

# Preseptal and Orbital Cellulitis: A 10-Year Review of Hospitalized Patients

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**Background:** Preseptal and orbital cellulitis range in severity from minor to potentially severe complications. The purpose of this study is to describe the clinical features of patients with preseptal or orbital cellulitis in one medical center in Taiwan, and to assess the effectiveness of treatments and the complications.

**Methods:** Patients admitted between 1996 and 2005 to Taipei Veterans General Hospital under the diagnosis of preseptal or orbital cellulitis were retrospectively reviewed. The demographics, administrative history, past history, clinical presentations, treatments, and complications were analyzed.

**Results:** In total, 94 patients fulfilling the diagnostic criteria for preseptal or orbital cellulitis were identified (67 had preseptal cellulitis, 27 had orbital cellulitis). While paranasal sinus disease was the most common predisposing cause in orbital cases, skin lesions in children and dacryocystitis in adults were the most common in preseptal cases. Microbiologic investigations showed variable results, but the most common pathogen isolated was *Staphylococcus aureus*. Cultures from eye swabs and local abscesses gave the highest positive yield. Blood cultures were taken in some patients, but the positive rate was extremely low. Treatments included intravenous antibiotics alone, or intravenous antibiotics combined with surgical drainage. Only one case had permanent ocular motility impairment after removal of the orbital foreign body.

**Conclusion:** Despite the past history of potential morbidity and even mortality from orbital cellulitis, early diagnosis and prompt treatment with proper antibiotics and/or surgical intervention can achieve a good prognosis. [*J Chin Med Assoc* 2006;69(9):415–422]

**Key Words:** cellulitis, orbital, preseptal

## Introduction

Cellulitis in the orbital area is a relatively common ocular disease. It can usually be treated effectively with antibiotics. However, a delay in diagnosis and management can lead to serious complications such as vision loss, cavernous sinus thrombosis, meningitis, and sepsis.<sup>1–5</sup>

The orbital septum is the only barrier impeding spread of infection from the eyelid into the orbit. Preseptal cellulitis is marked by swelling and erythema anterior to the orbital septum. Hence, it may not be localized by the arcus marginalis, and signs and symptoms can extend to involve the upper cheek or brow

area.<sup>6</sup> On the other hand, the most distinctive features of orbital cellulitis are proptosis and limitation of ocular motility. Useful but variable additional signs are conjunctival inflammation with chemosis, orbital pain, reduced visual acuity, and afferent pupillary defect. The onset of infection is usually explosive, and a minority of patients present with profound vision loss or even blindness.<sup>7,8</sup> Subperiosteal or intraorbital abscesses may occur. Although the difference between preseptal and orbital cellulitis is usually obvious, it is sometimes difficult to distinguish them based on initial presentations alone.

The aim of this study was to review all the patients admitted to Taipei Veterans General Hospital in the

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past 10 years with a diagnosis of preseptal or orbital cellulitis in order to illustrate the clinical features, management, and treatment outcomes.

## Methods

A retrospective chart review of the medical histories of patients admitted to Taipei Veterans General Hospital with a diagnosis of preseptal or orbital cellulitis during the period January 1996 to July 2005 was made. Preseptal cellulitis was considered as inflammation and infection confined to the eyelids and orbital structures anterior to the orbital septum. Those patients with clinical or radiologic evidence involving orbital soft tissue posterior to the orbital septum were diagnosed with orbital cellulitis. The histories were reviewed to differentiate patients who had orbital cellulitis from those who had preseptal cellulitis according to the presence of more than 1 of the following clinical features: painful ophthalmoplegia (limited eye movement), proptosis (eyeball protrusion of at least 2 mm), decreased visual acuity (for at least 2 lines on the Snellen chart) or abnormal pupillary reflex (afferent pupillary defect), conjunctival chemosis, and/or any radiologic evidence of orbital (postseptal) collections or inflammation.

