SCIE DOI: 10.14744/scie.2022.82574
South. Clin. Ist. Euras. 2022;33(4):360-365
Original Article

Preseptal and Orbital Cellulitis in Children: A Five-Year Single-Center Experience

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Submitted: 21.02.2022
Revised: 28.03.2022
Accepted: 01.04.2022

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Keywords: Children; orbital cellulitis; preseptal cellulitis; sinusitis.

ABSTRACT

Objective: Although orbital infections are one of the rare reasons for admission to Pediatric Outpatient Clinics, the differential diagnosis should be made and treatment should be started quickly due to the serious complications such as intracranial infection, vision loss, and cavernous sinus thrombosis. Our study aimed to evaluate the demographic, clinical, laboratory, and imaging findings and treatment methods of pediatric patients hospitalized and treated with preseptal and orbital cellulitis diagnosis at our center.

Methods: This retrospective study was conducted on pediatric patients hospitalized with a preseptal and orbital cellulitis diagnosis at Kartal Dr. Lütfi Kırdar City Hospital, Pediatric Outpatient Clinics and Ophthalmology Department between January 2016 and January 2021. The clinical and laboratory findings of the patients were compared.

Results: Forty patients (23 boys and 17 girls) who met the criteria over 5 years were included in the study. The mean age of the patients at the time of diagnosis was 145 (6.5–181.5) months. Thirty-five patients (87.5%) had preseptal cellulitis and five patients (12.5%) had orbital cellulitis. Paranasal sinusitis was the underlying cause in 17 (42.5%) of all cases. Twenty-eight patients (70%) were treated with ampicillin-sulbactam and seven patients (17.5%) with ceftriaxone. Cranial computerized tomography (CCT) was performed in 26 (65%) of 40 patients hospitalized for orbital infection, for both diagnosis and follow-up prognosis. Mean length of hospital stay (days) was statistically significantly lower in the preseptal cellulitis group than in the orbital cellulitis group (p=0.007).

Conclusion: In our study, sinusitis was found to be the most common predisposing factor for eyeball infections. Due to the serious complications that can develop, the differential diagnosis of preseptal and orbital cellulitis should be made quickly and treatment should be initiated immediately.

INTRODUCTION

Eyeball infections are more common in the pediatric age group than in adults.[1] Although this is one of the rare reasons for referral to Pediatric Outpatient Clinics, the differential diagnosis should be made quickly and treatment should be initiated immediately; otherwise, serious complications such as intracranial infection, vision loss, and cavernous thrombosis may ocur.[2]

Many classifications are used to describe infections of the eyeball. The Chandler classification is the most widely accepted one. Eyeball infections are classified into five different groups depending on the site of infection. These are 1th preseptal cellulitis, 2th orbital cellulitis, 3th subperiosteal abscess, 4th orbital abscess, and 5th cavernous sinus thrombosis.[3]

Preseptal cellulitis is an infection that affects skin and soft tissue of the palpebra and periorbital region that is anterior to the orbital septum. Preseptal cellulitis is more common than orbital cellulitis. Furthermore, its prognosis is better than orbital cellulitis.[4] Although preseptal cellulitis responds to antibiotic treatment, the infection rarely exceeds the orbital septum, which acts as a barrier, and spreads to the orbit and cranial structures. As a result, it causes serious complications in patients, such as intracranial infection, vision loss, and cavernous sinus thrombosis.[2] Preseptal cellulitis typically presents with redness, edema, and pain in the eyelid and periorbital tissues. Because the infection in preseptal cellulitis does not invade the orbital septum, the eyeball is not affected and vision loss is not expected. However, these symptoms may occur rarely due to late diagnosis or late initiation of treatment.

Orbital cellulitis is an infection that affects the tissue behind the orbital septum. Since it is close to the eyeball and cranial tissue, it requires prompt management to avoid serious complications.[5] In addition to the findings

seen in preseptal cellulitis, proptosis, chemosis, restricted eye movements, and decreased vision are commonly observed.[6]

The purpose of this study was to evaluate the demographic, clinical, laboratory, and imaging findings and treatment methods of pediatric patients hospitalized at our center with a diagnosis of preseptal and orbital cellulitis.

