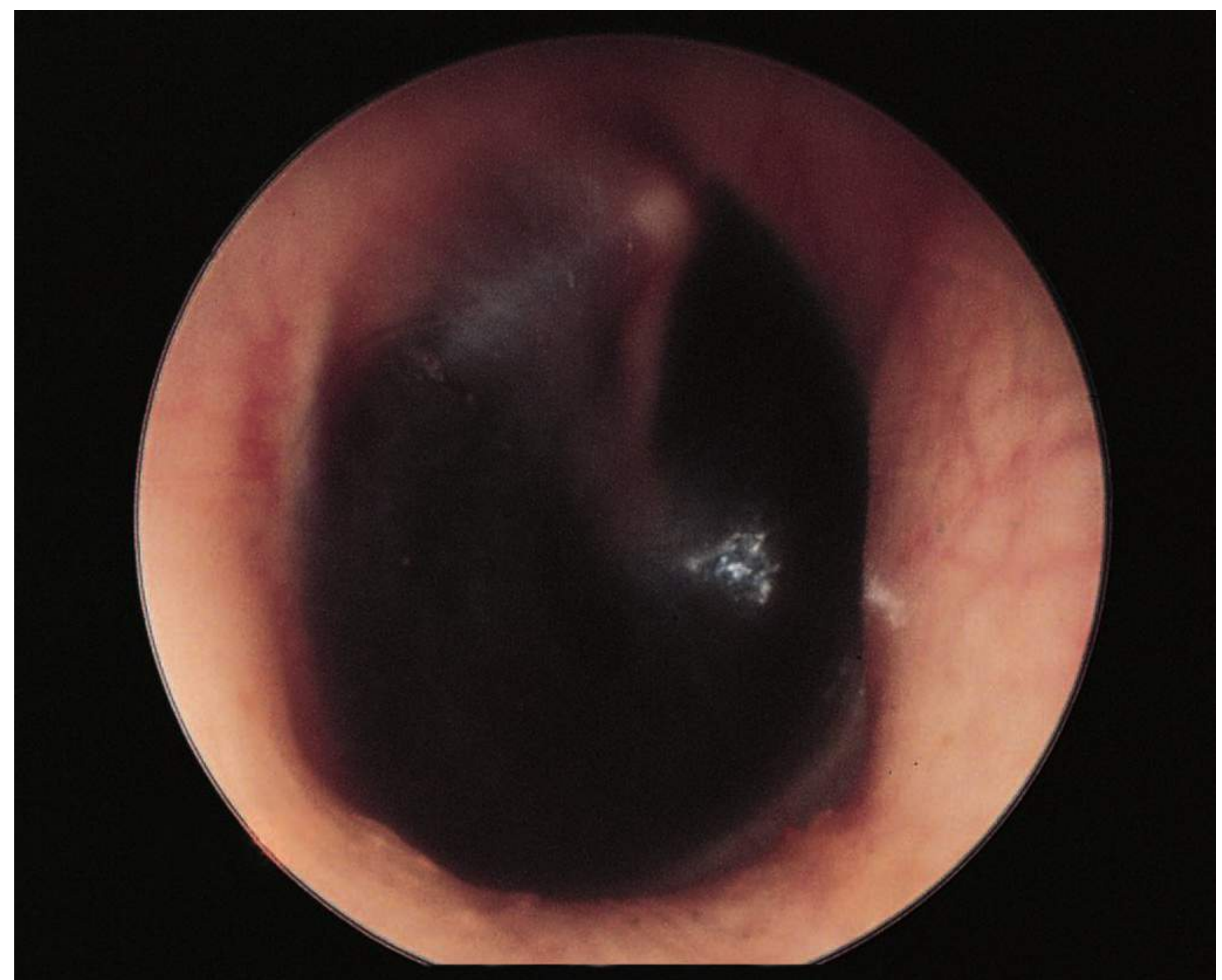


FIGURE 1.5 ■ **Hemotympanum.** Seen in a basilar skull fracture when the fracture line communicates with the auditory canal, resulting in bleeding into the middle ear. Blood can be seen behind the tympanic membrane. (Photo contributor: Richard A. Chole, MD, PhD.)