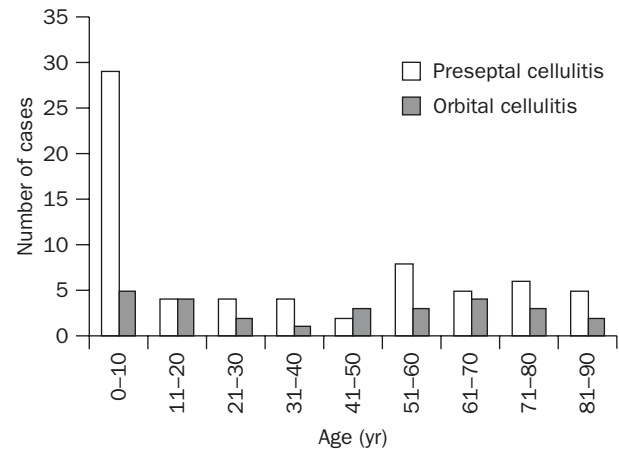
Indications for admission included poor response to oral antibiotics or systemic unwellness in patients with preseptal cellulitis. Those with the diagnosis of orbital cellulitis were also admitted. In addition, patients with neurologic signs or symptoms (e.g. drowsiness, nausea/vomiting, headaches, seizures, or cranial nerve lesion) or poor compliance who required further examinations were also hospitalized.

Radiologic study was indicated if full evaluation of the eye was not possible because of gross edema, when one could not assume that the swelling was preseptal. Patients with gross proptosis, ophthalmoplegia, deteriorating visual acuity or color vision, bilateral edema in the orbital area, or central symptoms and signs underwent computed tomography (CT) scan. Other parameters such as body temperature, complete blood cell counts, microbiologic cultures, medical and surgical treatments were reviewed. Finally, complications were recorded either on discharge or at last outpatient follow-up. Recurrence was regarded as re-admission under the same diagnosis after discharge. All cases were classified according to diagnosis (preseptal or orbital cellulitis) and patients' age (below or above 18 years). The  $\chi^2$  and Fisher's exact tests were used for statistical analysis. A  $p$  value  $< 0.05$  was considered significant.

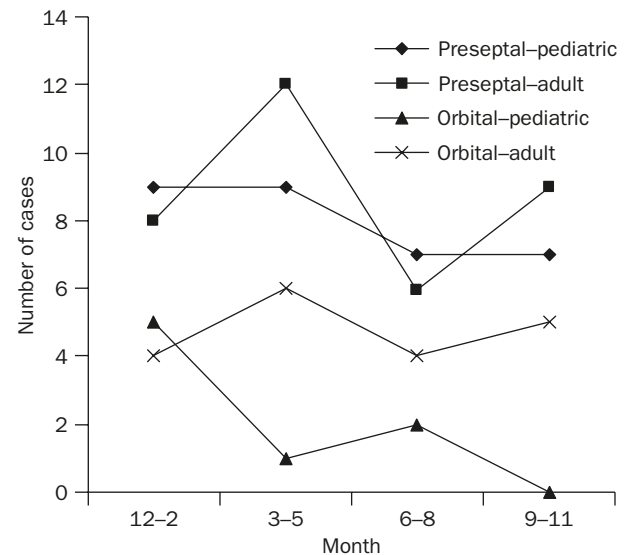
## Results

### Demographics

Sixty-seven patients with a diagnosis of preseptal cellulitis and 27 patients with a diagnosis of orbital cellulitis were identified. In the preseptal group, the mean age was 32.5 years (range, 0.1–89 years), and 32 patients (47.8%) were younger than 18 years. In the orbital group, the mean age was 41.5 years (range, 3–83 years), and 8 patients (29.6%) were younger than 18 years. Figure 1 demonstrates the age distribution of all patients. There was no gender preference noted in preseptal cellulitis (male:female = 32:35), but a male preponderance to orbital cellulitis was found (male:female = 18:9). Most cases had unilateral presentations,



**Figure 1.** A high peak incidence in the age group of 0–10 years old for preseptal cellulitis is shown.



**Figure 2.** In our study, peaks occurred in winter and spring in all groups.

except for 2 cases in the preseptal group with bilateral involvement.

As cellulitis in the orbital area has a close relationship with paranasal sinus and upper respiratory disease, a seasonal distribution paralleling that of upper respiratory tract infections might be expected. Figure 2 shows the seasonal distribution of the divided groups. In our study, peaks occurred in winter and spring.

The average length of stay was 3.8 days for pediatric preseptal cases, 7.2 days for adult preseptal cases, 11.4 days for pediatric orbital cases, and 13.8 days for adult orbital cases.

### *Predisposing factors*

In preseptal cellulitis, the most common disease in children was skin lesion such as pustule, rash, and

hordeolum; in the adult group, it was dacryocystitis. In orbital cellulitis, sinusitis was the most common predisposing factor in both pediatric and adult groups. In addition, dental problems and traumatic injuries were also important factors for cellulitis in the orbital area. The associated diseases of our patients are listed in Table 1.

