Paediatric periorbital cellulitis: A 10-year retrospective case series review

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Aim: To identify the predictors of poor outcome and need for surgical management in paediatric patients with periorbital cellulitis. To assess the adherence to local guidelines in the management of periorbital cellulitis.

Methods: Retrospective descriptive analysis of clinical, laboratory and radiological characteristics of 175 paediatric periorbital cellulitis presentations at a UK teaching hospital over a 10-year period. Regression investigated correlations for continuous and categorical variables.

Results: A total of 175 paediatric presentations were diagnosed as periorbital infections over the 10-year period. Of these, 139 had pre-septal cellulitis, 27 had a subperiosteal abscess, 6 had an orbital cellulitis, 1 had an orbital abscess, 1 a cavernous sinus thrombosis and 1 an extradural abscess. Median age at presentation was 5 years (range: 1 month–17 years). In total, 169 (97%) cases received systemic antimicrobial treatment. Cross-sectional imaging occurred in 30% of cases and 18% required surgical intervention. Increasing C-reactive protein was associated with greater risk of post-septal disease and requiring surgery. The best predictors of post-septal disease in the multivariate analysis (R2 = 0.49, P = <0.001) were ophthalmoplegia (P = 0.009), proptosis (P = 0.016) and pain on eye movement (P = 0.046). Proptosis was the single most significant predictor of surgical management (R2 = 0.53, P = <0.001).

Conclusion: Multidisciplinary involvement and early medical management can improve outcomes for most patients. Those who deteriorate despite medical management should be considered for prompt imaging and surgical management to avoid serious life-threatening or sight-threatening complications.

Key words: orbital abscess; orbital cellulitis; periorbital cellulitis; periorbital infection; pre-septal cellulitis; subperiosteal abscess.

What is already known on this topic

1 Periorbital cellulitis is common in the paediatric population, it describes a group of conditions ranging from pre-septal cellulitis to cavernous sinus thrombosis and can result in sight-threatening or life-threatening consequences.
2 There is a paucity of formal guidance for the management of paediatric periorbital cellulitis.
3 Hospital protocols and guidelines vary between institutions leading to a lack of consensus on management.

What this paper adds

1 Prompt medical treatment under close observation of the multidisciplinary team is successful at monitoring the progress of patients with periorbital cellulitis. Deterioration and requirement for surgical management can be recognised early to prevent complications.
2 The presence of ‘grave eye signs’, particularly proptosis, ophthalmoplegia, chemosis, pain on eye movement and diplopia, and a raised C-reactive protein are red-flag features and should prompt clinicians to consider post-septal disease.
3 Those patients who deteriorate or fail to improve despite medical management should be considered for prompt imaging and surgical management if required to avoid serious life-threatening or sight-threatening complications.

Periorbital cellulitis is the umbrella term used to describe a group of conditions ranging from pre-septal cellulitis to cavernous sinus thrombosis using the modified Chandler’s classification.1 Pre-septal cellulitis is the most common manifestation of periorbital cellulitis. It describes localised inflammation anterior to the orbital septum and usually presents with unilateral lid oedema and erythema.1 Pre-septal cellulitis generally resolves uneventfully following conservative medical management. Post-septal disease occurs when...
inflammation affects deeper structure behind the orbital septum. It includes orbital cellulitis, subperiosteal abscess, orbital abscess and cavernous sinus thrombosis. Potential complications of peri-orbital cellulitis are rare but significant and include loss of vision, meningitis and death. The distinction between pre-septal and post-septal disease is imperative because the patient is at greater risk of sight-threatening and life-threatening complications when deeper structures are affected.2

Periorbital cellulitis is more common in the paediatric population but can affect any age. Incidence is variable ranging from 0.3 cases per month up to 8.9 in specialist Children’s Hospitals. The main predisposing factors for periorbital cellulitis include paranasal sinusitis, facial and orbital soft-tissue infections and conjunctivitis. Evidence-based management suggests timely referral to oto- laryngology, antibiotics (intravenous (IV), oral and topical), appropriate imaging and early surgical intervention when necessary. In 2017, a review of 51 UK hospitals suggested that only 45% had guidelines specifying the management of periorbital cellulitis. The review also highlighted that guidance between hospitals is very variable in their suggested antibiotic regimes, criteria for imaging and surgical management.