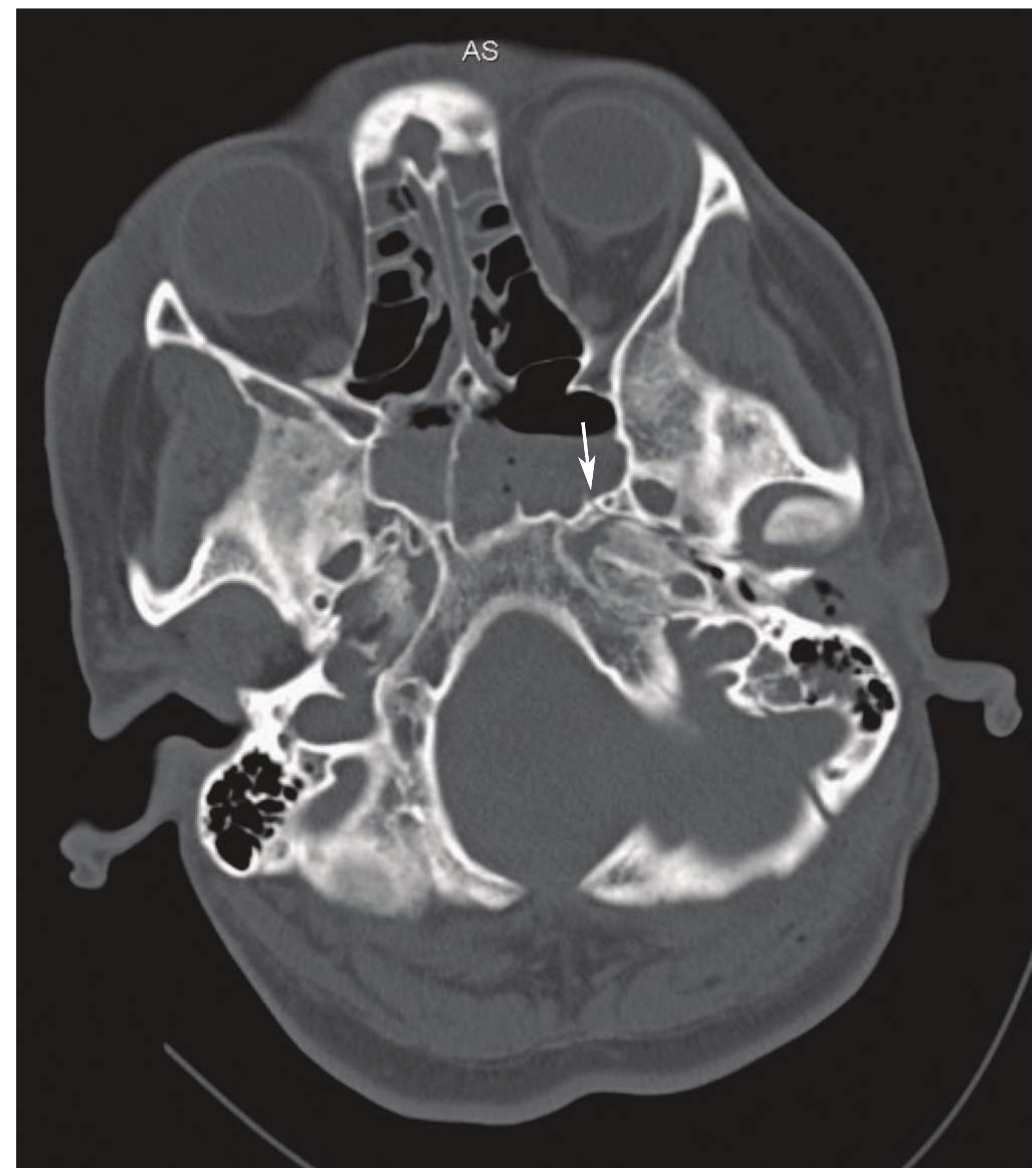


FIGURE 1.6 ■ **CT of Basilar Skull Fracture.** CT bone window demonstrates a fracture of the posterior wall left sphenoid sinus (arrow) and an air-fluid level. (Photo contributor: Jared McKinney, MD.)

