Preseptal cellulitis

INTRODUCTION — Preseptal cellulitis (sometimes called periorbital cellulitis) is an infection of the anterior portion of the eyelid, not involving the orbit or other ocular structures. In contrast, orbital cellulitis is an infection involving the contents of the orbit (fat and ocular muscles) but not the globe. Although preseptal and orbital cellulitis may be confused with one another because both can cause ocular pain and eyelid swelling and erythema, they have very different clinical implications. Preseptal cellulitis is generally a mild condition that rarely leads to serious complications, whereas orbital cellulitis may cause loss of vision and even loss of life. Orbital cellulitis can usually be distinguished from preseptal cellulitis by its clinical features (ophthalmoplegia, pain with eye movements, and proptosis) and by imaging studies. In cases in which the distinction is not clear, clinicians should treat patients as though they have orbital cellulitis. Both conditions are more common in children than in adults, and preseptal cellulitis is much more common than orbital cellulitis.

The pathogenesis, microbiology, clinical manifestations, diagnosis, and treatment of preseptal cellulitis will be reviewed here. Orbital infections caused by fungi, mainly the Mucorales (which cause mucormycosis) and Aspergillus spp and, much more rarely, Mycobacterium tuberculosis, are also presented elsewhere. (See "Orbital cellulitis" and "Mucormycosis (zygomycosis)" and "Epidemiology and clinical manifestations of invasive aspergillosis" and "Tuberculosis and the eye".)

TERMINOLOGY — Preseptal cellulitis and orbital cellulitis involve different anatomic sites, with preseptal cellulitis referring to infections of the soft tissues anterior to the orbital septum and orbital cellulitis referring to infections posterior to it (figure 1). Neither infection involves the globe. (See Anatomy below.)

There is some debate regarding the appropriate terminology for these infections. Some clinicians use the term "periorbital cellulitis" rather than "preseptal cellulitis" or use the terms interchangeably. We prefer the term "preseptal cellulitis" to make a clear distinction between this infection and the more serious infection, "orbital cellulitis." Orbital cellulitis is sometimes referred to as "postseptal cellulitis"; we favor the term "orbital cellulitis," and will use it throughout this topic.

ANATOMY — Basic familiarity with the anatomy of the eye is fundamental to understanding the pathogenesis, clinical manifestations, and complications of preseptal and orbital cellulitis. The orbit is a cone-shaped structure, lying horizontally, with its apex in the skull. It is surrounded by paranasal sinuses, namely, the frontal (lying superior), ethmoid (medial) and maxillary (inferior) sinuses (figure 2). The orbit is lined by periosteum. The ethmoid sinuses are separated from the orbit by a paper-thin layer called the lamina papyracea, which contains many perforations for nerves and blood vessels as well as some natural fenestrations termed Zuckerkandl’s dehiscences. The most common route of infection of the orbit is by extension from the ethmoid sinuses, presumably through these perforations.

The orbital septum is a membranous sheet that extends from the periosteum of the orbit to the tarsal plate and forms the anterior boundary of the orbital compartment (figure 1). As noted above, preseptal cellulitis involves the soft tissues anterior to the orbital septum. The superior and inferior ophthalmic veins drain blood directly into the cavernous sinus (figure 3). Because of this communication and because the inferior orbital veins are valveless, infection can pass readily from the orbit to intracranial structures [1].

EPIDEMIOLOGY — Preseptal cellulitis is much more common than orbital cellulitis. In two pediatric case series, 94 percent and 87 percent of cases, respectively, were diagnosed as preseptal cellulitis [2,3]; the remainder of cases were diagnosed as orbital cellulitis. Both infections are much more common in children than in adults; accordingly, most of the data regarding these infections comes from studies in children.
PATHOGENESIS — Whereas the paranasal sinuses are the main source of infection in orbital cellulitis, many cases of preseptal cellulitis (the proportion varying from study to study) arise from external sources. In one retrospective series of 315 children admitted to the hospital with preseptal or orbital cellulitis, sinusitis was the underlying condition in all 18 children with orbital cellulitis but in only 15 percent of those with preseptal cellulitis [2]. However, other studies have found sinusitis to be the most common cause of preseptal cellulitis [4,5].

Other sites from which preseptal cellulitis may arise are the surrounding tissues of the face and eyelids following local trauma [6,7], insect bites [7], animal bites [8], or foreign bodies. In one retrospective series of 104 patients with preseptal cellulitis admitted to a tertiary care center, roughly 30 percent were thought to originate from each of the following causes: acute dacryocystitis, sinusitis or upper respiratory tract infection, or trauma (including recent eyelid or strabismus surgery) [9]. In another retrospective study that included 262 children with preseptal or orbital cellulitis, trauma (including insect bites) was much more common in patients with preseptal cellulitis than in those with orbital cellulitis (40 versus 11 percent) [3]. Bacteremic seeding of the preseptal space is rare. It is occasionally seen in infants with bacteremia due to Streptococcus pneumoniae, Streptococcus pyogenes, or Haemophilus influenzae.

MICROBIOLOGY — Data concerning the causes of preseptal cellulitis are limited. Blood cultures are almost always negative, and it is usually difficult to obtain cultures from the infected site. Based on the available data, the most common causes of preseptal cellulitis are Staphylococcus aureus, Streptococcus pneumoniae, other streptococci, and anaerobes (table 1) [3,9], presumably depending on the site of origin of the infection.

Of S. aureus strains, community-acquired methicillin-resistant S. aureus (CA-MRSA) is thought to be an increasingly common cause of infection. Although most cases of preseptal cellulitis caused by CA-MRSA have been published only as case reports or retrospective series [10,11], the proportion of other skin and soft tissue infections caused by CA-MRSA has increased dramatically. In a report of 422 adults presenting to emergency departments in 11 United States cities in 2004 with skin and soft tissue infections, 59 percent were caused by MRSA and 97 percent of cases of MRSA were caused by CA-MRSA [12]. (See "Methicillin-resistant Staphylococcus aureus infection in adults: Epidemiology", section on 'Community-associated methicillin-resistant Staphylococcus aureus'.)

Although Haemophilus influenzae was previously a common cause of preseptal cellulitis, routine immunization of children with the H. influenzae type b vaccine has caused a sharp decline in the incidence of this species as a cause of preseptal cellulitis [2]. (See "Microbiology, epidemiology and treatment of Haemophilus influenzae".)

Infrequent causes of preseptal cellulitis include Acinetobacter species [13,14], Nocardia brasiliensis [15], Bacillus anthracis [16], Pseudomonas aeruginosa [17], Neisseria gonorrhoeae [18], Proteus spp [19], Pasteurella multocida [8], Mycobacterium tuberculosis [20], and Trichophyton spp (the cause of "ringworm") [21]. These pathogens can usually be linked to specific exposures.

CLINICAL MANIFESTATIONS — Patients with preseptal cellulitis typically present with ocular pain, eyelid swelling, and erythema (picture 1); importantly, preseptal and orbital cellulitis may be confused with one another because both infections can cause these manifestations, but they have very different clinical implications [3,22-25]. In contrast to preseptal cellulitis, orbital cellulitis causes swelling and inflammation of the extraocular muscles and fatty tissues within the orbit, leading to pain with eye movements, proptosis, and ophthalmoplegia with diplopia. Chemosis (conjunctival swelling) may occasionally occur in severe cases of preseptal cellulitis but is more common with orbital cellulitis. Orbital cellulitis, but not preseptal cellulitis, may cause visual impairment. In a retrospective study that included 262 children, fever occurred more commonly in those with orbital cellulitis than in those with preseptal cellulitis (94 versus 47 percent) [3]. Leukocytosis may be present in patients with preseptal cellulitis but is not a sensitive indicator of this infection. The clinical manifestations of orbital cellulitis are discussed in greater detail separately. (See "Orbital cellulitis", section on 'Clinical manifestations'.)

Serious complications are very rare in preseptal cellulitis. It is rare for untreated preseptal cellulitis to give rise to orbital cellulitis and very rare for either infection to invade the globe (to produce endophthalmitis). However, some cases that are initially diagnosed as preseptal cellulitis may, in fact, be orbital cellulitis. Therefore, clinicians must be vigilant for features suggesting possible misdiagnosis. (See "Diagnosis" below and "Orbital cellulitis", section on 'Diagnosis'.)
The tables indicate the clinical signs and symptoms associated with the two conditions (table 2 and table 3). Combined with imaging studies, when indicated, these features usually allow for a reasonable degree of confidence in distinguishing between the two entities. However, the clinical evaluation can be challenging in young children, who may not be able to cooperate with a full examination.