In this study we reviewed the clinical pathway of all paediatric patients who presented with a periorbital infection to a single teaching hospital in the UK. We aimed to identify predictors of complicated disease and need for surgical management. We have also reviewed compliance to local guidelines for the management of periorbital cellulitis.

Methods

Study design and setting

A retrospective, observational case-series review of all paediatric patients presenting to a UK teaching hospital with periorbital cellulitis between 1 January 2006 and 1 January 2016. The STROBE checklist was used to formulate the paper.

Participants

Inclusion criteria: Any patient 18 years old or younger who was diagnosed with periorbital cellulitis. Exclusion criteria: Patients over 18 years old and those who did not have a formal coded diagnosis of periorbital cellulitis.

Outcomes

Primary outcome: Risk factors predicting surgical management of periorbital cellulitis.

Secondary outcomes: Risk factors predicting complicated (post-septal) disease; compliance to current local hospital guidelines.

Variables

Full clinical notes, electronic laboratory tests and imaging were reviewed for each patient. Data on demographic information (age, gender, past medical history), baseline observations, clinical episode (predisposing factors, examination findings, investigations, surgical interventions), short-term (occurring within 1 month of initial presentation) and long-term (occurring more than 1 month after initial presentation) complications were recorded in an electronic database. During the study period, a local hospital guideline on the management of children with periorbital cellulitis was available on the hospital intranet (Fig. 1). The guideline was developed by a multidisciplinary team of ophthalmologists, otolaryngologists and paediatricians and most recently reviewed in 2015.

Statistical analysis

IBM SPSS statistics version 25 (IBM, United States) software was used to analyse data. Linear regression (Pearson correlation coefficient (RI)) examined correlations for continuous variables. Logistic regression investigated correlations for categorical variables and was reported as odds ratio (OR), 95% confidence interval (CI). Multivariate regression was used to predict post-septal disease and a requirement for surgery. P = ≤0.05 defined statistical significance.

Ethical considerations

Ethical approval was not required for this study. All patient data were fully anonymised. The study was registered with the local audit department. This study abides by the declaration of Helsinki.

Results

Participants and descriptive data

In total, there were 175 cases of periorbital cellulitis, which presented between January 2006 and January 2016. Eleven patients presented more than once in the 10-year period. Mean annual incidence was 15.9 cases per year (range: 9–26). There were 89 males and 73 females. Median age at presentation was 5 years (range: 1 month–17 years). The right eye was affected in 86 cases, the left eye in 86 and bilaterally in three. During the study period, 143 patients were admitted and treated as inpatients and 32 were treated as outpatients with open access to services if required. Average length of stay in patients managed medically was 2.2 (range: 0–10) days, whereas those who had an additional surgical intervention was 5.2 (range: 2–9) days (Table 1). In total, all cases accounted for 476 days of hospital care over 10 years.

Patient characteristics and management

Pre-septal cellulitis was diagnosed in 79.4% cases, orbital cellulitis in 3.4%, subperiosteal abscess in 15.4%, orbital abscess in 0.6%, cavernous sinus thrombosis in 0.6% and pre-septal cellulitis with an extradural abscess in 0.6%. At initial presentation, 97% of patients received input from the paediatric team, 83% from ophthalmology and 38% from otolaryngology. Input from all three specialties within the first 24 h occurred in 32% of cases. Input from otolaryngologists was sought later during the inpatient stay in 15% of cases. Only 32% of patients had management in concordance with the guidelines. The main divergence from the guideline occurred with timescales for review by ophthalmology or assessment by ENT. If you overlook the timescale factor, then 54% of patients loosely complied with the local guidelines provided.
A total of 144 patients were managed only with medical interventions and 31 required additional surgical intervention (Table 1).

Surgery was performed in 31 cases: subperiosteal abscesses (25), orbital cellulitis (3), orbital abscess (1) and pre-septal cellulitis (2) (one with an additional extradural abscess). Surgical interventions were performed after cross-sectional imaging in all cases. All patients were started on medical management before proceeding to surgical intervention. Patients received on average 2.7 (range 1–6) days of medical management before proceeding to surgery. Of the 31 cases requiring surgery, 19 underwent endoscopic sinus surgery and drainage of the abscess, 10 required combined endoscopic sinus surgery and external drainage and two had external drainage only. One patient, a 14-year-old male,  

