Praxis of Otorhinolaryngology 2026;14(3):172-178

ORIGINAL ARTICLE

Pediatric orbital complications secondary to acute rhinosinusitis: Clinical characteristics and treatment outcomes

Ahmet Adnan Cırık[1], Hüseyin Çubuk[2], Yeşim Esen Yiğit[1]

[1]*Department of Otolaryngology, Ümraniye Training and Research Hospital, İstanbul, Türkiye*
[2]*Department of Otolaryngology, Edirne Sultan 1. Murat State Hospital, Edirne, Türkiye*

ABSTRACT

Objectives: This study aimed to assess the clinical characteristics and outcomes of pediatric patients with orbital complications secondary to acute rhinosinusitis, categorized according to the Chandler classification.

Patients and Methods: This retrospective study included 27 pediatric patients diagnosed with orbital complications between January 2020 and June 2025 at Ümraniye Training and Research Hospital. Patients were categorized according to the Chandler classification, and demographic characteristics, clinical presentation, radiological findings, laboratory parameters, treatment modalities, and outcomes were evaluated.

Results: A total of 27 pediatric patients (18 males, 9 females; mean age: 7.9 ± 4.66 years; range, 2 to 17 years) who were diagnosed with orbital complications secondary to acute rhinosinusitis were included and divided into three groups according to the Chandler classification: the Chandler Stage I group (preseptal cellulitis; n = 9), the Chandler Stage II group (orbital cellulitis; n = 13), and the Chandler Stage III group (subperiosteal abscess; n = 5). Orbital cellulitis was the most frequently observed complication (48%). Patients with subperiosteal abscess demonstrated significantly longer hospital stays and follow-up periods, as well as higher leukocyte counts. Surgical drainage was required in patients with inadequate response to medical therapy or progressive visual involvement.

Conclusion: Our findings underscore the critical importance of early diagnosis, close monitoring, and the prompt initiation of appropriate treatment in preventing severe orbital and visual morbidity among pediatric patients with orbital complications secondary to acute rhinosinusitis.

Keywords: Acute rhinosinusitis, orbital cellulitis, orbital complication, pediatrics, subperiosteal abscess.

Acute rhinosinusitis is a common upper respiratory tract infection that may lead to serious complications if not treated promptly and appropriately. Among these, orbital complications are particularly important as, although rare, the spread of infection to the orbit and intracranial structures may result in significant morbidity and even mortality.[1]

Children are more susceptible to orbital complications than adults due to several anatomical and physiological factors. Incomplete sinus development, thinner and more porous bony structures, and differences in immune system function facilitate the rapid spread of infection in the pediatric population.[2] The orbital septum normally serves as a barrier to limit

Received: July 27, 2025
Accepted: August 28, 2026
Published online: September 08, 2026

Correspondence: Ahmet Adnan Cırık. MD.
E-mail: ahadnanc@gmail.com

Doi: https://doi.org/10.5606/kbbu.2026.46

Citation:
Cırık AA, Çubuk H, Esen Yiğit Y. Pediatric orbital complications secondary to acute rhinosinusitis: Clinical characteristics and treatment outcomes. Praxis Otorhinolaryngol 2026;14(3):172-178. https://doi.org/10.5606/kbbu.2026.46.

the extension of inflammation; however, once this barrier is breached, patients may present with eyelid erythema and edema, proptosis, restricted ocular motility, and visual impairment.

Chandler et al.[3] classified orbital complications into five groups according to disease severity: (1) preseptal cellulitis, presenting with eyelid edema, erythema, and tenderness without proptosis, diplopia, or restriction of ocular motility; (2) orbital cellulitis, characterized by intraorbital inflammation presenting with painful or restricted ocular motility, proptosis, and diplopia; (3) subperiosteal abscess, leading to abscess formation between the orbital wall and periosteum, typically associated with proptosis, globe displacement, and impaired ocular motility; (4) orbital abscess, presenting as diffuse intraorbital abscess characterized by marked proptosis, ophthalmoplegia, visual impairment, and elevated intraorbital pressure; and (5) cavernous sinus thrombosis, indicating intracranial spread characterized by cranial nerve palsies and altered mental status, which may be accompanied by systemic toxicity and sepsis.