**DIFFERENTIAL DIAGNOSIS** — The differential diagnosis of preseptal cellulitis includes:

- Orbital cellulitis (see "Orbital cellulitis")
- Insect bite
- Allergic response
- Hordeolum (stye)
- Conjunctivitis

It is critical to distinguish preseptal cellulitis from the more serious orbital cellulitis. (See "Orbital cellulitis", section on 'Diagnosis'.)

**DIAGNOSIS** — The diagnosis of preseptal cellulitis is based upon the history (eg, insect bite, local face and/or eyelid trauma) and physical examination, but, in cases in which there is doubt, computed tomography (CT) scanning of the orbits and sinuses is used to distinguish preseptal cellulitis from orbital cellulitis. The approach to diagnosis when a case of preseptal cellulitis is difficult to distinguish from orbital cellulitis is discussed separately. (See "Orbital cellulitis", section on 'Diagnosis'.)

Despite the low yield, we recommend obtaining blood cultures from patients with suspected preseptal cellulitis before the administration of antibiotics.

**Imaging studies** — Contrast-enhanced CT scanning of the orbits and sinuses is helpful for distinguishing between preseptal and orbital cellulitis. In preseptal cellulitis, there is swelling of the eyelid(s) but no proptosis, no fat stranding of the orbital contents, and no edema of the extraocular muscles. Sinusitis may be present in preseptal cellulitis but is almost always present in orbital cellulitis. It is important to note that in some cases of orbital cellulitis, the CT scan abnormalities may be subtle.

Imaging studies are indicated if any of the clinical signs or symptoms point to orbital cellulitis rather than preseptal cellulitis. They are also indicated in patients with presumed preseptal cellulitis who exhibit marked eyelid swelling, fever, and leukocytosis, or whose infection fails to show improvement after 24 to 48 hours of appropriate antibiotics. Imaging studies in patients with suspected orbital cellulitis are discussed in detail separately. (See "Orbital cellulitis", section on 'Imaging studies'.)

**TREATMENT** — There are no randomized trials of antibiotic regimens for the treatment of preseptal cellulitis. Blood cultures are rarely positive and cultures from the site of infection are difficult to obtain. Therefore, treatment is almost always empiric and based upon knowledge of the common infecting organisms (S. aureus, Streptococcus pneumoniae, other streptococci and anaerobes) and their usual susceptibility patterns.

Adults and children older than one year of age with mild preseptal cellulitis and no signs of systemic toxicity can generally be treated as outpatients with oral antibiotics provided that close follow-up can be ensured. Children younger than one year of age, children who cannot cooperate fully for an examination, and patients who are severely ill should generally be admitted to the hospital and managed according to the recommendations for orbital cellulitis. This is discussed in greater detail separately. (See "Orbital cellulitis", section on 'Treatment'.)

It is important to note that patients with subtle clinical and/or radiographic findings suggesting that the orbit is involved should be treated as though they have orbital cellulitis given the serious complications of this entity. Young children who are not able to cooperate for a thorough examination should also be treated as though they have orbital cellulitis. (See "Orbital cellulitis", section on 'Treatment'.)

**Antibiotic regimens** — The choice of antibiotics for empiric treatment has been made much more difficult by the emergence of community-acquired methicillin-resistant S. aureus (CA-MRSA), which now constitute a substantial proportion of community-acquired strains of S. aureus. Previously, amoxicillin-clavulanic acid, cefpodoxime, and cefdinir were excellent choices. However, these agents do not have activity against CA-MRSA. Orally administered drugs that have good activity against most strains of CA-MRSA include trimethoprim-sulfamethoxazole, clindamycin, and tetracyclines (eg, doxycycline). However, trimethoprim-sulfamethoxazole and doxycycline are not reliably effective for
group A streptococcal infections, and doxycycline is not approved for use in children under the age of eight years, and should be used with caution in such patients.

Therefore, we suggest one of the following regimens for empiric oral treatment of preseptal cellulitis:

- **Clindamycin**
  - In children: 30 to 40 mg/kg per day in three to four equally divided doses, not to exceed 1.8 grams per day [26]
  - In adults: 300 mg every eight hours) monotherapy or
- **Trimethoprim-sulfamethoxazole** (TMP-SMX; in children: 8 to 12 mg/kg per day of the trimethoprim component divided every 12 hours; in adults: 8 mg/kg per day of the trimethoprim component divided every 8 or 12 hours [one double strength tablet contains 160 mg of trimethoprim; as examples, TMP-SMX can be given as one double strength tablet every 8 hours or two double strength tablets every 12 hours depending on the patient's weight]) plus one of the following:
  - **Amoxicillin**
    - In children: usual dosing is 45 mg/kg per day divided every 12 hours; dosing for severe infections or when penicillin-resistant *Streptococcus pneumoniae* is a concern is 80 to 100 mg/kg per day in divided doses every eight hours
    - In adults: 875 mg orally every 12 hours or
  - **Amoxicillin-clavulanic acid**
    - In children: usual dosing is 45 mg/kg per day divided every 12 hours; dosing for severe infections or when penicillin-resistant *S. pneumoniae* is a concern (using the 600 mg/5 mL suspension) is 90 mg/kg per day divided every 12 hours
    - In adults: 875 mg every 12 hours or
  - **Cefpodoxime**
    - In children <12 years of age: 10 mg/kg per day divided every 12 hours, usual maximum dose 200 mg; in children ≥12 years and adolescents: 400 mg every 12 hours
    - In adults: 400 mg every 12 hours or
  - **Cefdinir**
    - In children: 7 mg/kg twice daily, maximum daily dose 600 mg
    - In adults: 300 mg twice daily

The recommendation to use clindamycin alone is based primarily on published susceptibility data rather than on clinical efficacy data for patients with preseptal cellulitis. However, the drug has shown good efficacy for skin and soft tissue infections caused by staphylococci and streptococci [26]. (See "Treatment of skin and soft tissue infections due to methicillin-resistant *Staphylococcus aureus* in adults", section on 'Clindamycin' and "Evaluation and management of suspected methicillin-resistant *Staphylococcus aureus* skin and soft tissue infections in children".)

If the patient has not been immunized against *Haemophilus influenzae*, one of the combination regimens should be used in order to insure coverage for this organism.

Topical antibiotics have no role in the treatment of this infection.

**Response to therapy** — Preseptal cellulitis typically responds rapidly and completely to appropriate antibiotics. Outpatients whose infections fail to show signs of improvement in 24 hours should generally be hospitalized, treated with broad-spectrum intravenous antibiotics, and undergo a computed tomography (CT) scan to evaluate for orbital cellulitis and its complications. (See "Orbital cellulitis", section on 'Treatment'.)

**Duration** — There are no controlled trials evaluating the duration of antimicrobial therapy in preseptal cellulitis. Treatment recommendations are based on small case series. We generally recommend a duration of 7 to 10 days [27,28], but if signs of cellulitis persist at the end of this period, treatment should be continued until the eyelid erythema and swelling have resolved or nearly resolved.

**Recurrent preseptal cellulitis** — Preseptal cellulitis rarely recurs. When it does, it is usually due to an underlying cause that has not been diagnosed [29,30]. A case series of six patients with recurrent preseptal cellulitis, defined as three or more episodes within a one year period with complete resolution between episodes, identified the underlying cause in two
patients as environmental allergies, and in one patient each as recurrent sinusitis, herpes simplex infection, contact dermatitis to cosmetics, and Munchausen’s syndrome [29]. An anatomic abnormality of the sinuses may also predispose to recurrent preseptal cellulitis [30].

SUMMARY AND RECOMMENDATIONS — Preseptal cellulitis and orbital cellulitis involve different anatomic sites, with preseptal cellulitis referring to infections of the soft tissues anterior to the orbital septum and orbital cellulitis referring to infections posterior to it (figure 1). Orbital cellulitis involves the muscles and fat located within the orbit. Although preseptal and orbital cellulitis may be confused with one another because both can cause ocular pain and eyelid swelling and erythema, they have very different clinical implications. Preseptal cellulitis is generally a mild condition that rarely leads to serious complications, whereas orbital cellulitis may cause loss of vision and even loss of life. Orbital cellulitis can usually be distinguished from preseptal cellulitis by its clinical features (ophthalmoplegia, pain with eye movements, and proptosis) and by imaging studies; in cases in which the distinction is not clear, clinicians should treat patients as though they have orbital cellulitis. Both conditions are more common in children than in adults. (See ‘Introduction’ above and ‘Terminology’ above.)