FIGURE 1.7 ■ **Halo Sign—Cerebrospinal Fluid Leak.** Otorrhea on bed sheet demonstrating a halo sign from a patient with severe head trauma. The distinctive double-ring sign, seen here, comprises blood (inner ring) and CSF (outer ring). The reliability of this test has been questioned. (Photo contributor: Suzanne Bryce, MD.)

Clinical Summary

Depressed skull fractures typically occur when a large force is applied over a small area. They are classified as open if the skin above them is lacerated. Abrasions, contusions, and hematomas may also be present over the fracture site. The patient's mental status is dependent upon the degree of underlying brain injury. Direct trauma can cause abrasions, contusions, hematomas, and lacerations without an underlying depressed skull fracture. Evidence of other injuries such as a basilar fracture, facial fractures, or cervical spinal injuries may also be present.

Management and Disposition

Explore all scalp lacerations to exclude a depressed fracture. CT should be performed in all suspected depressed skull fractures to determine the extent of underlying brain injury. Depressed skull fractures require immediate neurosurgical consultation. Treat open fractures with antibiotics and tetanus prophylaxis as indicated. The decision to observe or operate immediately is made by the neurosurgeon. Children below 2 years of age with skull fractures can develop leptomeningeal cysts, which are extrusion of CSF or brain through dural defects. For this reason, children below age 2 with skull fractures require close follow-up or admission.