### *Presentations*

Most patients presented with local symptoms (erythema, swelling, warmth, tenderness) and/or systemic illness. Blurred vision, ophthalmoplegia, proptosis, and chemosis were much more prominent but not exclusive in orbital cellulitis. However, diplopia, eyelid entropion/ectropion, and abnormal pupillary reflex were seen only in patients with orbital cellulitis.

**Table 1.** Predisposing factors to preseptal and orbital cellulitis

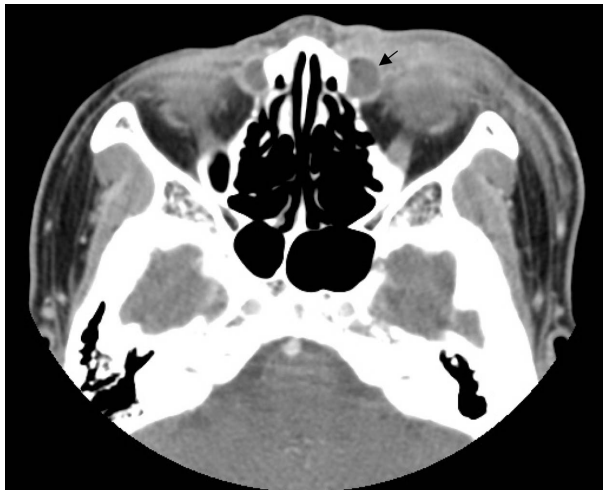
Predisposing factors	Preseptal (n=67) n (%)	Orbital (n=27) n (%)	p
Ear, nose, and throat			
Sinusitis	6 (9.0)	14 (51.9)	<0.001*
Upper respiratory infection	7 (10.4)	7 (26.0)	0.060
Otitis	1 (1.5)	0	0.713
Tumor	1 (1.5)	2 (7.4)	0.197
Face and eyelid			
Pustule/rash	13 (19.4)	0	0.009*
Hordeolum	11 (16.4)	0	0.019*
Chalazion	1 (1.5)	0	0.713
Insect bite	3 (4.5)	0	0.357
Ocular condition			
Dacryocystitis	13 (19.4)	1 (3.7)	0.045*
Dacryoadenitis	0	2 (7.4)	0.080
Endophthalmitis	0	1 (3.7)	0.287
Conjunctivitis	2 (3.0)	0	0.506
Tumor/cyst	1 (1.5)	1 (3.7)	0.494
Dental disease			
Caries	3 (4.5)	0	0.357
Periodontitis	1 (1.5)	0	0.713
Abscess	0	2 (7.4)	0.080
Systemic disease			
Diabetes	6 (9.0)	3 (11.1)	0.507
Hypertension	8 (11.9)	3 (11.1)	0.609
Malignancy	2 (3.0)	1 (3.7)	0.643
Bacteremia	1 (1.5)	1 (3.7)	0.494
Trauma			
Open wound	3 (4.5)	1 (3.7)	0.675
Orbital fracture	1 (1.5)	0	0.713
Foreign body	0	1 (3.7)	0.287
Postevisceration	0	1 (3.7)	0.287

\*p < 0.05.

**Table 2.** Presenting symptoms and signs

Presentation ranking	Symptom/sign (n)	
	Preseptal (n = 67)	Orbital (n = 27)
1	Erythematous swelling/tender warmth (67)	Erythematous swelling/tender warmth (27) Ophthalmoplegia (27)
2	Fever (41)	Chemosis (14)
3	Leukocytosis (13)	Proptosis (12)
4	Discharge/tearing (11)	CRP elevation (11)*
5	Chemosis (9)	Fever (10)
6	CRP elevation (8)*	Blurred vision (8)
7	Headache/drowsiness (5)	Headache/drowsiness (5) Leukocytosis (5)
8	Blurred vision (3) Nausea/vomiting (3)	Diplopia (4) Discharge/tearing (4)
9	Ecchymosis/hemorrhage (2) Ophthalmoplegia (2) ESR elevation (2)*	Abnormal pupillary reflex (2) Entropion/ectropion (2) ESR elevation (2)*
10	Proptosis (1)	Ecchymosis/hemorrhage (1)

\*CRP and ESR were not routinely checked in all patients; they were checked in 16 and 14 patients in the preseptal and orbital groups, respectively. CRP = C-reactive protein; ESR = erythrocyte sedimentation rate.