**●** Preseptal cellulitis arises most commonly from sinusitis or a contiguous infection of the soft tissues of the face and eyelids secondary to local trauma, insect or animal bites, or foreign bodies. (See ‘Pathogenesis’ above.)

**●** The most common causes of preseptal cellulitis are *Streptococcus pneumoniae* and other streptococci, *Staphylococcus aureus* (including community-acquired methicillin-resistant *S. aureus* [CA-MRSA]), and anaerobes (table 1). (See ‘Microbiology’ above.)

**●** The diagnosis of preseptal cellulitis is based upon the history (eg, insect bite, local face and/or eyelid trauma) and physical examination. However, in cases in which there is doubt, computed tomography (CT) scanning of the orbits and sinuses can usually distinguish preseptal cellulitis from orbital cellulitis. (See ‘Diagnosis’ above.)

**●** During the initial evaluation, it is critical to distinguish preseptal cellulitis from the more serious orbital cellulitis (table 2 and table 3). Although both preseptal cellulitis and orbital cellulitis typically cause eyelid swelling and erythema, the presence of ophthalmoplegia, pain with eye movements, chemosis, and/or proptosis occur only with orbital cellulitis. (See ‘Clinical manifestations’ above.)

**●** Adults and children older than one year of age with mild preseptal cellulitis can be managed on an outpatient basis, provided that the patient has no signs of systemic toxicity and close follow-up is ensured. In these cases, we recommend treatment with oral antibiotics with activity against *S. aureus* (including MRSA) and streptococci, such as clindamycin monotherapy or combination therapy with trimethoprim-sulfamethoxazole plus one of the following agents: amoxicillin, amoxicillin-clavulanic acid, cefpodoxime, or cefdinir (Grade 2B). If the patient has not been immunized against *Haemophilus influenzae*, one of the combination regimens should be used. (See ‘Antibiotic regimens’ above.)

**●** We generally recommend a treatment duration of 7 to 10 days, but if signs of cellulitis persist at the end of this period, treatment should be continued until the erythema and swelling have resolved or nearly resolved. (See ‘Duration’ above.)

**●** Patients younger than one year of age and those who are severely ill should be admitted to the hospital and managed according to the recommendations for orbital cellulitis. Patients with subtle clinical and/or radiographic findings suggesting that the orbit is involved, as well as young children who are not able to cooperate for a thorough examination, should also be treated as though they have orbital cellulitis given the serious complications of this entity. (See ‘Orbital cellulitis’, section on ‘Treatment’.)

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REFERENCES

The orbital septum

Diagram showing the proximity of the periosteum in relation to the orbital septum. Orbital cellulitis arises posterior to the orbital septum.

**Medial wall of the left orbit (lateral wall removed)**
Note the proximity of the frontal, ethmoidal, and maxillary sinuses to the orbital space. The lamina papyracea is the thin bone wall on the surface of the ethmoid air cells.

**Venous drainage of the orbit**

![Diagram showing venous drainage of the orbit](image)

The diagram demonstrates the communication between ethmoidal sinuses, the orbit, and the cavernous sinus.
## Microbiology of preseptal and orbital cellulitis

<table>
<thead>
<tr>
<th></th>
<th>Preseptal cellulitis</th>
<th>Orbital cellulitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>104</td>
<td>227</td>
</tr>
<tr>
<td>Number of patients with</td>
<td>36</td>
<td>53</td>
</tr>
<tr>
<td>a positive culture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(except for Staphylococcus aureus)</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>Δ</td>
<td>11</td>
</tr>
<tr>
<td>MSSA</td>
<td>NR</td>
<td>3</td>
</tr>
<tr>
<td>Alpha-hemolytic streptococci (including S. pneumoniae) or non-hemolytic streptococci</td>
<td>NR</td>
<td>8</td>
</tr>
<tr>
<td>Beta-hemolytic streptococci (including S. pyogenes)</td>
<td>Δ</td>
<td>4</td>
</tr>
<tr>
<td>Streptococcus anginosus (formerly S. milleri)</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Rothia mucilaginosa</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Haemophilus parainfluenzae</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Arcanobacterium spp</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Eikenella corrodens</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Skin flora/contaminant</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Possible pathogen</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- MSSA: Methicillin-sensitive Staphylococcus aureus
- MRSA: Methicillin-resistant Staphylococcus aureus
- Possible pathogen indicates organisms that were not isolated but were found as possible pathogens.

References:
MSSA: methicillin-susceptible *Staphylococcus aureus*; MRSA: methicillin-resistant *Staphylococcus aureus*; NR: not reported.* Results are reported as the number of cultures that grew a given organism. Some cultures grew >1 organism and some patients had >1 positive culture.¶ Results are reported as number of positive cultures (rather than number of patients with a positive culture); some patients may have had >1 positive culture. Δ *Staphylococcus* spp and *Streptococcus* spp were recovered from 26 (72 percent) of cultures, but the authors did not report the number of positive cultures for individual species.◊ In McKinley, et al[3], coagulase-negative *Staphylococcus* spp was reported as a recovered organism, but in Seltz, et al[4], this organism was classified as a contaminant. We have classified it as a contaminant for both studies.§ The authors of this study classified some (but not all) sinus/orbit cultures as possible pathogens rather than true pathogens.

**Orbital cellulitis**

This young girl has erythema and edema in the preseptal area, which could be caused by either orbital or preseptal infection.
<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>Preseptal cellulitis</th>
<th>Orbital cellulitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyelid swelling with or without erythema</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Eye pain/tenderness</td>
<td>May be present</td>
<td>Yes; may cause deep eye pain</td>
</tr>
<tr>
<td>Pain with eye movements</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Proptosis</td>
<td>No</td>
<td>Usually, but may be subtle</td>
</tr>
<tr>
<td>Ophthalmoplegia +/- diplopia</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Vision impairment</td>
<td>No</td>
<td>May be present*</td>
</tr>
<tr>
<td>Chemosis</td>
<td>Rarely present</td>
<td>May be present</td>
</tr>
<tr>
<td>Fever</td>
<td>May be present</td>
<td>Usually present</td>
</tr>
</tbody>
</table>
Clinical manifestations of preseptal and orbital cellulitis studies on admission

<table>
<thead>
<tr>
<th>Study: Study design, patient population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nageswaran, et al(^a): Retrospective, children</td>
</tr>
<tr>
<td>Botting, et al(^a): Retrospective, children</td>
</tr>
<tr>
<td>Chaudhry, et al(^a): Retrospective(^b), children and adults</td>
</tr>
<tr>
<td>Sobol, et al(^a): Retrospective, children</td>
</tr>
<tr>
<td>Seltz, et al(^a): Retrospective, children</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Type of cellulitis</th>
<th>Type of cellulitis</th>
<th>Type of cellulitis</th>
<th>Type of cellulitis</th>
<th>Type of cellulitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preseptal (n = 41)</td>
<td>Orbital (n = 227)</td>
<td>Preseptal (n = 104)</td>
<td>Orbital (n = 101)</td>
<td>Preseptal (n = 94)</td>
</tr>
<tr>
<td>Age (yrs)(^c)</td>
<td>7.5 (range 0-16)</td>
<td>3.9</td>
<td>7.5</td>
<td>3.8 (range 0-16)</td>
</tr>
<tr>
<td>History of trauma*</td>
<td>Excluded</td>
<td>89 (39)</td>
<td>4 (11)</td>
<td>28</td>
</tr>
<tr>
<td>Eye pain and/or tenderness</td>
<td></td>
<td>64 (62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyelid swelling +/- erythema</td>
<td></td>
<td>104 (100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proptosis</td>
<td>25 (61)</td>
<td>2 (0.9)</td>
<td>33 (94)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Ophthalmoplegia</td>
<td>19 (46)</td>
<td>1 (0.4)</td>
<td>4 (11)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Diplopia</td>
<td>2 (0.9)</td>
<td>19 (54)</td>
<td></td>
<td>20 (77)</td>
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<tr>
<td>Vision impaired</td>
<td>0</td>
<td>1 (3)</td>
<td>3 (3)</td>
<td>3 (11)</td>
</tr>
<tr>
<td>No ophthalmologic signs (proptosis, ophthalmoplegia, visual loss)</td>
<td></td>
<td>11 (27)</td>
<td></td>
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<tr>
<td>Chemosis</td>
<td></td>
<td></td>
<td></td>
<td>10 (11)</td>
</tr>
<tr>
<td>Fever</td>
<td>27 (66)</td>
<td>106 (47)</td>
<td>33 (94)</td>
<td>59 (59)</td>
</tr>
<tr>
<td>White blood cell</td>
<td>19 (46)</td>
<td></td>
<td></td>
<td>18 (69)</td>
</tr>
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</table>