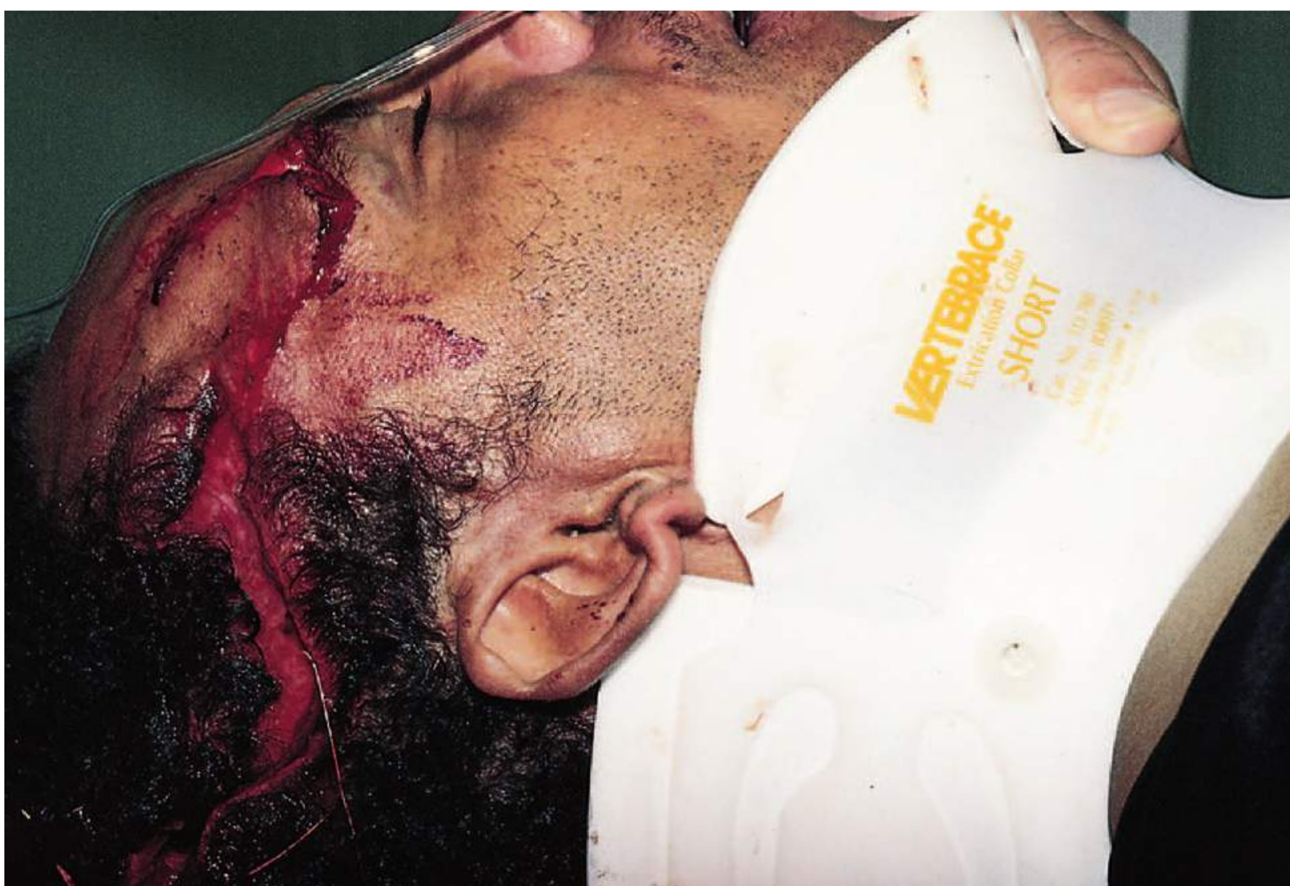


FIGURE 1.8 ■ **Depressed Skull Fracture.** A scalp laceration overlying a depressed skull fracture. Scalp lacerations should undergo sterile exploration for skull fracture. (Photo contributor: David W. Munter, MD.)