Fig 1  Norfolk and Norwich University Hospital’s guideline for the management of paediatric periorbital infections. CAU, children assessment unit; CNS, central nervous system; CRP, c-reactive protein; CT, computed tomography; ENT, ear, nose and throat; FBC, full blood count; h, hour(s); LP, lumbar puncture; Ophth, ophthalmology; Paeds, paediatrics. †Indications for CT Scan: CNS signs, gross proptosis or ophthalmoplegia, deteriorating visual acuity, bilateral oedema, no improvement at 48 h, swinging pyrexia not resolved by 48 h.
with pre-septal cellulitis underwent endoscopic sinus surgery to treat their underlying chronic pansinusitis. One patient, a 17-year-old male, had a craniotomy and frontal sinus drainage due to a large extradural abscess.

Ancillary results

Sixty-eight percent of cases had an antecedent or current respiratory tract infection or sinusitis, 24% had an ophthalmological predisposing factor, 16.6% reported recent facial trauma or infection and 1.7% reported a previous history of periorbital cellulitis. All patients presented with periorbital oedema, 22.9% with pain on eye movement, 14.9% with chemosis, 9.7% with proptosis, 9.7% with ophthalmoplegia, 4.6% with diplopia, 1.7% with decreased visual acuity and 1.1% with loss of colour vision. Rhinorrhoea was present in 18.3% of cases and nasal obstruction in 12.6%.

Twenty-three percent were septic at presentation due to a large extradural abscess.

Most patients (169 (97%)) were treated with at least one systemic antimicrobial treatment (3% received topical antimicrobial eye drops only). One hundred and twenty-five patients were treated with IV ceftriaxone and oral or IV metronidazole (10 patients received a different combination of two antibiotics). An additional antibiotic was added for nine patients according to microbiological swab results and clinical progress. Additionally, 37.1% of patients received nasal decongestants, 12.6% nasal steroids and 32.4% antimicrobial eye drops.

Eighteen were treated as an outpatient with IV ceftriaxone and open access to the hospital if deteriorating; five were not readmitted after the initial presentation. The remaining 13 patients were treated as inpatients for several days and discharged home with daily outpatient reviews and IV antibiotics. None were readmitted or experienced short-term or long-term sequelae.

One patient with a cavernous sinus thrombosis was treated with low molecular weight heparin for 7 days whilst an inpatient and then was started on oral anticoagulation for 6 weeks. No long-term complications occurred.

Fifty-three patients underwent cross-sectional imaging; 51 (96.2%) were investigated with computed tomography of the sinuses and/or brain and two with a magnetic resonance imaging scan of the head. Imaging was performed in 31 cases due to the presence of grave eye signs or because the eye could not be assessed adequately; 18 required imaging due to clinical deterioration or symptoms not improving within 48 h.

Associations and predictors

Univariate analysis of patient characteristics and laboratory results was performed to determine which factors are associated

| Variables                        | Medical management (n = 144) | Surgical management (n = 31) |
|----------------------------------|-----------------------------|-----------------------------|
| Age, years                       | 5.4                         | 10.2                        |
| Sepsis on admission, n (%)       | 23 (16)                     | 13 (41.9)                   |
| Bloods, WCC (x 10^9/L)           | 13.47 (range 5.2–27.3)      | 15.11 (range 7–27.7)       |
| Bloods, CRP (mg/L)               | 41.2 (range 1–215)          | 104.4 (range 9–225)        |
| Grave eye symptoms, n (%)       |                             |                             |
| Proptosis                        | 0 (0)                       | 17 (54.8)                   |
| Chemosis                         | 7 (4.9)                     | 12 (38.7)                   |
| Ophthalmoplegia                  | 3 (2.1)                     | 14 (45.2)                   |
| Diplopia                         | 3 (2.1)                     | 5 (16.1)                    |
| Pain on eye movement             | 21 (14.6)                   | 19 (61.3)                   |
| Loss of colour vision            | 0 (0)                       | 2 (6.5)                     |
| Decreased visual acuity          | 0 (0)                       | 3 (9.7)                     |
| Nasal symptoms, n (%)            |                             |                             |
| Rhinorrhoea                      | 17 (11.8)                   | 15 (48.4)                   |
| Nasal obstruction                | 10 (6.9)                    | 12 (38.7)                   |
| Joint care (Paediatric/ENT/Ophthalmology), n (%) | 73 (50.7) | 31 (100) |
| Length of stay (days)            | 2.2 (range 0–10)            | 5.2 (range 2–9)            |
| Diagnosis                        |                             |                             |
| Pre-septal cellulitis            | 138                         | 1                           |
| Orbital cellulitis               | 3                           | 3                           |
| Subperiosteal abscess            | 2                           | 25                          |
| Orbital abscess                  | 0                           | 1                           |
| Cavernous sinus thrombosis       | 1                           | 0                           |
| Extradural abscess               | 0                           | 1                           |

CRP, C-reactive protein; ENT, ear, nose and throat; WCC, white cell count.