**Figure 3.** Computed tomography of the orbits shows preseptal cellulitis secondary to dacryocystitis. The left lacrimal sac is markedly enlarged (arrow) and the anterior orbit is opacified.



**Figure 4.** Computed tomography of the orbits demonstrates right ethmoid sinusitis with spread into the orbit (arrow). The medial rectus muscle is displaced and the right eye is proptotic.

Table 2 summarizes the ranking of these symptoms and signs at presentation.

### Investigations

CT scan of the orbits was performed in 25 patients; among them, postseptal orbital involvement was shown in 20 (80%), and 8 had an orbital abscess noted on the CT scan. Figures 3 and 4 illustrate typical cases of preseptal and orbital cellulitis, respectively.

The results of microbiologic investigation varied, with differences in the rate of testing. Table 3 shows the proportion of positive cultures according to swab

site for each of the study groups. The percentage of patients who received local or systemic culture ranged from 23.9% to 74.1%. While the positive rate of local culture was around 75%, there were only 2 patients in our study (1 preseptal, 1 orbital cellulitis) who had positive blood cultures.

### Pathogens

In those patients with a positive culture, *Staphylococcus aureus* was the most common pathogen. Coagulase-negative *Staphylococcus*, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, and *Prevotella intermedia* are

**Table 3.** Cultures by site

	Preseptal (n = 67) n (%)	Orbital (n = 27) n (%)
Local culture	35 (52.2)	20 (74.1)
Conjunctival swab	18*	7
Pus/abscess aspirate	18*	7
Sinus/nasal	0	5
Throat swab	1	1
Positive culture rate	26/35 (74.3)	15/20 (75.0)
Systemic culture	16 (23.9)	10 (37.0)
Blood	16	10 <sup>†</sup>
Cerebrospinal fluid	0	1 <sup>†</sup>
Positive culture rate	1/16 (6.3)	1/10 (10.0)

\*Two patients had both conjunctival swabs and abscess aspirate cultures;  
<sup>†</sup>1 patient had both blood and cerebrospinal fluid cultures.

relatively common pathogens of preseptal cellulitis, and the first two pathogens are also frequently responsible for orbital cellulitis. In children, only *Staphylococcus* and *Streptococcus* were identified. In adults, the pathogens varied. Multiple organisms were found in 7 patients: 5 in the preseptal adult group, 1 in the orbital pediatric group, and another 1 in the orbital adult group. Table 4 shows the numbers of each pathogen isolated for each group of patients.

### Treatments

All patients received intravenous antibiotic treatment promptly on admission. In all cases, initial treatment regimens were empirically based and instituted before the responsible organisms were identified. Most patients received a combination of first-generation cephalosporin and aminoglycoside, except in the preseptal pediatric group, where penicillinase-resistant penicillin was the initial drug of choice. Some initial regimens were changed later according to the sensitivity tests. All patients received oral antibiotics on discharge for varying periods. Table 5 sets out the numbers treated with the various antibiotics used.

Surgical intervention was more common in adults in both preseptal and orbital groups; incision and drainage was the most common procedure, accounting for 26.9% and 18.5% of patients with preseptal and orbital cellulitis, respectively. Dacryocystorhinostomy was performed in 2 patients with preseptal cellulitis secondary to dacryocystitis. Functional endoscopic sinus surgery was performed in 5 patients with orbital cellulitis secondary to paranasal sinusitis. Orbitotomy was performed in 2 patients with orbital abscess, and 1 patient with an intraorbital foreign body.

**Table 4.** Case numbers of isolated pathogens

	Preseptal (n)		Orbital (n)	
	Pediatric	Adult	Pediatric	Adult
<i>Staphylococcus aureus</i>	6	10	3	3
Coagulase(-)	1	2	3	
<i>Streptococcus pyogenes</i>	1			
<i>viridans</i>		1		1
<i>Peptostreptococcus</i>		1		
<i>Propionibacterium acne</i>		1		
<i>Corynebacterium</i>				1
Gram(+) bacillus				1
<i>Pseudomonas aeruginosa</i>		2		2
<i>Haemophilus influenzae</i>		3		
<i>Prevotella intermedia</i>		3		
<i>Escherichia coli</i>				1
<i>Alcaligenes denitrificans</i>				1
<i>Flavobacterium indologenes</i>				1
<i>Fusobacterium</i>		1		
Gram(-) bacillus		1		

### Complications

Although 5 patients (4 preseptal cellulitis, 1 orbital cellulitis) experienced recurrence, all patients eventually recovered well. The number of major complications was few. None were recorded in preseptal cases; in orbital cases, 1 child developed presumed meningitis and another had symptoms of increased intracranial pressure, which were resolved later by hyperosmotic agents. In adults with orbital cellulitis, 1 patient developed meningitis, and another suffered ophthalmoplegia after the removal of the orbital foreign body.