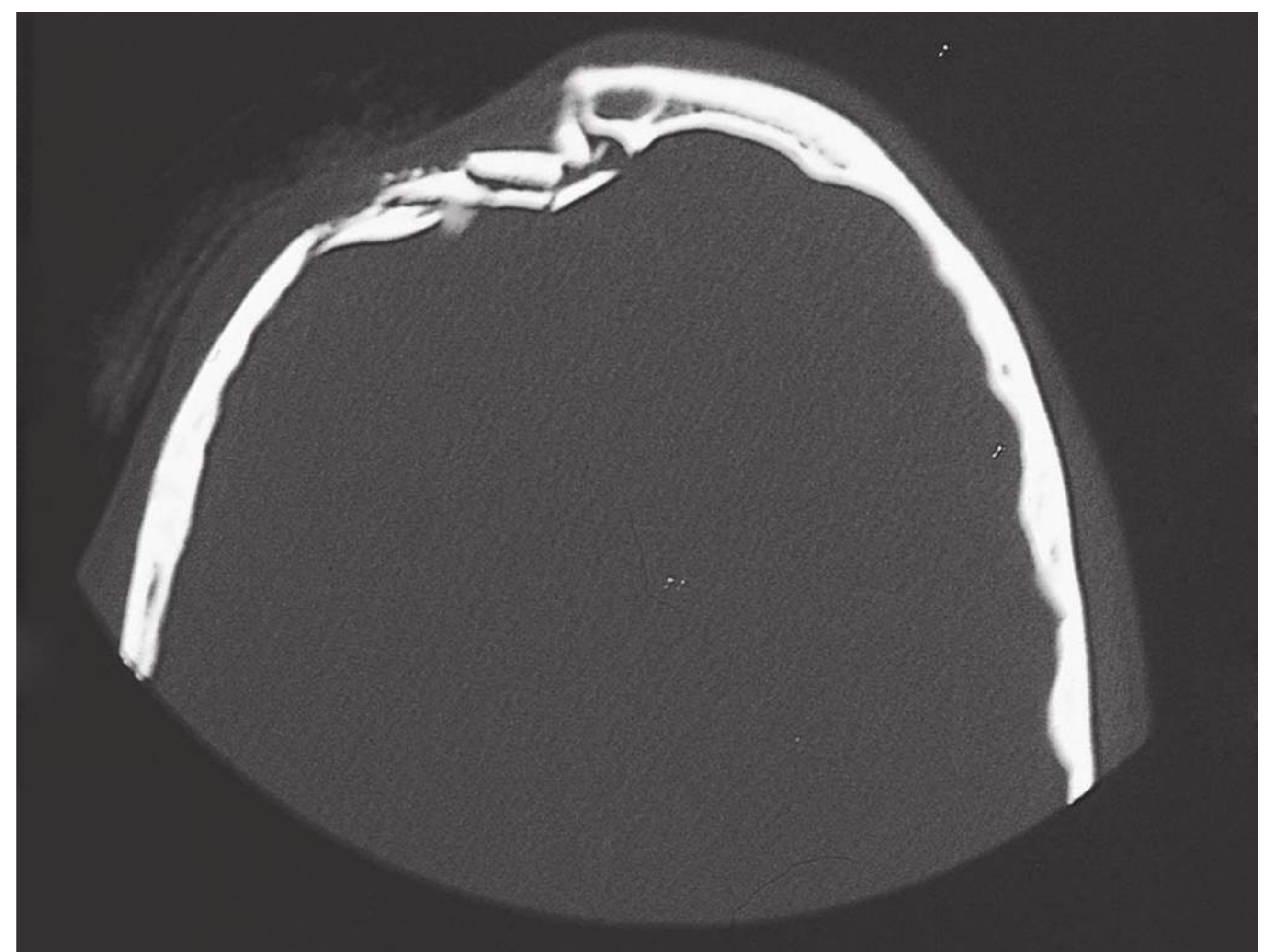


FIGURE 1.9 ■ **Depressed Skull Fracture.** CT demonstrating depressed skull fracture. (Photo contributor: David W. Munter, MD.)

Pearls

1. Examine all scalp injuries including lacerations for evidence of fractures or depression. When fragments are depressed 5 mm below the inner table, penetration of the dura and injury to the cortex are more likely.
2. Children with depressed skull fractures are more likely to develop epilepsy.
3. Ping pong ball skull fractures can occur from a forceps delivery or from compression by mother's sacral promontory during delivery.
4. Patients with head injuries must be evaluated for cervical spine injuries.