\(^a\) Retrospective, \(^b\) Retrospective\(^b\), \(^c\) Age

<table>
<thead>
<tr>
<th>Type of syndrome</th>
<th>Nageswaran, et al(^a)</th>
<th>Botting, et al(^a)</th>
<th>Chaudhry, et al(^a)</th>
<th>Sobol, et al(^a)</th>
<th>Seltz, et al(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of trauma*</td>
<td>Excluded</td>
<td>89 (39)</td>
<td>4 (11)</td>
<td>28</td>
<td>Excluded</td>
</tr>
<tr>
<td>Eye pain and/or tenderness</td>
<td></td>
<td>64 (62)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyelid swelling +/- erythema</td>
<td></td>
<td>104 (100)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proptosis</td>
<td>25 (61)</td>
<td>2 (0.9)</td>
<td>33 (94)</td>
<td>1 (1)</td>
<td>36 (38)</td>
</tr>
<tr>
<td>Ophthalmoplegia</td>
<td>19 (46)</td>
<td>1 (0.4)</td>
<td>4 (11)</td>
<td>1 (1)</td>
<td>45 (48)</td>
</tr>
<tr>
<td>Diplopia</td>
<td>2 (0.9)</td>
<td>19 (54)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vision impaired</td>
<td>0</td>
<td>1 (3)</td>
<td>3 (3)</td>
<td>3 (11)</td>
<td>11 (12)</td>
</tr>
<tr>
<td>No ophthalmologic signs (proptosis, ophthalmoplegia, visual loss)</td>
<td>11 (27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemosis</td>
<td></td>
<td></td>
<td></td>
<td>10 (11)</td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>27 (66)</td>
<td>106 (47)</td>
<td>33 (94)</td>
<td>59 (59)</td>
<td>63 (67)</td>
</tr>
<tr>
<td>White blood cell</td>
<td>19 (46)</td>
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<tr>
<td>count &gt;15,000</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sinusitis $^g$</td>
<td>21 (9)</td>
<td>32 (91)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ethmoid sinusitis</td>
<td>40 (98)</td>
<td>30 (86)</td>
<td>22 (86)</td>
<td>87 (93)</td>
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<tr>
<td>Maxillary sinusitis</td>
<td>29 (71)</td>
<td>21 (60)</td>
<td>22 (86)</td>
<td>84 (89)</td>
<td></td>
</tr>
<tr>
<td>Subperiosteal abscess</td>
<td>24 (59)</td>
<td>12 (34)</td>
<td>Δ</td>
<td>44 (47)</td>
<td></td>
</tr>
<tr>
<td>Orbital abscess</td>
<td>10 (24)</td>
<td>2 (6)</td>
<td>0</td>
<td>8 (8)</td>
<td></td>
</tr>
<tr>
<td>&gt;Surgical procedure</td>
<td>29 (71)</td>
<td>11 (5)</td>
<td>8 (23)</td>
<td>52 (50) $^3$</td>
<td>0</td>
</tr>
</tbody>
</table>

Results are reported as number of patients with a given finding (percent). * Eg, insect bites, scratches. ¶ This study involved patients referred to a tertiary care hospital in Saudi Arabia. 38.5 percent of patients were >16 years of age. Many had acute dacryocystitis, trauma, or recent surgery, which is probably why such a large proportion of patients underwent surgical procedures. Δ In this study, 12 cases of children with subperiosteal abscess were evaluated separately; these cases are not shown in the table, but the findings were similar to those with simple orbital cellulitis. Of patients with orbital cellulitis or subperiosteal abscess, 12 of 38 (32 percent) had a subperiosteal abscess; 66 percent of patients with subperiosteal abscess underwent surgery. ◇ The mean age is reported for all studies except for Seltz et al $^5$; this study reported the median age. § The ethmoid and maxillary sinuses were involved most commonly, but some patients had frontal sinusitis and/or sphenoid sinusitis; many patients had involvement of multiple sinuses.
INTRODUCTION — Orbital cellulitis is an infection involving the contents of the orbit (fat and ocular muscles). It must be distinguished from preseptal cellulitis (sometimes called periorbital cellulitis), which is an infection of the anterior portion of the eyelid. Neither infection involves the globe itself.

Although preseptal and orbital cellulitis may be confused with one another because both can cause ocular pain and eyelid swelling and erythema, they have very different clinical implications. Preseptal cellulitis is generally a mild condition that rarely leads to serious complications, whereas orbital cellulitis may cause loss of vision and even loss of life. Orbital cellulitis can usually be distinguished from preseptal cellulitis by its clinical features (ophthalmoplegia, pain with eye movements, and proptosis) and by imaging studies; in cases in which the distinction is not clear, clinicians should treat patients as though they have orbital cellulitis. Both conditions are more common in children than in adults, and preseptal cellulitis is much more common than orbital cellulitis.

The pathogenesis, microbiology, clinical manifestations, complications, diagnosis, and treatment of orbital cellulitis will be reviewed here. Preseptal cellulitis is discussed separately. Orbital infections caused by fungi, mainly the Mucorales (which cause mucormycosis) and Aspergillus spp, and, much more rarely, Mycobacterium tuberculosis are also presented separately. (See "Preseptal cellulitis" and "Mucormycosis (zygomycosis)" and "Epidemiology and clinical manifestations of invasive aspergillosis" and "Tuberculosis and the eye".)

TERMINOLOGY — Preseptal cellulitis and orbital cellulitis involve different anatomic sites, with preseptal cellulitis referring to infections of the soft tissues anterior to the orbital septum, and orbital cellulitis referring to infections posterior to it (figure 1). Orbital cellulitis involves the muscle and fat located within the orbit. Orbital cellulitis does not involve the globe. (See 'Anatomy' below and "Preseptal cellulitis", section on 'Anatomy'.)

There is some debate regarding the appropriate terminology for these infections. Some clinicians use the term "periorbital cellulitis" rather than "preseptal cellulitis" or use the terms interchangeably. We prefer the term "preseptal cellulitis" to make a clear distinction between this infection and the more serious infection, "orbital cellulitis." Orbital cellulitis is sometimes referred to as "postseptal cellulitis"; we favor the term "orbital cellulitis," and will use it throughout this topic.

ANATOMY — Basic familiarity with the anatomy of the eye is fundamental to understanding the pathogenesis, clinical manifestations, and complications of orbital cellulitis. The orbit is a cone-shaped structure, lying horizontally, with its apex in the skull. It is surrounded by paranasal sinuses, namely, the frontal (lying superior), ethmoid (medial) and maxillary (inferior) sinuses (figure 2). The orbit is lined by periosteum. The ethmoid sinuses are separated from the orbit by a paper-thin layer called the lamina papyracea, which contains many perforations for nerves and blood vessels as well as some natural fenestrations termed Zuckerkandl's dehiscences. The most common route of infection of the orbit is by extension from the ethmoid sinuses, presumably through these perforations.

The orbital septum is a membranous sheet that extends from the periosteum of the orbit to the tarsal plate and forms the anterior boundary of the orbital compartment (figure 1). The superior and inferior orbital veins drain blood directly into the cavernous sinus (figure 3). Because of this communication and because the inferior orbital veins are valveless, infection can pass readily from the orbit to intracranial structures [1].

EPIEIDEMIOLOGY AND PATHOGENESIS — Orbital cellulitis is much more common in young children than in older children or adults. Orbital cellulitis is an uncommon complication of bacterial rhinosinusitis, but rhinosinusitis is the source of most cases of orbital cellulitis; coexisting rhinosinusitis is present in 86 to 98 percent of cases of orbital cellulitis [2-5]. Ethmoid sinusitis and pansinusitis are the forms of rhinosinusitis most likely to lead to orbital cellulitis. (See 'Acute
sinusitis and rhinosinusitis in adults: Clinical manifestations and diagnosis" and "Acute bacterial rhinosinusitis in children: Clinical features and diagnosis", section on 'Complications'."

As has been noted above, the ethmoid sinuses are separated from the orbit by the lamina papyracea, a thin structure with many fenestrations. Computed tomography (CT) scanning often shows the predominant site of inflammation to be the medial aspect of the orbit, adjacent to the ethmoid sinuses, and subperiosteal abscesses most often occur in the same location (figure 2). (See ‘Anatomy’ above and "Preseptal cellulitis", section on ‘Anatomy’.)