### Discussion

Preseptal and orbital cellulitis are two distinct disorders. Preseptal cellulitis was more frequent in our series, representing 71.3% of the medical records reviewed in this study. In contrast, orbital cellulitis is less common but considered to be a more serious infection in the orbital area, accounting for 28.7% of patients in our study. Jackson and Baker<sup>9</sup> described a similar ratio of preseptal and orbital cellulitis in his series (72% vs. 28%), which included adult patients as well. The age distribution

**Table 5.** Types of antibiotics

	Preseptal (n = 67)		Orbital (n = 27)	
	Pediatric n (%)	Adult n (%)	Pediatric n (%)	Adult n (%)
Intravenous antibiotics	32 (100)	35 (100)	8 (100)	19 (100)
Penicillin	2 (6.3)	1 (2.9)	0	0
Oxacillin	23 (71.9)	8 (22.9)	4 (50.0)	2 (10.5)
Amoxicillin	2 (6.3)	3 (8.6)	1 (12.5)	1 (5.3)
First-generation cephalosporin	2 (6.3)	18 (51.4)	3 (37.5)	14 (73.7)
Second-generation cephalosporin	1 (3.1)	0	0	0
Third-generation cephalosporin	1 (3.1)	0	0	0
Aminoglycoside	9 (28.1)	18 (51.4)	3 (37.5)	16 (84.2)
Clindamycin	1 (3.1)	1 (2.9)	0	0
Fosfomycin	0	1 (2.9)	0	0
Vancomycin	2 (6.3)	2 (5.7)	0	3 (15.8)
Oral antibiotics	32 (100)	35 (100)	8 (100)	19 (100)
Local antibiotics	16 (50.0)	27 (77.1)	6 (75.0)	16 (84.2)

curves of both preseptal and orbital cellulitis in our series showed a bimodal distribution which was mentioned in Jakobiec's article discussing orbital cellulitis.<sup>10</sup> We found higher incidences of preseptal cellulitis in the age groups of 0–10 and 51–60 years, while incidences of orbital cellulitis were slightly higher in the groups of 0–10 and 61–70 years. The peak incidence of both diseases occurred in children younger than 10 years, which has been suggested to be due to relatively incomplete immunologic development in children.<sup>10</sup>

A seasonal variation has been found by Ferguson et al<sup>11</sup> in orbital cellulitis and was attributed to the increased incidence of upper respiratory tract infection and paranasal sinusitis in the same seasons of the year. This tendency in winter was typically demonstrated in our pediatric patients with orbital cellulitis. Moreover, in other study groups, there were also smaller peaks in winter or spring, showing a seasonal preference of cellulitis in the orbital area.

Preseptal cellulitis can be caused by multiple factors, common ones being paranasal sinusitis, upper respiratory tract infection, acute or chronic otitis, dental origin, and ocular trauma.<sup>9,12</sup> Interestingly in our series, the most common predisposing factors of preseptal cellulitis were skin lesions in children and dacryocystitis in adults. Sinusitis and otitis were relatively minor factors. Based on our clinical observation, the increasing prevalence of skin atopy in children in Taiwan might be a possible consideration, and the carelessness of adult patients regarding their tearing problems resulted in delayed treatment.

Sinusitis is the most common predisposing factor for orbital cellulitis. Bacterial orbital cellulitis attributable to sinusitis is primarily a disease of the pediatric population,<sup>2,11</sup> although it can affect any age group. Sixty to 91% of patients with orbital cellulitis secondary to sinusitis has been reported.<sup>2,4,11–14</sup> In the pediatric population with orbital cellulitis due to sinusitis, ethmoidal and maxillary sinuses were the most commonly affected.<sup>2,11,15</sup> In our pediatric group of orbital cellulitis, we found that 7 of 8 (87.5%) patients had sinusitis, and the ethmoidal sinus was mostly involved, probably because of its close anatomic relationship with the orbit.