Table 1 
A comparison of periorbital cellulitis cases which required medical management only with those requiring surgical management
with post-septal disease and requiring surgery (Table 2). Multivariate regression was performed to predict post-septal disease. WCC, CRP, sepsis, proptosis, diplopia, ophthalmoplegia, chemosis, rhinorrhoea and pain on eye movement were inserted into the model. After variables were adjusted for, proptosis ($P = 0.016$), ophthalmoplegia ($P = 0.009$) and pain on eye movement ($P = 0.046$) were significant predictors of post-septal disease ($R^2 = 0.49$, $P = 0.001$). The same variables were used to predict a requirement for surgery; proptosis ($P = <0.001$) was the only significant predictor ($R^2 = 0.53$, $P = <0.001$).

### Discussion

Our case series of 175 paediatric cases of periorbital cellulitis highlighted that the overwhelming majority (79%) had pre-septal disease; these patients are younger, admitted to hospital for fewer days and rarely require surgery. Patients with post-septal disease tend to be older, admitted for longer periods of time, all required cross-sectional imaging and 85.7% required surgical management.

### Limitations

There were several limitations to our study. It was retrospective and performed at a single UK teaching hospital. Cases were identified through hospital coding so incorrectly coded cases or milder cases, which were diagnosed and managed in an outpatient setting, may have been missed. Variability of clinician reported outcomes and missing information predispose to both observer and ascertainment bias.

### Interpretation

Our incidence rate was 1.5 cases per month, which is in keeping with previous research reporting 0.3–8.9 cases per month.\(^5\,6\) Our paediatric patients with pre-septal disease were generally younger (average 5.4 years) and admitted for fewer days (2 days) or managed as outpatients with daily reviews after their initial hospital care. Those with post-septal disease were older (average 9.4 years) and required longer inpatient care (5.2 days). Basic demographics and clinical descriptors are similar in this study to published literature and we report slightly lower complication rates.\(^6\,12\)

### Predictors of poor outcome and advanced disease

Only 7% of cases with pre-septal cellulitis were septic on admission and average CRP was 38 mg/L. In comparison, 48.6% of patients with post-septal cellulitis were septic on admission and had an average CPR of 106 mg/L. Children presenting with sepsis and higher CRP are at increased risk of developing complicated disease and requiring surgery (Table 2). The association between septic clinical characteristics and raised inflammatory and infective biochemical markers with more complicated periorbital cellulitis categories has been discussed in previous literature.\(^13\,14\) Clinicians should be aware of these features and their presence should prompt early multidisciplinary involvement, medical management and in some cases, cross-sectional imaging and surgical intervention.

Thirty-nine cases had a microbiology swab taken from their eye or nose, but only 13 had a positive culture growth. Five patients were prescribed an additional antibiotic to more specifically target the cultured microorganism. It can be difficult to gain meaningful information from nasal or eye microbiology swabs due to contamination from commensal organisms.\(^15\,16\) However, identifying specific organisms where possible is important because some patients may require different antimicrobial therapy due to resistant strains or different pathogens. The use of real-time polymerase chain reaction in hospital laboratories shows promise toward improving the detection of specific microorganisms in everyday clinical practice and enabling more targeted antimicrobial therapies in the future.

‘Grave eye signs’ are well known to be positive predictors of advanced periorbital disease. We showed that ‘grave eye signs’,
particularly ophthalmoplegia (OR = 105.23 (95% CI: 13.19–840.16); \(P = 0.001\)), proptosis (OR = 22.86 (95% CI: 7.51–69.59); \(P = 0.001\)) and diplopia (OR = 15.50 (95% CI: 3.06–78.64); \(P = 0.001\)), were strongly associated with post-septal disease. After variables were adjusted for, the best predictors of post-septal disease were ophthalmoplegia, proptosis and pain on eye movement (\(R^2 = 0.49, P = 0.001\)). The presence of ‘grave eye signs’ should prompt clinicians to consider post-septal disease. These patients may require cross-sectional imaging and close observation by the multidisciplinary team.