MATERIALS AND METHODS

The study was approved by the Ethics Committee of Istanbul Kartal Dr. Lütfi Kırdar City Hospital on June 22, 2021 under the number 2021/514/204/23. The study was performed in accordance with the ethical principles of the Declaration of Helsinki.

We retrospectively reviewed the medical records of 40 patients under 18 years of age hospitalized at our center with a diagnosis of orbital cellulitis and preseptal cellulitis between January 2016 and January 2021. All medical records collected from our hospital's computer database and archived patient files. Patients were diagnosed using the multidisciplinary approach of ophthalmologists, otolaryngologists, and pediatricians, in accordance with clinical and imaging findings. Study patients were divided into three groups to evaluate relevant variables: total study group, orbital cellulitis group, and preseptal cellulitis group. Patients who had only redness, edema, and pain in the eyelid and periorbital tissues were classified as preseptal cellulitis. In addition to this findings seen in preseptal cellulitis, patients with proptosis, chemosis, restricted eye movements, and decreased vision, as well as patients with retro-orbital infection findings on radiologic imaging, were diagnosed as orbital cellulitis.[7] Twenty-six of our cases were performed cranial computerized tomography (CCT) during diagnosis and follow-up of treatment.

Diagnosis, age, gender, season at the time of disease onset, admission complaint, provenance, clinical symptoms, antibiotic treatment, length of hospital stay, complications, laboratory values (leukocyte count, neutrophil count, platelet count, neutrophil/lymphocyte ratio, and C-reactive protein (CRP)), blood cultures, and radiologic findings were retrospectively evaluated from the patients files. Patients diagnosed with cellulitis whose records could not be obtained were excluded from the study.

Statistical evaluation

In this study, statistical analyses were performed using the Number Cruncher Statistical System 2007 Statistical Software (Utah, USA) package program. In addition to descriptive statistical methods (mean, standard deviation, median, and interquartile range) in data analysis, the distribution of variables was tested with the Shapiro–Wilk normality test. Independent t-test was used for comparison of normally distributed variables between paired groups, Mann–Whitney U-test for comparison of non-normally distributed variables between pairs, Chi-square, and Fisher's reality test in the comparison of qualitative data. Results were evaluated at a significance level of $p<0.05$.

RESULTS

A total of 40 pediatric patients were enrolled in the study. Of the patients, 23 (57.5%) were male and 17 (42.5%) were female. The mean age of patients hospitalized with preseptal cellulitis was 63 (29–113) months, and the mean age of patients hospitalized with orbital cellulitis was 145 (6.5–181.5) months (Table 1). There were 35 cases (87.5%) with preseptal cellulitis and five (12.5%) with orbital cellulitis (Table 1). Twenty-five patients (62.5%) had right eye involvement and 15 patients (37.5%) had left eye involvement. No statistically significant difference was observed between the mean age and gender distribution of the orbital cellulitis and preseptal cellulitis groups (Table 1) ($p=0.609$; $p=0.277$, respectively). Of all patients, eight (20%) were hospitalized in winter, 11 (27.5%) in spring, nine (22.5%) in summer, and 12 (30%) in fall (Table 1). Of the patients diagnosed with orbital cellulitis, two (40%) were hospitalized in winter, two (40%) in fall, and one (20%) in spring.

Of all cases, 17 (42.5%) had sinusitis, six (15%) had upper respiratory tract infection (URTI), five (12.5%) had trauma, five (%12.5) had dacryocystitis, three (7.5%) had insect bite, three (7.5%) had dental decays, and one (2.5%) had lacrimal duct obstruction. Of the sinus infections, four (10%) were pansinusitis and 13 (32.5%) were ethmoidal sinusitis. In four (80%) of the patients with orbital cellulitis, the underlying cause was sinusitis (Table 1). In one (20%) patient, orbital cellulitis developed after dacryocystitis. All patients complained of redness, swelling, and pain in the eye on admission. While all patients hospitalized for orbital cellulitis had proptosis and chemosis, two (5.7%) patients hospitalized for preseptal cellulitis had chemosis. The comparison of patient demographic and clinical characteristics is shown in Table 1.