Clinical signs of postseptal orbital involvement in our study were ophthalmoplegia (100%), chemosis (51.9%), proptosis (44.4%), and decreased vision (29.6%), which suggested a diagnosis of orbital cellulitis and triggered appropriate evaluation and management.<sup>16</sup> However, in this study, chemosis was also seen in 13.4% of patients with preseptal cellulitis; Jackson and Baker<sup>17</sup> reported a similar proportion of 14%. Thus, it should be noted that conjunctival chemosis not only presents in orbital cellulitis but also in preseptal cellulitis. As long as the orbit is inflamed, either in the preseptal or postseptal region, tissue fluid can accumulate subconjunctively since local venous return is impaired.

Laboratory investigations can provide benefits to clinical assessment. The elevation of C-reactive protein (CRP) was more common in the orbital group than in the preseptal group (78.6% vs. 50.0%,  $p = 0.105$ ); in children, the difference was more significant (87.5% vs. 44.4%,  $p = 0.088$ ). Thus, CRP elevation might be



thought of as an indicator of orbital involvement, representing a more serious condition of infection and inflammation, especially in children.

One of the most frequently used investigations was bacterial culture by swab, especially that made directly from pus drainage. The effectiveness of bacteria culture by swab was demonstrated by providing evidence of infection in about half of our cases, which is consistent with a positive culture rate of 50% reported by Chang et al<sup>18</sup> in another hospital in Taiwan. As to systemic culture, only 2 patients' blood cultures were found to be positive in our samples. Previous reports seldom showed positive results from blood samples.<sup>11</sup> Since infection is usually localized in the orbit and adjacent structures, we suggest that blood samples are not necessarily required in preseptal or orbital cellulitis, unless no other predisposing factors can be found or the patient is immunocompromised.

The most important pathogens of preseptal and orbital cellulitis in our study were *Staphylococcus* species, and *Staphylococcus aureus* was the most common, which was also mentioned in Chang et al's report.<sup>18</sup> *Streptococcus* species, another group of important pathogens in orbital cellulitis, were demonstrated in Ferguson and McNab's series.<sup>11</sup> However, only 3 of our patients had cellulitis caused by *Streptococcus* species. The high variability of pathogens, including *Pseudomonas aeruginosa*, *Prevotella intermedia* (usually from dental origin), and mixed infection in adults, reflected that multiple predisposing factors were involved in the pathogenesis. *Haemophilus influenzae* has been a major pathogen in the pediatric group in previous studies.<sup>19</sup> However, in our series, only 3 cases of *Haemophilus influenzae* infection were identified in preseptal adult patients, and there were none in children. This might be a result of the general immunization of children with *Haemophilus influenzae* vaccine over the past 10 years.<sup>19</sup>

The proper prescription of effective antibiotics is a mainstay for the treatment of preseptal and orbital cellulitis.<sup>20</sup> Empirical intravenous antibiotics were given to all of our patients, prior to the identification of pathogens. Therefore, the majority of antibiotic regimens were chosen to cover a broad spectrum of bacteria, including aerobes and anaerobes. First-generation cephalosporin combined with aminoglycoside was used most frequently in adults. In children, the choice of antibiotic treatment was oxacillin, a potent antistaphylococcal penicillin. Since penicillin and amoxicillin were not effective for some isolated bacteria and oxacillin and gentamicin might encounter drug resistance in some cases, several patients were instead prescribed with second-line antibiotics, according to the sensitivity tests. Amikacin

and vancomycin, with few instances of resistance in bacterial susceptibility tests, were reserved for vision-threatening, critical, and intractable cases.

Complications resulting from preseptal and orbital cellulitis were uncommon in our study, which may be due to the timely and extensive use of antibiotics. No patient suffered permanent vision impairment, and only 1 had consequent ocular motility impairment after removal of the orbital foreign body. Meningitis, one of the most serious complications, occurred in 1 adult and 1 child. Fortunately, they recovered completely. Recurrence occurred mostly in adults with preseptal cellulitis, especially in patients with dacryocystitis, which was resolved by surgical management (dacryocystorhinostomy).

In conclusion, preseptal cellulitis is more prevalent than orbital cellulitis. The peak age in both groups is less than 10 years old. A seasonal preference of winter and spring has been demonstrated in our patients. The most common predisposing factors are skin lesions in children and dacryocystitis in adults for preseptal cellulitis, and sinusitis for orbital cellulitis. The most important pathogens causing preseptal or orbital cellulitis are *Staphylococcus* species, which are usually sensitive to first-line antibiotics. Since early diagnosis with prompt medical and surgical intervention leads to an excellent prognosis, adequately treated cellulitis in the orbital area rarely has significant morbidity today.

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