**Predictors of surgery**

In our study, 17.8% of cases required surgical management. This is slightly higher than other published literature, which generally reports that 12–13% of patients with periorbital cellulitis require surgery.\(^{13,17,18}\) Patients requiring surgical management were generally older with an average age of 10.2 years compared to those managed medically who were 5.4 years old on average. In addition, ophthalmoplegia (OR = 37.33 (95% CI: 9.67–114.14); \(P = 0.001\)) and proptosis (OR = 33.00 (95% CI: 10.45–104.00); \(P = 0.001\)) showed a particularly strong association with requiring surgical management. Multivariate analysis showed that proptosis was a significant predictor of surgery (\(R^2 = 0.53, P = 0.001\)). This study supports previous literature, which suggested that children who are older and have ‘grave eye signs’ are more likely to require surgical intervention.\(^{13,14,18,19}\)

**Guideline adherence**

A paediatric periorbital cellulitis guideline was developed by a group of paediatricians, otolaryngologists and ophthalmologists in our hospital (Fig. 1). Compared with other guidelines,\(^{10,16,20,21}\) it emphasises early multidisciplinary care for patients. Evidence suggests that a multidisciplinary approach improves diagnosis and clinical outcomes, particularly in severe cases.\(^{6,22–23}\) Adherence to the guideline was only 52%. Only 32% of cases were assessed by all three teams within the first 24 h of admission. Input from all three teams increased during the inpatient stay to 52.6%. This is an improvement from 21.1% reported by Upile et al.\(^{6}\) Mild cases of pre-septal cellulitis in patients who do not require IV antibiotics or regular observations may not need to be seen by all sub-specialty groups. Patients with post-septal disease or pre-septal disease with any ‘grave eye sign’, sepsis or increased inflammatory makers should receive a multidisciplinary team approach. Involving otolaryngologists early is important because they can diagnose and treat nasal or paranasal causes of peri-orbital cellulitis and can provide early surgical intervention if the patient deteriorates.

**Generalisability**

We have presented a case series of 175 cases over a 10-year period. This is one of the largest case series in a single-site hospital.\(^{5,24–25}\) Whilst our case series has a large sample size, it may not be applicable to the whole of the UK.

Directly comparing results with other studies is challenging because previous studies frequently involve heterogeneous patient cohorts, which include both children and adults.\(^{5,10}\) There are few systematic reviews that focus on the management of paediatric patients with periorbital cellulitis.\(^{26}\) No randomised controlled trials to investigate the management of post-septal disease have been performed. To optimise future management decisions, an adequately powered multi-centred controlled study should be performed to determine the frequency of rare complications and to discover which characteristics predict disease progression or surgical management of periorbital cellulitis.

**Conclusion**

The presence of ‘grave eye signs’ particularly ophthalmoplegia, proptosis, chemosis, pain on eye movement and diplopia, and a raised CRP at presentation should prompt clinicians to consider post-septal disease. Furthermore, proptosis is the most specific indicator for surgical management of periorbital cellulitis. Multidisciplinary involvement and early medical management can improve outcomes for most patients. Those who deteriorate or fail to improve despite medical management should be considered for prompt imaging and surgical management to avoid serious sight-threatening and life-threatening complications. A multi-centered study would help to identify the frequencies of rare complications and other factors that affect disease progression.