Although bacterial rhinosinusitis is the most common cause of orbital cellulitis, other potential causes are:

- Ophthalmic surgery, including strabismus surgery [6], blepharoplasty [7], radial keratotomy [8], and retinal surgery.
- Peribulbar anesthesia [9,10].
- Orbital trauma with fracture or foreign body [11,12].
- Dacryocystitis [13,14]. (see "Congenital nasolacrimal duct obstruction (dacryostenosis) and dacryocystocele", section on ‘Acute dacryocystitis’)
- Infection of the teeth [15], middle ear [16], or face.
- An infected mucocele that erodes into the orbit [17].

Fungal rhinosinusitis can also lead to orbital cellulitis. (See 'Fungi and mycobacteria' below and "Fungal rhinosinusitis".)

**MICROBIOLOGY** — The causative organisms of orbital cellulitis are often difficult to identify. Cultures from the orbit are only obtained if surgical intervention is needed, usually to drain an abscess. Sinus cultures obtained during surgery can be used to guide antimicrobial therapy [18], but may not accurately reflect the pathogen(s) in the orbit. Blood cultures are sometimes positive in children, the percentages ranging from 0 to 33 percent in various retrospective series [19-23]. They are rarely positive in adults. In one series of patients with orbital cellulitis, blood cultures were positive in 33 percent of children younger than four years of age but in only 5 percent of adults [20].

**Bacteria** — The most commonly identified pathogens in orbital cellulitis are Staphylococcus aureus and streptococci (table 1) [2-4,24]. In one series of 94 children admitted to a tertiary care children's hospital with orbital cellulitis between 2004 and 2009, members of the Streptococcus anginosus (milleri) group were the most commonly identified pathogens (15 percent) followed by S. aureus (9 percent), group A beta-hemolytic streptococci (Streptococcus pyogenes, 6 percent), and Streptococcus pneumoniae (4 percent) [3]. Only one patient had methicillin-resistant S. aureus (MRSA) infection but one would expect an increasing proportion of MRSA infections given the rising prevalence of community-acquired MRSA (CA-MRSA) among strains of S. aureus. Cases of neonatal and infantile orbital cellulitis caused by CA-MRSA have been reported [25].

Uncommon causes of orbital cellulitis include Haemophilus influenzae and nonspore-forming anaerobes [24,26], Aeromonas hydrophila [27], Pseudomonas aeruginosa [28] and Eikenella corrodens [29]. H. influenzae type b, formerly an important cause of orbital cellulitis in children, has become rare with the widespread use of the vaccine [24,30,31].

Some cases of orbital cellulitis are polymicrobial, often with a combination of aerobic and anaerobic bacteria. As an example, in a study of 20 children with orbital cellulitis who had positive cultures from specimens obtained during surgery (from an orbital or subperiosteal abscess and/or a paranasal sinus), seven (35 percent) had more than one organism isolated [4]. Two small studies have observed polymicrobial infections in all patients [32,33].

**Fungi and mycobacteria** — Although most cases of orbital cellulitis are caused by bacteria, fungi, especially Mucorales (which causes mucormycosis) and Aspergillus spp can cause life-threatening, invasive orbital infections. Mucormycosis and invasive aspergillosis should be considered in patients with defects in host defenses. Mucormycosis primarily affects patients with diabetic ketoacidosis and sometimes in patients with renal acidosis. Aspergillus infection of the orbit occurs in patients with severe neutropenia or other immune deficiencies, including HIV infection. These infections are discussed briefly below and more fully elsewhere. (See ‘Diagnosis’ below and "Mucormycosis (zygomycosis)" and "Fungal rhinosinusitis" and "Epidemiology and clinical manifestations of invasive aspergillosis".)

Fungal causes of orbital cellulitis have been reported rarely in apparently immunocompetent infants [34].

Rarely, fungal pathogens other than the Mucorales or Aspergillus spp [35] or mycobacteria (especially Mycobacterium tuberculosis) cause orbital infections. (See "Tuberculosis and the eye".)
CLINICAL MANIFESTATIONS — It is important to distinguish preseptal from orbital cellulitis because the two conditions have very different clinical implications (table 2 and table 3) [2-5,36]. Both orbital cellulitis and preseptal cellulitis cause ocular pain and eyelid swelling with erythema (picture 1); in some cases of orbital cellulitis, eyelid erythema is absent. Only orbital cellulitis causes swelling and inflammation of the extraocular muscles and fatty tissues within the orbit, leading to pain with eye movements, proptosis, and ophthalmoplegia with diplopia. Chemosis (conjunctival swelling) may occasionally occur in severe cases of preseptal cellulitis, but is more common with orbital cellulitis. In both conditions, but especially in orbital cellulitis, there may be fever and peripheral leukocytosis with a predominance of neutrophils [2,37]. In a retrospective study that included 262 children, fever occurred more commonly in those with orbital cellulitis than in those with preseptal cellulitis (94 versus 47 percent) [2]. Rarely in orbital cellulitis, there may be visual impairment, and even blindness, arising from inflammation or ischemia of the optic nerve [38].

The frequencies with which the signs and symptoms of orbital and preseptal cellulitis have been reported in different studies are summarized in the table (table 2).

COMPLICATIONS — Although it is much less common than preseptal cellulitis, orbital cellulitis is a far more consequential infection because it can be sight- or even life-threatening [36,39]. It can be complicated by subperiosteal abscess, orbital abscess, vision loss, cavernous sinus thrombophlebitis, and/or brain abscess [18,36]. The most common complications of orbital cellulitis are subperiosteal abscess and orbital abscess. These complications may develop rapidly; therefore, close monitoring is indicated, with daily checks of visual acuity and assessment of the pupillary light reflex. A sluggish or absent pupillary light reflex or a relative afferent pupillary defect indicates optic nerve involvement. Any worsening of the patient's symptoms or signs should lead to a contrast-enhanced computed tomography (CT) scan of the orbits and sinuses (or repeat CT if one was done earlier) to detect an abscess. (See 'Imaging studies' below.)

Orbital cellulitis results in loss of vision in 3 to 11 percent of patients and in death in 1 to 2 percent of patients [39]. Rare complications include cavernous sinus thrombosis and central retinal artery occlusion [40,41]. These complications are discussed separately. (See "Septic dural sinus thrombosis" and "Central and branch retinal artery occlusion".)

Subperiosteal abscess — Subperiosteal abscess is a fairly common complication of orbital cellulitis, occurring in 15 to 59 percent of cases in various retrospective series (table 2) [2-4,42]. It is difficult to distinguish subperiosteal abscess from simple orbital cellulitis on clinical grounds, although marked displacement of the globe is suggestive of abscess. Orbital imaging or surgery is necessary to make the diagnosis (image 1).

In some patients, a subperiosteal abscess, arising by extension from a sinus infection, precedes orbital cellulitis [43] or occurs without orbital cellulitis. The abscess can present with minimal symptoms [44] until it ruptures into the orbit.

Subperiosteal abscesses in younger children tend to lie medially in the orbit [45], to be amenable to antibiotic treatment without surgery (when small or in the form of poorly organized phlegmons) [18,32,45], and to contain a single aerobic species [32]. Nonmedial abscesses in older children, and abscesses located superiorly (near the frontal sinus) appear to be at highest risk for intracranial abscess. Abscesses in older patients usually contain mixtures of aerobic and anaerobic microbes [33,46] and are more likely to require drainage than those in children.

Orbital abscess — Like subperiosteal abscess, orbital abscess is difficult to distinguish from uncomplicated orbital cellulitis. It has been reported in up to 24 percent of cases of orbital cellulitis (table 2) [2-5,37]. Patients with orbital abscess typically have more severe signs (proptosis, ophthalmoplegia) and symptoms (pain with eye movements) than those with uncomplicated orbital cellulitis [37].

In a retrospective cohort study that included 298 otherwise healthy children admitted to a pediatric emergency department who underwent CT scanning for suspected acute peri orbital (preseptal) or orbital cellulitis, six (2 percent) were found to have an orbital abscess [37]. Proptosis, pain with external ocular movement, and ophthalmoplegia were associated with the presence of an orbital abscess, although 51 percent of patients with abscess did not have these findings. On multivariate analysis, other factors associated with orbital abscess were a peripheral absolute neutrophil count (ANC) >10,000 per microL, absence of conjunctivitis, periorbital edema, age >3 years, and previous antibiotic therapy. (See 'Imaging studies' below.)