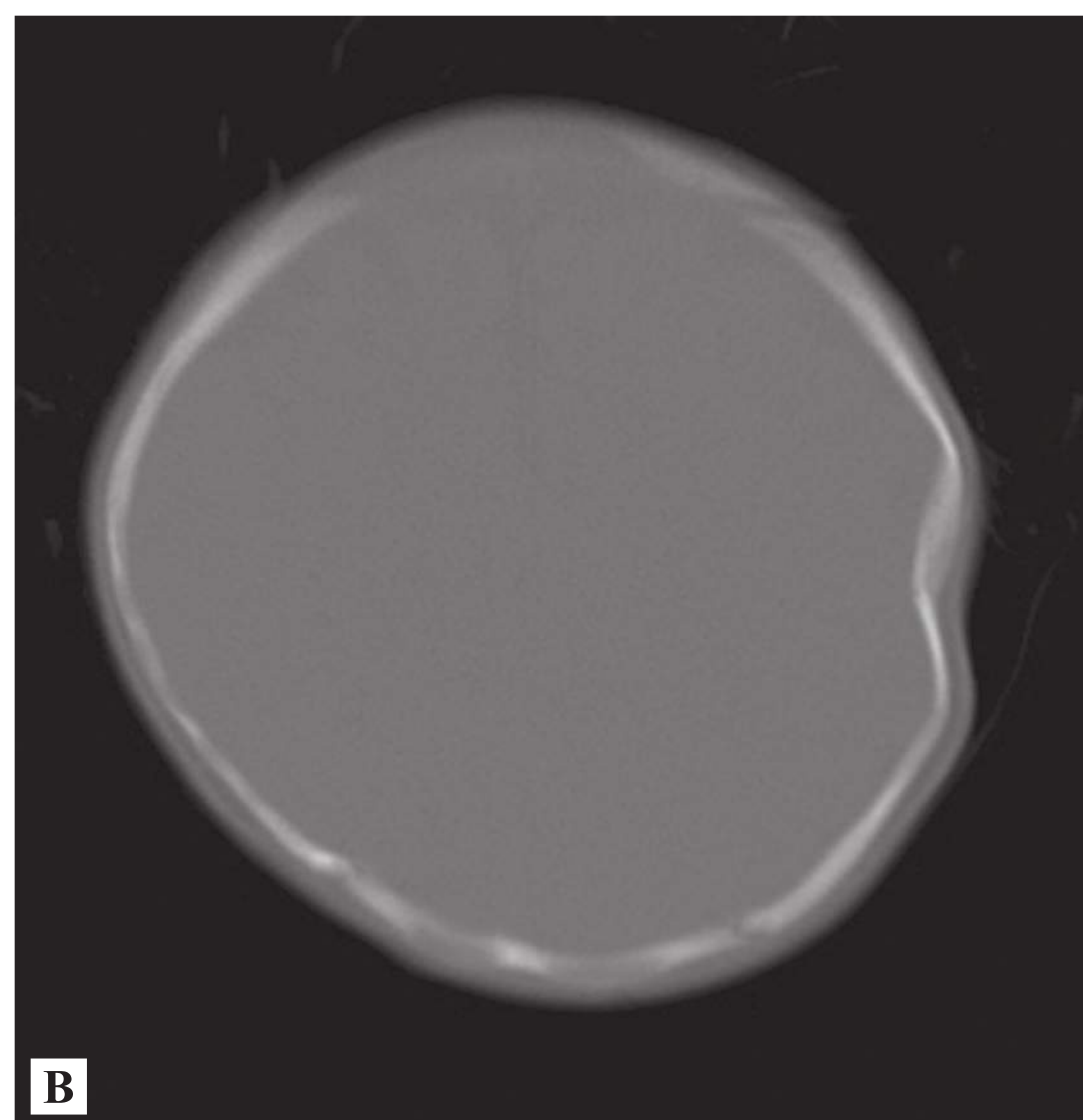


FIGURE 1.10 ■ **Ping Pong Ball Skull Fracture.** (**A**) Akin to the greenstick fracture, a ping pong ball fracture occurs when a newborn or infant's relatively soft skull is indented by the corner of a table or similar object without causing a frank break in the bone. (**B**) CT demonstrates the ping pong ball effect. (Photo contributor: Johnny Wei, BS.)

Clinical Summary

Clinically significant nasal fractures are almost always evident with deformity, swelling, and ecchymosis. Fractures to adjacent bony structures, including the orbit, frontal sinus, or cribriform plate, often occur. Epistaxis may be due to a septal or turbinate laceration but can also be seen with fractures of adjacent bones, including the cribriform plate. Septal hematoma is a rare but important complication that, if untreated, may result in necrosis of the septal cartilage and a resultant "saddle-nose" deformity. A frontonasoethmoid fracture has nasal or frontal crepitus and may have telecanthus or obstruction of the nasolacrimal duct.