The mean leukocyte count of the patients was 13493.5±4836.37/mm^3, mean neutrophil count was 7350 (3850–10935)/mm^3, mean lymphocyte count was 3105 (2125–4425)/mm^3, mean hemoglobin was 12.06±1.25g/dL, mean platelet count was 321000 (270000–403500)/mm^3, and mean CRP was 40.6 mg/dL (13.35–103.5 mg/dl). No statistically significant difference was observed between Neu/Len and CRP mean values of orbital cellulitis and preseptal cellulitis groups ($p=0.379$; $p=0.806$). Bacteria were detected in the blood culture of four (10%) of the hospitalized patients. (*Staphylococcus hominis* in three cases, *Haemophilus influenza* in one case). No statistically significant difference was observed in the distribution of culture growth presence between the orbital cellulitis and preseptal cellulitis groups ($p=0.426$). The comparison of the patients' laboratory values is given in Table 2.

In 26 (65%) of 40 patients hospitalized for orbital infection, cranial computerized tomography (CT) was performed for both diagnosis and follow-up. The patients' radiologic imaging (CCT) findings are presented in Table 3.

Table 1. Comparison of patient demographic and clinical characteristics

	Total study group	Orbital cellulitis group	Preseptal cellulitis group	p-value
Number of patients, n (%)	40 (100)	5 (12.5)	35 (87.5)	
Age (month) Median (IQR)	68 (27.5–121.25)	145 (6.5–181.5)	63 (29–113)	0.609
Age group (y), n (%)				
≤5	17 (42.5)	2 (40)	15 (42,.9)	0.904
>5	23 (57.5)	3(60)	20 (57.1)	
Season, n (%)				
Winter	8 (20)	2(40)	6(17.1)	0.434
Spring	11 (27.5)	1(20)	10 (28.6)	
Summer	9 (22.5)	0(0)	9 (25.7)	
Autumn	12 (30)	2(40)	10 (28.6)	
Eye involvement, n (%)				
Right	25 (62.5)	1 (20)	24 (68.6)	0.036
Left	15 (37.5)	4 (80)	11 (31.4)	
Examination finding, n (%)				
Redness ± Swelling ± Pain	40 (100)	5 (100)	35 (100)	
Proptosis	5 (12.5)	5 (100)	0 (0)	0.0001*
Chemosis	7 (17.5)	5 (100)	2 (5.7)	0.0001*
Etiology, n (%)				
Maxillary sinusitis	9 (22.5)	1 (20)	8 (22.7)	0.886
Frontal sinusitis	9 (22.5)	4 (80)	5 (14.3)	0.001*
Ethmoidal sinusitis	13 (32.5)	2 (40)	11 (31.4)	0.702
Upper respiratory tract infection	6 (15)	0 (0)	6 (17.1)	0.366
Dacryocystitis	5 (12.5)	1 (20)	4 (11.4)	0.507
Dental decay	3 (7.5)	0 (0)	3 (8.6)	0.999
Insect sting	3 (7.5)	0 (0)	3 (8.6)	0.999
Trauma	5 (12.5)	0 (0)	5 (14.3)	0.565
Duct obstruction	1 (2.5)	0 (0)	1 (2.9)	0.125

*Independent t-test, ⁑Mann–Whitney U test +Chi-square test ‡Fisher's Reality testIQR: interquartile range; *statistically significant, p<0.05.

Table 2. Comparison of the patients' laboratory values

	Total study group	Orbital cellulitis group	Preseptal cellulitis group	p-value
Leukocyte (/mm^3)	13493.5±4836.37	13460±3568.33	13498.29±5033.09	0.987
Hemoglobin(g/dl)	12.06±1.25	13.28±1.58	11.88±1.11	0.017*
Platelets (/mm^3)	321000 (270000-403500)	303000 (274000–637000)	328000 (266000–393000)	0.526
CRP (mg/dl)	40.6 (13.35–103.5)	74 (11–98.5)	38.2 (13–105)	0.806
Neutrophil (/mm^3)	7350 (3850–10935)	7400 (3240–8750)	7300 (3800–11000)	0.668
Lymphocyte (/mm^3)	3105 (2125–4425)	2900 (1720–6150)	3210 (2100–4200)	0.886
Neutrophil/Lymphocyte	2.343 (0.99–4.69)	1.409 (1.05–2.73)	2.457 (0.93–5)	0.379
Culturegrowth (+), n (%)	4 (10)	1 (20)	3 (8.6)	0.426

*Independent t-test, ⁑Mann–Whitney U-test +Chi-square test ‡Fisher's reality test IQR: Interquartile range; *statistically significant, p<0.05.