Extraorbital extension — Infection may rarely extend to the orbital apex, causing visual loss, or intracranially, causing epidural or subdural empyema, brain abscess, meningitis, cavernous sinus thrombosis, or dural sinus thrombosis [18]. The visual loss associated with orbital cellulitis is thought to result from any of the following processes [38]:
Optic neuritis as a result of inflammation from nearby infection
Ischemia resulting from thrombophlebitis along the orbital veins
Pressure resulting in central retinal artery occlusion

Intracranial complications may be heralded by severe headache, protracted vomiting, mental status changes and, in patients with cavernous sinus thrombosis, cranial nerve palsies. Bilateral cranial nerve palsies can be a sign of bilateral cavernous sinus thrombosis.

Intracranial extension may be more common in patients with frontal sinus involvement [18,47]; of note, frontal sinusitis does not occur in young children since the frontal sinuses do not develop until at least six years of age, and do not develop fully until mid-adolescence. (See "Acute bacterial rhinosinusitis in children: Clinical features and diagnosis", section on 'Anatomy'.)

**DIFFERENTIAL DIAGNOSIS** — The differential diagnosis of orbital cellulitis includes a range of infectious and noninfectious diseases. Although orbital cellulitis is most commonly caused by bacteria, in patients with certain risk factors, fungal pathogens (and occasionally tuberculosis) should be considered. As noted below, it is critical to distinguish preseptal cellulitis from the more serious orbital cellulitis. (See 'Diagnosis' below.)

Diseases that should be considered in the differential diagnosis of orbital cellulitis include:

- Preseptal cellulitis (See "Preseptal cellulitis").
- Mucormycosis or aspergillosis involving the orbit (See "Mucormycosis (zygomycosis)" and "Epidemiology and clinical manifestations of invasive aspergillosis").
- Cavernous sinus thrombosis (See "Septic dural sinus thrombosis", section on 'Septic cavernous sinus thrombosis'.)
- Herpes simplex or varicella zoster virus infections involving the eye (See "Herpes simplex keratitis" and "Clinical manifestations of varicella-zoster virus infection: Herpes zoster", section on 'Herpes zoster ophthalmicus'.)
- Tuberculosis involving the orbit (See "Tuberculosis and the eye").
- Endophthalmitis (See "Bacterial endophthalmitis" and "Treatment of endogenous endophthalmitis due to Candida species" and "Treatment of exogenous endophthalmitis due to Candida species" and "Treatment of endophthalmitis due to molds").
- Tumors (eg, neuroblastoma [48], rhabdomyosarcoma [49])
- Orbital pseudotumor (idiopathic orbital inflammation) and Tolosa-Hunt syndrome [50,51] (See "Tolosa-Hunt syndrome").
- Posterior scleritis [52]
- Periocular dermoid cyst [53]
- Granulomatosis with polyangiitis (Wegener's disease) of the orbit [54]
- Trauma, including insect bites
- Allergic response [55,56]
- Hordeolum (stye)
- Severe conjunctivitis [57,58]
- Mucocele
- Thrombosed orbital varix
- Graves' disease

Certain findings are suggestive of the following serious conditions:

- Cavernous sinus thrombosis should be suspected if signs of orbital inflammation (redness and swelling of the eyelids, ophthalmoplegia, decreased visual acuity) also occur in the contralateral eye. The second eye may become involved a day or two after the first eye. The cranial nerves III, IV, V₁, V₂, and VI pass through the cavernous sinus and account for many of the manifestations. In addition, there may be decreased visual acuity due to edema of the optic disc and there may be numbness over the upper face due to involvement of V₁ and V₂. These patients often have sphenoid and posterior ethmoid sinusitis. This topic is discussed in greater detail elsewhere. (See "Septic dural sinus thrombosis").
● Mucormycosis and aspergillosis arise by spread from the upper airway, especially the posterior ethmoid or sphenoid sinuses. Accordingly, they sometimes present as the “orbital apex syndrome” with ophthalmoplegia and progressive visual loss, but otherwise minimal signs of inflammation (eg, mild eyelid swelling, little or no fever). They may begin in indolent fashion, but may progress quickly to involve critical structures in the eye, nose, and brain. (See "Mucormycosis (zygomycosis)", section on ‘Rhino-orbital-cerebral mucormycosis’ and “Epidemiology and clinical manifestations of invasive aspergillosis”, section on ‘Rhinosinusitis’.)

● Endophthalmitis should be considered if visual acuity is reduced and the red reflex cannot be seen due to vitreous haze.

**DIAGNOSIS** — The diagnosis of orbital cellulitis is suspected clinically and can be confirmed by computed tomography (CT) scanning. During the initial evaluation, it is critical to distinguish preseptal cellulitis from the more serious orbital cellulitis. It is also important to look for complications of orbital cellulitis, such as subperiosteal abscess, orbital abscess, visual loss, and intracranial extension. Although both preseptal cellulitis and orbital cellulitis typically cause eyelid swelling with or without erythema, the presence of ophthalmoplegia, pain with eye movement, and/or proptosis occur only with orbital cellulitis. Another finding that is more common with orbital cellulitis, and rare or absent with preseptal cellulitis, is chemosis. Fever is more common with orbital cellulitis than with preseptal cellulitis [2,4].

It is important for an ophthalmologist to evaluate patients with suspected orbital cellulitis in order to evaluate the extraocular movements and visual acuity, and to assess for proptosis. In patients with extensive rhinosinusitis, an otolaryngologist should generally be consulted as well. (See ‘Surgery’ below.)

**Imaging studies** — The goals of imaging studies are to support the diagnosis of orbital cellulitis and to search for an abscess or other complications requiring surgical drainage. (See ‘Surgery’ below.)

**Imaging modalities** — CT scanning and magnetic resonance imaging (MRI) are useful for the diagnosis of orbital cellulitis and its complications. There are no controlled trials comparing these modalities and the choice is usually based on the availability of the test and on the clinical experience of the physicians involved. CT scanning of the orbits and sinuses is used most commonly to evaluate for possible orbital cellulitis and its complications. MRI is superior to CT scan in following the progression of soft tissue disease [59], but may not be readily available and may require sedation in young children.

When cavernous sinus thrombosis is suspected, an imaging study that includes venography should be performed, such as magnetic resonance (MR) venography or CT venography. These modalities are discussed in detail separately. MR venography is used most commonly, and would show nonfilling of the cavernous sinus in patients with cavernous sinus thrombosis. (See “Etiology, clinical features, and diagnosis of cerebral venous thrombosis”, section on ‘Diagnosis’.)

**Imaging findings** — In preseptal cellulitis, inflammation is confined to the eyelids. In orbital cellulitis, inflammation of extraocular muscles, fat stranding, and anterior displacement of the globe are common findings. It is important to note that some cases of orbital cellulitis will have subtle abnormalities by CT scan. There is almost always evidence of rhinosinusitis, most commonly ethmoid sinusitis, and the most intense inflammatory response in the orbit is often seen adjacent to the ethmoid sinus.

Subperiosteal abscesses and orbital abscesses appear as low-density collections on CT scan. Subperiosteal abscesses lie between the periosteum and the wall of the bony sinus (image 1). Both types of abscesses, but especially subperiosteal abscesses, are often found adjacent to the ethmoid sinus.

**Indications for imaging** — Whether every patient with suspected orbital cellulitis should have a CT scan is controversial [19,26,60,61]. Clinicians may be reluctant to obtain a CT scan due to concern about exposure of the pediatric patient to radiation. Guidelines for the management of orbital cellulitis from the United Kingdom offer the following indications for CT scanning: inability to assess vision; proptosis, ophthalmoplegia, bilateral edema, or deteriorating visual acuity; lack of improvement after 24 hours of administration of intravenous antibiotics; “swinging” fevers not resolving within 36 hours; or signs or symptoms of central nervous system (CNS) involvement [60].

In the study of CT scanning in children with suspected acute preseptal or orbital cellulitis described above, the presence of edema beyond the eyelid margin or an absolute neutrophil count (ANC) >10,000 cell/microL were independent risk factors for an orbital abscess; the authors concluded that the presence of either of these findings should necessitate an expedited evaluation, including emergent CT scanning [37]. (See ‘Orbital abscess’ above.)