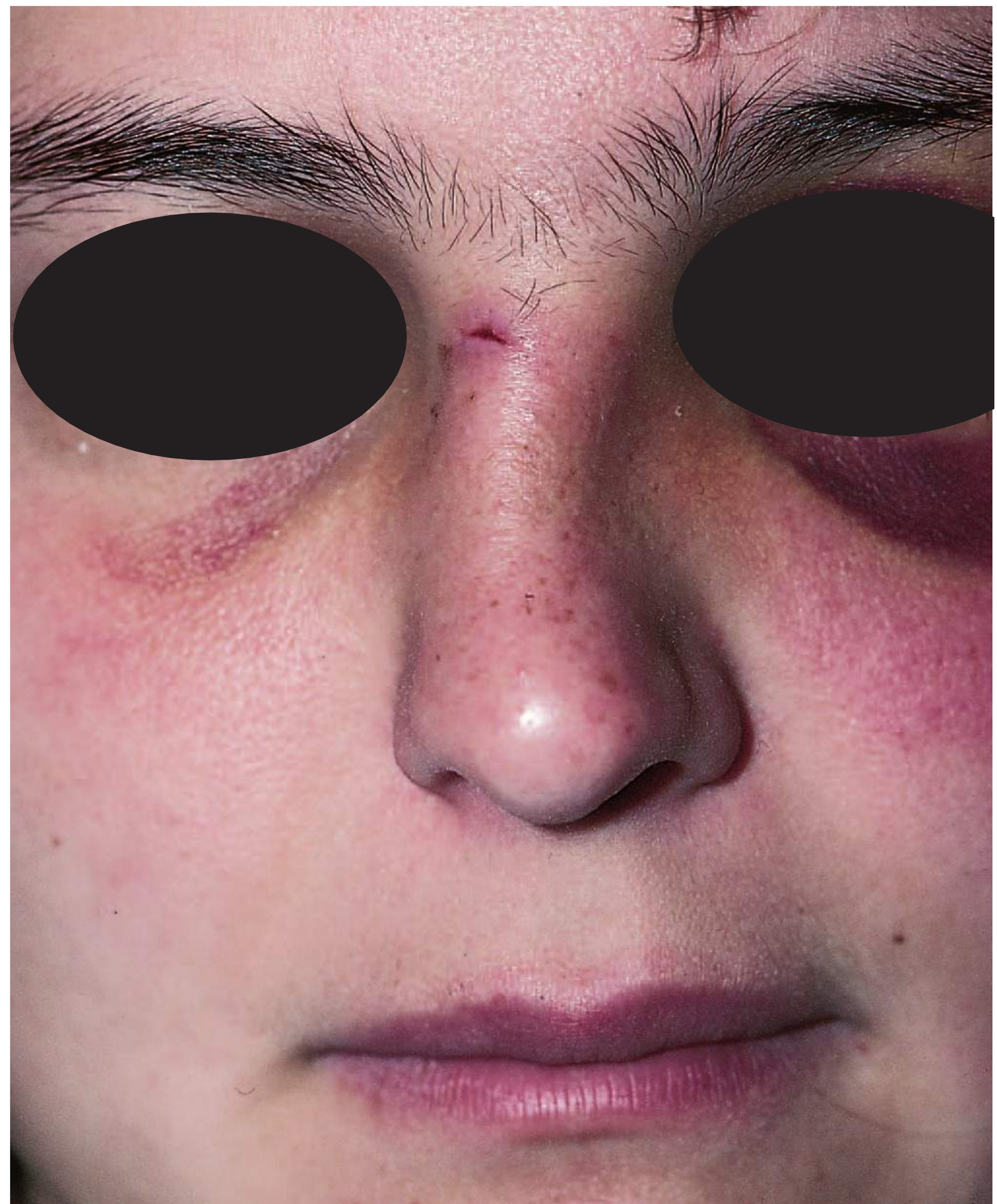


FIGURE 1.11 ■ **Nasal Fracture.** Deformity is evident on examination. Note periocular ecchymosis indicating the possibility of other facial fractures (or injuries). The decision to obtain radiographs is based on clinical findings. A radiograph is not indicated for an isolated simple nasal fracture. (Photo contributor: David W. Munter, MD.)

Management and Disposition

Look for more serious injuries first. Patients with associated facial bone deformity or tenderness may require CT to rule out facial fractures. Isolated nasal fractures rarely require radiographs. Refer obvious deformities within 2 to 5 days for reduction, after the swelling has subsided. Nasal fractures with mild angulation and without displacement may be reduced in the emergency department (ED). Nasal injuries without deformity need only conservative therapy with an analgesic and possibly a nasal decongestant. Immediately drain septal hematomas, with packing placed to prevent reaccumulation. Uncontrolled epistaxis may require nasal packing. Vigorously irrigate and suture lacerations overlying a simple nasal fracture and place the patient on antibiotic coverage. Complex nasal lacerations with underlying fractures should be repaired by a facial surgeon.