While ampicillin + sulbactam was used in the treatment of 28 (80%) of patients hospitalized with preseptal cellulitis, ceftriaxone was used in seven (20%) of them. Broad-spectrum and combined antibiotic drugs were preferred in the treatment of patients hospitalized with orbital cellulitis; ceftriaxone was used in two (40%) patients, vancomycin + meropenem in two (40%) patients, and vancomycin + ceftriaxone in one (20%) patient. The mean length of hospital stay and duration of intravenous antibiotic treatment in patients hospitalized for preseptal cellulitis was 7 (5–8) days, whereas the mean length of hospital stay and duration of intravenous antibiotic treatment in patients hospitalized for orbital cellulitis was 10 (8.5–28) days. The mean length of hospital stay (days) was statistically significantly lower in the preseptal cellulitis group than in the orbital cellulitis group (p=0.007).

The eye abscess developed as a complication in three patients (60%) treated for orbital cellulitis, an eye abscess

Table 3. Imaging (CCT) findings of the patients.

	Total study group	Orbital cellulitis group	Preseptal cellulitis group	p
Imaging (CCT), n (%)	26 (65)	4 (80)	22 (63)	0.452
Periorbital thickness and edema, n (%)	23 (57.5)	2 (40)	21 (60)	0.397
Sinusitis findings, n (%)	17 (42.5)	4 (80)	13 (37.1)	0.07
Arachnoid cyst, n (%)	1 (2.5)	0 (0)	1 (2.9)	0.999
Eye abscess, n (%)	4 (10)	1 (20)	3 (8.6)	0.427
Bone defect, n (%)	1 (2.5)	1 (20)	0 (0)	0.125

*Independent t-test, ⁂Mann–Whitney U-test †Chi-square test ‡Fisher's Reality test IQR: Interquartile range; *statistically significant, p<0.05. CCT: Cranial computerized tomography.

developed after treatment for preseptal cellulitis in three patients (8.5%), and meningitis developed in one patient (2.85%). No visual or neurologic sequelae were observed in our patients after treatment.

DISCUSSION

Clinical findings in eyeball infections vary from mild to severe, depending on the anatomical involvement of the infection. While preseptal cellulitis is associated with milder findings such as eyelid swelling, redness, and pain, the infection may spread beyond the orbital septum and cause more severe clinical pictures if appropriate treatment is not initiated promptly. In orbital cellulitis, in addition to the findings of preseptal cellulitis, more advanced findings such as orbital pain, chemosis, proptosis, restricted eye movements, and decreased vision are observed.[6] While preseptal cellulitis has generally favorable prognosis, orbital cellulitis can lead to serious complications such as intracranial infections, vision loss, and cavernous sinus thrombosis.[2,8]

Infections of the eyeball are more common in the pediatric age group than in adults.[1] In other studies comparable to ours, the most common age was reported between 4 months and 16 years, with a mean of 5.8 years.[9,10] The age of our patients ranged from 6 months to 17 years, similar to studies in the literature, with a mean of 68 (27.5–121.25) months.

All patients complained of swelling, redness, and pain in the eyelids at admission. While all patients hospitalized for orbital cellulitis had additional proptosis and chemosis, two (5.7%) patients hospitalized for preseptal cellulitis had chemosis. Although chemosis occurs in advanced preseptal cellulitis, it is the most common clinical finding in orbital cellulitis.[7,10] Other studies have reported this rate to be 9–14%.[7,10,11]

In eyeball infections, preseptal cellulitis is more common than orbital cellulitis.[4] While this rate was slightly lower in studies conducted with adults, an even greater increase was observed in studies conducted in the pediatric age group.[12,13] In the study published by Liu et al.[7] that included adult patients, the rate of preseptal cellulitis was 71.3%, whereas the rate of orbital cellulitis was 28.7%. In a study that included only pediatric cases, the rate of preseptal cellulitis was 88.9%, whereas the rate of orbital cellulitis was 11.1%.[10] In our study, the rate of preseptal cellulitis was 87.5% and the rate of orbital cellulitis was 12.5%.