The widespread use of antibiotics has reduced the incidence of sinusitis-related complications; however, orbital complications secondary to acute rhinosinusitis remain an important clinical concern. Prompt recognition and appropriate management are particularly important in children, in whom rapid disease progression may lead to serious sequelae, including vision loss and intracranial spread.[4]

Although orbital complications of acute rhinosinusitis have been well described, comparative data on the clinical characteristics and treatment outcomes of different Chandler stages in pediatric patients remain limited.[4]

In this retrospective study, pediatric patients diagnosed with orbital complications secondary to acute rhinosinusitis were evaluated according to the Chandler classification. Clinical characteristics, radiological findings, and medical and surgical treatment outcomes were analyzed. The findings were interpreted in the context of the current literature to contribute to the diagnosis, follow-up, and management of pediatric orbital complications associated with acute rhinosinusitis.

PATIENTS AND METHODS

This retrospective study was conducted at Ümraniye Training and Research Hospital, Departments of Otorhinolaryngology and Pediatrics between January 2020 and June 2025. All patients included in the study were diagnosed with orbital complications secondary to acute rhinosinusitis, and their diagnostic, treatment, and follow-up data were retrospectively reviewed. Exclusion criteria were as follows: patients with orbital complications unrelated to acute rhinosinusitis, chronic or fungal rhinosinusitis, significant immunodeficiency, previous sinonasal or orbital surgery affecting disease assessment and those with insufficient clinical or radiological data for Chandler staging were excluded. Owing to the retrospective design of the study, the requirement for informed consent was waived. The study protocol was approved by the Ümraniye Training and Research Hospital Ethics Committee (Date: March 28, 2024, Approval No. 102). The study was conducted in accordance with the principles of the Declaration of Helsinki. Acute bacterial rhinosinusitis was diagnosed according to the American Academy of Pediatrics clinical criteria,[5] based on persistent symptoms lasting more than 10 days without improvement, worsening symptoms after initial improvement, or severe onset characterized by high fever (≥ 39°C) and purulent nasal discharge for at least three consecutive days.

Orbital complications were diagnosed based on clinical ophthalmologic findings and, when indicated, radiological findings and were classified according to the Chandler classification.

Patient evaluation

All patients underwent routine otorhinolaryngological examination including nasal endoscopic evaluation, after admission. Topical anesthesia and nasal decongestants were administered before endoscopic examination to facilitate detailed assessment of the sinonasal regions. Comprehensive ophthalmologic examination, including evaluation of ocular motility, visual fields, and visual function, was performed by an ophthalmologist in all patients. Visual acuity was assessed using the Snellen chart.

Imaging and diagnostic evaluation

Paranasal sinus computed tomography (PNSCT) was performed in 24 patients to confirm the diagnosis, exclude possible differential diagnoses, and guide treatment planning. Computed tomography (CT) imaging was not performed in three patients with Chandler Stage I disease due to their favorable clinical course and rapid improvement following medical treatment. Axial, coronal and sagittal sections were used to evaluate sinus involvement, the extent of inflammation, and orbital structures. Disease staging according to the Chandler classification was based on both clinical and radiological findings.

Treatment protocol

All patients received intravenous antibiotic therapy. The antibiotics administered included ampicillin-sulbactam, ceftriaxone, clindamycin, vancomycin, and metronidazole. In addition to medical treatment, nasal steroids, nasal decongestants, and saline nasal irrigation were administered according to the standard treatment protocol. Endonasal surgical drainage was planned for patients with subperiosteal abscess or orbital cellulitis who failed to respond to medical therapy.

Data collection and analysis

All cases were analyzed in terms of age, sex, duration of hospitalization, duration of fever, follow-up period, stage of complication, involved sinuses, leukocyte (WBC) count, and C-reactive protein (CRP) levels at admission, and clinical findings.