Pearls

1. Control epistaxis to perform a good intranasal examination. If obvious deformity is present, including a new septal deviation or deformity, treat with ice and analgesics and provide ENT referral in 2 to 5 days for reduction.
2. Although the effectiveness of prophylactic antibiotics to prevent toxic shock syndrome is unproven, patients discharged with nasal packing should be placed on antistaphylococcal antibiotics and referred to ENT in 2 to 3 days.
3. Consider cribriform plate fractures in patients with clear rhinorrhea after nasal injury, with the understanding that this finding may be delayed.
4. Patients with facial trauma should be examined for a septal hematoma.

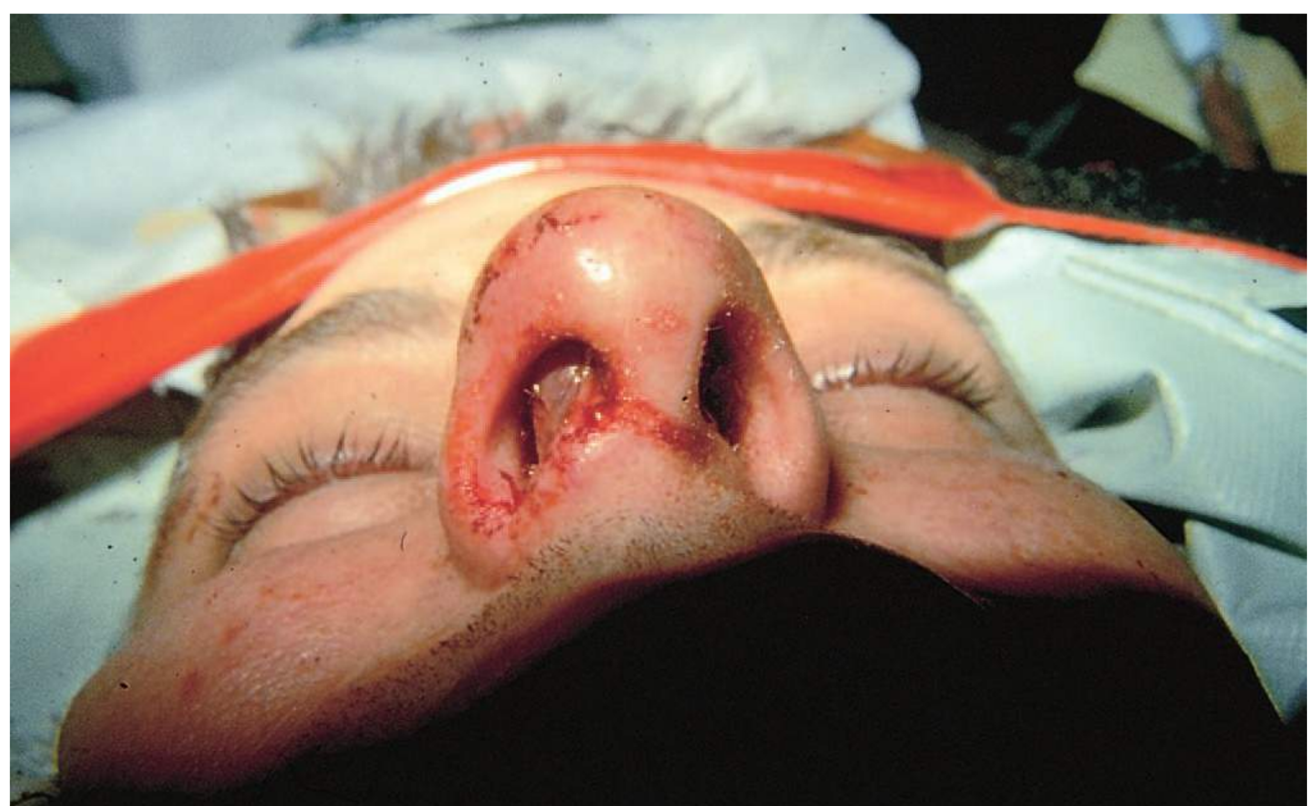


FIGURE 1.12 ■ **Septal Hematoma.** A bluish, grapelike mass on the nasal septum. If untreated, this can result in septal necrosis and a saddle-nose deformity. An incision, drainage, and packing are indicated. (Photo contributor: Lawrence B. Stack, MD.)