In addition, CT scanning should be done in all patients in whom surgical drainage is being considered [5].
Based on the studies and guidelines described above, we recommend that patients with suspected orbital cellulitis with any of the following features undergo a contrast-enhanced CT scan of the orbits and sinuses:

- Proptosis
- Limitation of eye movements
- Pain with eye movements
- Double vision
- Vision loss
- Edema extending beyond the eyelid margin
- ANC >10,000 cell/microL
- Signs or symptoms of CNS involvement
- Inability to examine the patient fully (usually patients less than one year of age)
- Patients who do not begin to show improvement within 24 to 48 hours of initiating appropriate therapy

**Microbiologic studies** — Despite the low yield, we recommend obtaining blood cultures from patients with suspected orbital cellulitis before the administration of antibiotics. If surgery is performed, the material obtained should be examined by Gram stain and, in patients with risk factors for a fungal and/or mycobacterial etiology, by special stains for fungi and mycobacteria. Cultures should be done for ordinary bacterial pathogens and, depending on the circumstances, fungi and mycobacteria.

**TREATMENT**

**Antibiotic regimens** — Most patients with uncomplicated orbital cellulitis can be treated with antibiotics alone [4,5,62]. Even in patients who are initially treated with antibiotics alone, an ophthalmologist and an otolaryngologist should be consulted because the physical examination requires ophthalmologic and/or otolaryngologic expertise and surgery is sometimes required. (See ‘Surgery’ below.)

There are no randomized controlled trials evaluating empiric antibiotic regimens for the treatment of orbital cellulitis. Treatment regimens are usually empiric and designed to address the most common pathogens because, in the absence of surgical intervention, reliable culture results are difficult to obtain.

The usual choices are a parenterally administered broad-spectrum regimen aimed at S. aureus (including methicillin-resistant S. aureus [MRSA]), S. pneumoniae and other streptococci, as well as gram-negative bacilli. When intracranial extension is suspected, the regimen should also include coverage for anaerobes. Prompt treatment is important because delayed intervention can lead to loss of vision and/or other serious complications [12,18,38].

Appropriate antibiotic regimens for empiric treatment in patients with normal renal function include a combination of:

- **Vancomycin** (in children: 40 to 60 mg/kg IV per day in three or four divided doses, maximum daily dose 4 g; in adults: 30 to 60 mg/kg IV per day in two or three divided doses; the appropriate dose in adults requires measurement of a trough concentration of vancomycin) **plus** one of the following:
  - **Ceftriaxone** (in children: 50 mg/kg per dose IV once or twice per day [the higher dose should be used if intracranial extension is suspected], maximum daily dose 4 g/day; in adults: 2 g IV every 24 hours [2 g IV every 12 hours if intracranial extension is suspected]) **or**
  - **Cefotaxime** (in children: 150 to 200 mg/kg IV per day in three doses, maximum daily dose 12 g; in adults: 2 g IV every four hours) **or**
  - **Ampicillin-sulbactam** (in children: 300 mg/kg IV per day in four divided doses in children, maximum daily dose 12 g ampicillin-sulbactam [8 g ampicillin component]; in adults: 3 g IV every six hours) **or**
  - **Piperacillin-tazobactam** (in children: 240 mg/kg per day in three divided doses, maximum daily dose 16 g of piperacillin component; in adults: 4.5 g IV every six hours)

In patients with suspected intracranial extension who are being treated with ceftriaxone or cefotaxime, metronidazole (in children: 30 mg/kg IV or orally per day in divided doses every 6 hours; in adults: 500 mg IV or orally every 8 hours) should be added to include coverage for anaerobes. (See “Treatment and prognosis of bacterial brain abscess”.)

Like vancomycin, daptomycin, linezolid and telavancin also are active against MRSA, but there is little experience using them for orbital or intracranial infections. Moreover, linezolid concentrations in the central nervous system (CNS) have
been inconsistent in children and, accordingly, linezolid is not recommended for children with CNS infections [63]. Therefore, unless there is a contraindication to its use (eg, allergy), vancomycin is the preferred agent for MRSA coverage of orbital cellulitis.

Adults and children with a serious allergy to penicillins and/or cephalosporins can be treated with a combination of vancomycin and either ciprofloxacin or levofloxacin. In adults, ciprofloxacin is given at a dose of 400 mg IV twice daily (or 500 to 750 mg orally twice daily) and levofloxacin is given at a dose of 500 to 750 mg IV or orally once daily. In children, ciprofloxacin is given at a dose of 20 to 30 mg/kg per day divided every 12 hours with a maximum dose of 1.5 grams orally daily or 800 mg IV daily. Limited information regarding levofloxacin use in pediatric patients is available. Some centers recommend a dose for infants ≥6 months and children <5 years of 10 mg/kg per dose every 12 hours, and for children ≥5 years of 10 mg/kg per dose every 24 hours (maximum daily dose 500 mg).

Desensitization to a penicillin or cephalosporin may be considered in patients with a history of an IgE-mediated (anaphylactic) reaction to these agents. (See "Penicillin allergy: Immediate reactions", section on 'Desensitization'.)

If a pathogen is retrieved on cultures of blood or orbital or subperiosteal aspirates, or from sinuses from cultures obtained by endoscopic sinus surgery, treatment should be modified accordingly. For example, if a methicillin-susceptible strain of S. aureus (MSSA) is recovered, treatment should be changed from vancomycin to oxacillin or nafcillin (in children: 100 to 200 mg/kg/day in divided doses every six hours, maximum daily dose 12 g; in adults: 2 g IV every four hours) because these agents are more rapidly bactericidal for MSSA than vancomycin. Because these infections are often polymicrobial, broad-spectrum therapy is usually continued until anaerobic culture data are available, usually for approximately five days after collection.

Response to therapy — Patients should begin to show improvement within 24 to 48 hours of initiating appropriate therapy; if this does not occur, repeat imaging should be performed to search for an abscess or another indication for surgery. (See 'Surgery' below.)

Duration and switch to oral therapy — There have been no controlled trials to define the optimal duration of antimicrobial therapy in orbital cellulitis or when to switch from intravenous to oral treatment. For patients with uncomplicated orbital cellulitis (ie, without abscess or other complications) whose infection responds well, it is reasonable to switch to oral therapy. We generally switch to oral therapy after the patient is afebrile and the eyelid and orbital findings have begun to resolve substantially, which usually takes three to five days. When a range of doses can be used for an oral antibiotic, we favor the higher end of the dose range if penicillin-resistant Streptococcus pneumoniae is a concern.

If there are no definitive culture data, appropriate empiric oral regimens include:

● **Clindamycin** (for adults: 300 mg every eight hours; for children: 30 to 40 mg/kg per day in three to four equally divided doses, not to exceed 1.8 grams per day) alone [64].

● Either clindamycin or trimethoprim-sulfamethoxazole (for adults: 1 to 2 double strength tablets every 12 hours; for children: 10 to 12 mg/kg per day of the trimethoprim component divided every 12 hours) PLUS one of the following:
  
  • **Amoxicillin**
    
    - For adults: 875 mg orally every 12 hours
    
    - For children: the dose range is 45 mg/kg per day (in divided doses every 12 hours) to 80 to 100 mg/kg per day in divided doses every eight hours (maximum dose 500 mg/dose) or
  
  • **Amoxicillin**-clavulanic acid
    
    - For adults: 875 mg every 12 hours
    
    - For children: the dose range is 40 to 45 mg/kg per day (in divided doses every 8 to 12 hours) to 90 mg/kg per day divided every 12 hours (using the 600mg/5 mL suspension) or
  
  • **Cefpodoxime**
    
    - For adults: 400 mg every 12 hours
    
    - For children: 10 mg/kg per day divided every 12 hours, not to exceed 200 mg per dose or
  
  • **Cefdinir**
    
    - For adults: 300 mg twice daily
    
    - For children: 7 mg/kg twice daily, not to exceed 600 mg/day

If definitive culture data are available, oral therapy should be directed against the infecting organism(s).
The recommendation to use clindamycin alone is based primarily on published susceptibility data rather than on clinical efficacy data for patients with orbital cellulitis. However, the drug has shown good efficacy for skin and soft tissue infections caused by staphylococci and streptococci [64]. (See "Treatment of skin and soft tissue infections due to methicillin-resistant Staphylococcus aureus in adults", section on 'Clindamycin' and "Evaluation and management of suspected methicillin-resistant Staphylococcus aureus skin and soft tissue infections in children").