Many studies have shown that sinus infections are the most common cause of orbital infections.[10,12,14] In turn, some of these studies have indicated that the ethmoid sinus was the most commonly involved site for paranasal sinus infections.[10,12,15] In our study, 17 (42.5%) of the patients were also found to have sinus infection. Ethmoidal sinus infection was present in 13 (32.5%) of these patients. Orbital cellulitis is seen mainly after paranasal sinus infections.[7,8,15] In our study, paranasal sinus infection was the underlying cause in four of five cases with orbital cellulitis infections. In addition, orbital infections can develop due to skin lesions, dental abscesses, insect bites, trauma, nasolacrimal duct obstruction, and URTI.[7,10,16] It developed in 17 (42.5%) patients after sinusitis, in six (15%) patients after URTI, in five (12.5%) patients after trauma, in five (12.5%) patients after dacryocystitis, in three (7.5%) patients after insect bites, in three (7.5%) patients after dental decays, and in one (2.5%) patient after nasolacrimal duct obstruction.

Although infection values (WBC and CRP) were high in our patients' blood tests, no statistically significant difference was found between the mean values of CRP, WBC, and Neu/Len in the orbital cellulitis and preseptal cellulitis groups (p>0.05). In some studies, no significant difference was observed between the two groups.[10,12] In our study, four patients had growth in the blood cultures. *S. hominis* growth was observed in the cultures of three (7.5%) of the hospitalized patients, whereas *Haemophilus influenzae* growth was observed in one (2.5%). Although *Staphylococcus species* were noted to be the most common causative agent of orbital infections in some studies, *Streptococcus pyogenes, H. influenzae, Streptococcus pneumoniae*, and anaerobic bacteria were also detected.[17] H. influenzae infections decreased dramatically with the introduction of the vaccine. In our study, *S. hominis* was the most common cause and *H. influenzae* was the second most common cause.

CT is the preferred imaging modality when examining a patient with orbital infection. It shows us the presence of si-

nusitis as well as complications such as orbital abscess and subperiosteal abscess.[18,19] Contrast-enhanced imaging CT is recommended for patients who do not improve despite intravenous antibiotic therapy, who cannot undergo an eye examination, and whose vision level cannot be assessed.[10] Computerized tomography should have limited use in children due to the high risk of radiation. On the other hand, magnetic resonance imaging is most commonly used to evaluate soft tissues such as cavernous sinus thrombosis.[18,20] In our study, CCT imaging was performed in 26 (65%) of our 40 patients, and paranasal sinusitis was detected in 17 (42.5%) and orbital abscess in four (10%) patients.

There is no standard treatment protocol for orbital infections. Because it is difficult to fully differentiate orbital infections and due to their potential complications, they should be treated as inpatients, and broad-spectrum intravenous antibiotic treatment against aerobic and anaerobic infectious agents should be initiated after cultures are obtained.[7,20] In many studies, treatment with ampicillin + sulbactam or ceftriaxone has been shown to be sufficient for the treatment of preseptal cellulitis.[21–23] In our study, all pediatric patients diagnosed with preseptal and orbital cellulitis were hospitalized and started on parenteral antibiotic treatment after cultures were taken.

While ampicillin + sulbactam was used in 28 (80%) of the patients hospitalized with preseptal cellulitis, ceftriaxone was used in seven (20%) of them. Due to the complication of orbital abscess in one patient with preseptal cellulitis and meningitis in one patient, treatment with ampicillin + sulbactam was discontinued and treatment with ceftriaxone was started. No sequelae were observed in patients after treatment. In contrast, broad-spectrum and combined antibiotic drugs should be preferred in the treatment of orbital cellulitis due to the anatomical localization and higher risk of complications. Ceftriaxone was used in two (40%) patients hospitalized for orbital cellulitis, vancomycin + meropenem in two (40%) patients, and vancomycin + ceftriaxone in one (20%) patient. In our study, the mean length of hospital stay (days) was statistically significantly lower in the preseptal cellulitis group than in the orbital cellulitis group (p=0.007). In other studies similar to our study, it was reported that the length of hospital stay of patients hospitalized for orbital cellulitis was longer.[21,23]

There is no clear opinion about the treatment in case of abscess development due to orbital infection. In some studies, parenteral antibiotic therapy has proven effective in treating small, medially located abscess cases that are less than nine years old.[24,25] In older children and adults, surgical intervention is required if the size of small abscesses has not changed within 48 h despite drug treatment, inflammation progresses very close to the optic nerve in sinus infections, abscesses are large, vision is decreased, severe proptosis and limited gaze are present, relative afferent pupillary defect occurs, gasses appear in the orbit, and dental infection is present.[14] In our study, a total of six patients developed abscess, five (83.3%) patients underwent surgical drainage, and one (16.7%) patient responded to treatment after a change of antibiotic and surgical drainage was not required.