**Data availability statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

**References**

1. Watts P. Preseptal and orbital cellulitis in children: A review. *J. Paediatr. Child Health* 2012; 22: 1–8.
2. Chandler JR, Langenbrunner DJ, Stevens ER. The pathogenesis of orbital complications in acute sinusitis. *Laryngoscope* 1970; 80: 1414–28.
3. Moloney JR, Badhram NJ, McRae A. The acute orbit. Preseptal (peri-orbital) cellulitis, subperiosteal abscess and orbital cellulitis due to sinusitis. *J. Laryngol. Otol. Suppl.* 1987; 12: 1–18.
4. Schramm VL, Curtin HD, Kennerdell JS. Evaluation of orbital cellulitis and results of treatment. *Laryngoscope* 1982; 92: 732–8.
5. Beech T, Robinson A, McDermott A-L, Sinha A. Paediatric periorbital cellulitis and its management. *Rhinology* 2007; 45: 47–9.
6. Upile NS, Munir N, Leong SC, Swift AC. Who should manage acute periorbital cellulitis in children? *Int. J. Pediatr. Otorhinolaryngol.* 2012; 76: 1073–7.
7. von Elm E, Altman DG, Egger M et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *J. Clin. Epidemiol.* 2008; 61: 344–9.
8. Goldstein B, Giroir B, Randolph A; International Consensus Conference on Pediatric Sepsis. International pediatric sepsis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics. *Pediatr. Crit. Care Med.* 2005; 6: 2–8.
9. Liu I-T, Kao S-C, Wang A-G, Tsai C-C, Liang C-K, Hsu W-M. Preseptal and orbital cellulitis: A 10-year review of hospitalized patients. *J. Chin. Med. Assoc.* 2006; 69: 415–22.
10. Atfeh MS, Khalil HS. Orbital infections: Five-year case series, literature review and guideline development. *J. Laryngol. Otol.* 2015; 129: 670–6.
11 Welkoborsky H-J, Graß S, Deichmüller C, Bertram O, Hinni ML. Orbital complications in children: Differential diagnosis of a challenging disease. Eur. Arch. Otorhinolaryngol. 2015; 272: 1157–63.

12 Sciarretta V, Dematté M, Farneti P et al. Management of orbital cellulitis and subperiosteal orbital abscess in pediatric patients: A ten-year review. Int. J. Pediatr. Otorhinolaryngol. 2017; 96: 72–6.

13 Mahalingam-Dhingra A, Lander L, Preciado DA, Taylormoore J, Shah RK. Orbital and periorbital infections: A national perspective. Arch. Otalaryngol. Head Neck Surg. 2011; 137: 769–73.

14 Smith JM, Bratton EM, Dewitt P, Davies BW, Hink EM, Durairaj VD. Predicting the need for surgical intervention in pediatric orbital cellulitis. Am. J. Ophthalmol. 2014; 158: 387–394.e1.

15 Mills R. Orbital and periorbital sepsis. J. Laryngol. Otol. 1987; 101: 1242–7.

16 Hauser A, Fogarasi S. Periorbital and orbital cellulitis. Pediatr. Rev. 2010; 31: 242–9.

17 Marchiano E, Raikundalia MD, Carniol ET et al. Characteristics of patients treated for orbital cellulitis: An analysis of inpatient data. Laryngoscope 2016; 126: 554–9.

18 Jiramongkolchai P, Lander DP, Kallogjeri D et al. Trend of surgery for orbital cellulitis: An analysis of state inpatient databases. Laryngoscope 2020; 130: 567–74.

19 Garcia GH, Harris GJ. Criteria for nonsurgical management of subperiosteal abscess of the orbit: Analysis of outcomes 1988–1998. Ophthalmology 2000; 107: 1454–6.

20 Howe L, Jones NS. Guidelines for the management of periorbital cellulitis/abscess. Clin. Otorhinolaryngol. Allied Sci. 2004; 29: 725–8.

21 Uzcátegui N, Warman R, Smith A, Howard CW. Clinical practice guidelines for the management of orbital cellulitis. J. Pediatr. Ophthalmol. Strabismus. 1998; 35: 73–9.

22 Gonçalves R, Menezes C, Machado R, Ribeiro I, Lemos JA. Periorbital cellulitis in children: Analysis of outcome of intravenous antibiotic therapy. Orbit 2016; 35: 175–80.

23 Lee S, Yen MT. Management of preseptal and orbital cellulitis. Saudi J. Ophthalmol. 2011; 25: 21–9.

24 Georgakopoulos CD, Eliopoulou ML, Stasinos S, Exarchou A, Pharmakakis N, Varvarigou A. Periorbital and orbital cellulitis: A 10-year review of hospitalized children. Eur. J. Ophthalmol. 2010; 20: 1066–72.

25 Santos JC, Pinto S, Ferreira S, Maia C, Alves S, da Silva V. Pediatric preseptal and orbital cellulitis: A 10-year experience. Int. J. Pediatr. Otorhinolaryngol. 2019; 120: 82–8.

26 Wong SJ, Levi I. Management of pediatric orbital cellulitis: A systematic review. Int. J. Pediatr. Otorhinolaryngol. 2018; 110: 123–9.