In adults and children who have serious allergies to penicillins and cephalosporins, appropriate alternatives to the agents listed above are ciprofloxacin or levofloxacin. In adults, ciprofloxacin is given at a dose of 500 to 750 mg orally twice daily and levofloxacin is given at a dose of 500 to 750 mg orally once daily. In children, ciprofloxacin is given at a dose of 20 to 30 mg/kg per day divided every 12 hours with a maximum dose of 1.5 grams orally daily. Limited information regarding levofloxacin use in pediatric patients is available. Some centers recommend a levofloxacin dose for infants ≥6 months and children <5 years of 10 mg/kg per dose every 12 hours, and for children ≥5 years of 10 mg/kg per dose every 24 hours (maximum daily dose 500 mg). When a fluoroquinolone is used, it should be combined with clindamycin or trimethoprim-sulfamethoxazole to cover MRSA. Desensitization to a penicillin or cephalosporin may be considered in patients with a history of an IgE-mediated (anaphylactic) reaction to these agents. (See "Penicillin allergy: Immediate reactions", section on 'Desensitization').

For patients with uncomplicated orbital cellulitis, we suggest that antibiotics be continued until all signs of orbital cellulitis have resolved, and for a total of at least two to three weeks. A longer period (at least four weeks), is recommended for patients with severe ethmoid sinusitis and bony destruction of the sinus [26,65]. The management of the complications of orbital cellulitis is discussed separately. (See "Septic dural sinus thrombosis" and "Treatment and prognosis of bacterial brain abscess" and "Epidural abscess").

**Surgery** — The main indications for surgery are a poor response to antibiotic treatment, worsening visual acuity or pupillary changes, or evidence of an abscess, especially a large abscess (>10 mm in diameter) or one that fails to respond promptly to antibiotic treatment [66,67]. In some cases, drainage of affected sinuses is also required to control the infection. The results of cultures and susceptibility testing from samples obtained during surgery can be used to tailor therapy.

Medial subperiosteal abscesses in children often respond to medical therapy without surgery [32,45]. In one series of 68 children with subperiosteal abscess, only 21 (31 percent) underwent surgery [42]. Those undergoing surgery had, on average, larger abscesses (>10 mm in diameter). Another study also found the volume of the abscess to be an important criterion for surgery, with volumes <1250 mm³ not requiring surgery [68]. In another study in children, the degree of proptosis was the only significant predictor of the need for surgical intervention [69].

We suggest that patients with large abscesses (>10 mm in diameter) be strongly considered for surgery. Patients with smaller abscesses can generally be followed clinically and with repeat imaging unless impairment of vision is a concern. If either the clinical findings or CT scan show no improvement within 24 to 48 hours, surgical drainage is generally indicated. Surgery is almost always indicated in patients with intracranial extension of the infection. Surgery may also be indicated to obtain culture material (eg, in patients with suspected fungal or mycobacterial infection of the orbit).

External approaches (through the orbit) and endoscopic transcranular surgery have been employed [70-73]. The transcranular approach involves a lower eyelid transconjunctival incision extended medially around the lacrimal caruncle [71].

Sinus surgery is indicated for debridement in patients with severe, destructive rhinosinusitis.

**OUTCOMES** — The outcomes of orbital cellulitis depend on whether complications are present. The majority of patients with orbital cellulitis respond rapidly and completely to appropriate therapy. The most serious complications are cavernous sinus thrombosis, intracranial extension, and vision loss, which can lead to permanent sequelae and, in the case of complications in the former two, death. These complications are rare. (See 'Complications' above.)

**INFORMATION FOR PATIENTS** — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.
Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient information: Orbital cellulitis (The Basics)"

**SUMMARY AND RECOMMENDATIONS** — Orbital cellulitis is an infection involving the contents of the orbit (fat and ocular muscles). Preseptal cellulitis and orbital cellulitis involve different anatomic sites, with preseptal cellulitis referring to infections of the soft tissues anterior to the orbital septum and orbital cellulitis referring to infections posterior to it (figure 1). Although the two entities may initially be confused with one another, it is important to distinguish between them because they have very different clinical implications. Preseptal cellulitis is generally a mild condition that rarely leads to serious complications, whereas orbital cellulitis may cause loss of vision and even loss of life. Orbital cellulitis can usually be distinguished from preseptal cellulitis by its clinical features (ophthalmoplegia, pain with eye movements, and proptosis) and by imaging studies; in cases in which the distinction is not clear, clinicians should treat patients as though they have orbital cellulitis. Both conditions are more common in children than in adults. (See 'Introduction' above and 'Terminology' above.)

- The most common underlying factor that leads to orbital cellulitis is acute sinusitis, particularly ethmoid sinusitis; less common causes are ophthalmic surgery and orbital trauma. (See 'Epidemiology and pathogenesis' above.)
- Orbital cellulitis is often a polymicrobial infection. The most commonly identified pathogens in orbital cellulitis are Staphylococcus aureus and streptococci (table 1). (See 'Microbiology' above.)
- The diagnosis of orbital cellulitis is suspected clinically and can be confirmed by contrast-enhanced computed tomography (CT) scanning of the orbits and sinuses. During the initial evaluation, it is critical to distinguish preseptal cellulitis from the more serious orbital cellulitis (table 3 and table 2). It is also important to evaluate for complications of orbital cellulitis, such as subperiosteal abscess, orbital abscess, visual loss, and intracranial extension. Although both preseptal cellulitis and orbital cellulitis typically cause eyelid swelling with or without erythema, features such as ophthalmoplegia, pain with eye movements, and/or proptosis occur only with orbital cellulitis. (See 'Clinical manifestations' above and 'Diagnosis' above.)
- We recommend that patients with suspected orbital cellulitis with any of the following features undergo a contrast-enhanced CT scan of the orbits and sinuses to confirm the diagnosis of orbital cellulitis and detect potential complications:
  - Proptosis
  - Limitation of eye movements
  - Pain with eye movements
  - Double vision
  - Vision loss
  - Edema extending beyond the eyelid margin
  - Absolute neutrophil count (ANC) >10,000 cell/microL
  - Signs or symptoms of central nervous system (CNS) involvement
  - Inability to examine the patient fully (usually patients less than one year of age)
  - Patients who do not begin to show improvement within 24 to 48 hours of initiating appropriate therapy (see 'Indications for imaging' above)
- Complications of orbital cellulitis may develop rapidly and include subperiosteal and orbital abscesses, extension to the orbital apex causing vision loss, or intracranial extension causing epidural abscess or subdural empyema, intracranial abscess, meningitis, or cavernous sinus thrombosis. (See 'Complications' above.)
- For patients with orbital cellulitis, we suggest initial empiric antibiotic treatment with parenteral broad-spectrum therapy with activity against S. aureus (including methicillin-resistant S. aureus [MRSA]), streptococci, and gram-negative bacilli; this should include vancomycin plus one of the following: ampicillin-subactam-piperaclillin-tazobactam, ceftriaxone, or cefotaxime (Grade 2B). If ceftriaxone or cefotaxime is employed and there is concern for intracranial extension, we suggest that metronidazole be added to the regimen to cover anaerobes (Grade 2B). (See 'Antibiotic regimens' above.)
● Signs and symptoms should begin to show improvement within 24 to 48 hours following the initiation of appropriate therapy; if this does not occur, repeat imaging should be performed and surgery should be considered. (See 'Response to therapy' above.)

● For patients with uncomplicated orbital cellulitis, we suggest that antibiotics be continued until all signs of orbital cellulitis have resolved, and for a total of at least two to three weeks (including both intravenous and oral therapy). A longer period (at least four weeks) is recommended for patients with severe ethmoid sinusitis and bony destruction of the sinus. The management of the complications of orbital cellulitis is discussed separately. (See 'Duration and switch to oral therapy' above.)

● Although initial treatment may consist of intravenous antibiotics alone, management should be in consultation with an ophthalmologist and an otolaryngologist because the physical examination requires ophthalmic and/or otolaryngologic expertise and surgery is sometimes required. The main indications for surgery are a poor response of the infection to antibiotic treatment, worsening visual acuity or pupillary changes, or evidence of an abscess, especially a large abscess (>10 mm in diameter) or one that fails to respond promptly to antibiotic treatment. (See 'Surgery' above.)

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REFERENCES

The orbital septum

Diagram showing the proximity of the periosteum in relation to the orbital septum. Orbital cellulitis arises posterior to the orbital septum

Medial wall of the left orbit (lateral wall removed)

Note the proximity of the frontal, ethmoidal, and maxillary sinuses to the orbital space. The lamina papyracea is the thin bone wall on the surface of the ethmoid air cells
Venous drainage of the orbit

The diagram demonstrates the communication between ethmoidal sinuses, the orbit, and the cavernous sinus.

Subperiosteal abscess by CT scan

This CT scan with intravenous contrast shows a medial subperiosteal abscess associated with maxillary and ethmoid sinusitis. The arrows indicate the location of the subperiosteal abscess.