CONCLUSION

Preseptal cellulitis is more common than orbital cellulitis. In our study, sinusitis was found to be the most common predisposing factor for preseptal and orbital cellulitis. Follow-up of the patient during treatment is important for the early detection of potential complications and requires a multidisciplinary approach.

Ethics Committee Approval

This study approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Research Ethics Committee (Date: 22.06.2021, Decision No: 2021/514/204/23).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: M.T.K, U.K., Y.Ç., S.M., A.K., C.Ç., B.Y., Y.A.; Design: M.T.K, U.K., Y.Ç., S.M., A.K., C.Ç., B.Y., Y.A.; Supervision: M.T.K, U.K., Y.Ç., S.M., A.K., C.Ç., B.Y., Y.A.; Data: M.T.K, U.K., Y.Ç., S.M.; Analysis: M.T.K, Y.Ç., A.K., C.Ç., B.Y., Y.A.; Literature search: M.T.K, U.K., Y.Ç., A.K., C.Ç., Y.A.; Writing: M.T.K, U.K., Y.Ç., Y.A.; Critical revision: M.T.K, Y.Ç., A.K., C.Ç., B.Y., Y.A.

Conflict of Interest

None declared.

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Çocuklarda Preseptal ve Orbital Selülit: Beş Yıllık Tek Merkez Deneyimi

Amaç: Göz küresi enfeksiyonları çocuk sağlığı ve hastalıkları polikliniklerine nadir başvuru sebeplerinden biri olsa da gelişebilecek intrakranial enfeksiyon, görme kaybı, kavernoz sinüs trombozu gibi ciddi komplikasyonlar nedeniyle hızlı şekilde ayırıcı tanı yapılmalı ve tedaviye başlanmalıdır. Çalışmamız, merkezimizde preseptal ve orbital selülit tanısıyla yatırılarak tedavi edilen çocuk hastaların demografik, klinik, laboratuar ve görüntüleme bulguları ve tedavi yöntemlerinin değerlendirilmesini amaçladı.

Gereç ve Yöntem: Bu geriye dönük araştırma Ocak 2016 ile Ocak 2021 arasında Kartal Dr. Lütfi Kırdar Şehir Hastanesi, Çocuk Sağlığı ve Hastalıkları ile Göz Hastalıkları Klinikleri'nde preseptal ve orbital selülit tanısıyla yatan çocuk hastalarda yapılmıştır. Hastaların klinik ve laboratuvar bulguları karşılaştırılmıştır.

Bulgular: Çalışmaya beş yıl içinde, kriterleri karşılayan 40 hasta (23 erkek, 17 kız) dahil edildi. Hastaların tanı anında ortalama yaşı 145 (6.5–181.5) ay idi. Otuz beş hastada (%87.5) preseptal selülit, beş hastada (%12,5) orbital selülit vardı. Tüm vakaların 17'sinde (%42.5) altta yatan sebep paranazal sinüzit idi. Yirmi sekiz hasta (tümünün %70'i) ampisilin-sulbaktam ve yedi (tümünün %17.5'i) hasta seftriakson ile tedavi edilmişti. Orbita enfeksiyonu nedeniyle hastaneye yatırılan 40 hastanın 26'sında (%65) hem tanı koymak hem de prognoz takibi için kranial bilgisayarlı tomografi (KBT) çekildi. Ortalama hastanede yatış süresi (gün) preseptal selülit grubunda orbital selülit grubuna göre istatistiksel olarak anlamlı derecede daha düşüktü (p=0.007).

Sonuç: Çalışmamızda sinüzit, göz küresi enfeksiyonları için en sık predispozan faktör olarak bulundu. Gelişebilecek ciddi komplikasyonlar nedeniyle preseptal ve orbital selülit ayırıcı tanısı hızlı bir şekilde yapılmalı ve hemen tedaviye başlanmalıdır.

Anahtar Sözcükler: Çocuklar; orbital selülit; preseptal selülit; sinüzit.