Statistical analysis

Statistical analyses were conducted using NCSS 2007 (Number Cruncher Statistical System; Kaysville, UT, USA). Continuous variables were summarized using the mean, standard deviation, median, minimum, and maximum values, whereas categorical variables were presented as frequencies and percentages. The normality of data distributions was assessed using the Shapiro-Wilk test. Comparisons among three or more groups were performed using the Kruskal-Wallis test. When statistically significant differences were identified, post hoc pairwise comparisons were conducted using the Mann-Whitney U test with Bonferroni correction. Categorical variables were compared using Fisher's exact test. A two-sided p-value <0.05 was considered statistically significant. For Bonferroni-adjusted pairwise comparisons, the statistical significance threshold was set at $p < 0.0167$.

RESULTS

A total of 27 pediatric patients (18 males, 9 females; mean age: 7.9 ± 4.66 years; range, 2 to 17 years) who were diagnosed with orbital complications secondary to acute rhinosinusitis were included and divided into three groups according to the Chandler classification: the Chandler Stage I group (preseptal cellulitis; n = 9), the Chandler Stage II group (orbital cellulitis; n = 13), and the Chandler Stage III group (subperiosteal abscess; n = 5).

No statistically significant difference was found in age distribution among the groups ($p = 0.467$). All patients presented with periorbital swelling, erythema, and nasal discharge. Fever was present in five patients (18.5%), and vomiting was observed in one patient (3.7%). Regarding pre-admission antibiotic use, nine of 13 patients in the Chandler Stage II group had not received antibiotic therapy for sinusitis before admission, while none of the patients in the Chandler Stage I and III groups had a history of antibiotic use.

Of the nine patients presenting with Chandler Stage I disease, two were followed on an outpatient basis with oral antibiotic therapy. The remaining seven patients were hospitalized for a mean duration of 6 ± 2.45 days and received intravenous ampicillin-sulbactam therapy. Following clinical improvement, the patients were discharged with oral antibiotic treatment and scheduled for outpatient follow-up. A statistically significant difference in the length of hospital stay was observed among the groups ($p = 0.002$). Bonferroni-adjusted pairwise comparisons showed that the length of hospital stay was significantly longer in the Chandler Stage III group than in the Chandler Stage I group.

A statistically significant difference in follow-up duration was observed among the groups ($p = 0.031$). Bonferroni-adjusted post hoc analysis showed that follow-up duration was significantly longer in the Chandler Stage III group than in the Chandler Stage II group.

Fever duration differed significantly among the groups ($p = 0.036$), but no pairwise difference remained significant after Bonferroni correction. The WBC count at admission differed significantly among the groups ($p = 0.019$) and was higher in Chandler Stage III than Stage II after Bonferroni correction.

The Chandler Stage I, II, and III groups were compared in terms of clinical and biochemical parameters, and the results are summarized in Table 1.

All patients in the Chandler Stage III group underwent surgical drainage at a mean of 3.6 ± 1.5 days after hospitalization. Additionally, one patient in the Chandler Stage II group with isolated frontal sinusitis required endoscopic sinus surgery due to inadequate response to medical therapy. One patient who developed visual impairment and another who developed extraocular movement restriction one day after admission underwent surgery on the same day. A patient who developed extraocular movement restriction on the second day was also operated on that day. Another patient underwent surgery within the first day owing to epidural empyema, extensive

Table 1. Comparison of clinical and laboratory parameters between Chandler Stage II and III

	Groups						
	Chandler Stage II (n = 13)			Chandler Stage III (n = 5)			
Variables	Mean ± SD	Median	Min-Max	Mean ± SD	Median	Min-Max	*p*
Age (y)	6.85 ± 5.16	5	2-17	9.60 ± 4.04	11	4-14	0.254
Hospital stay (d)	12.0 ± 7.78	9	3-30	24.8 ± 11.95	26	10-41	**0.026**
Follow-up (d)	25.69 ± 31.43	17	0-105	88.4 ± 76.02	53	23-212	**0.012**
Fever duration (d)	0.85 ± 1.14	0	0-3	3.2 ± 2.39	2	1-7	**0.019**
CRP (mg/L)*	72.69 ± 64.29	47	6.38-215	103.79 ± 40.95	97	43-147	0.218
WBC ($\times 10^3/\mu L$)*	14.71 ± 5.44	15	7.3-23.8	23.31 ± 2.66	22.8	19.8-26	**0.007**

SD, standard deviation; *, at admission; Fisher's exact test.

subperiosteal abscess, and osteomyelitis at presentation. The remaining patients underwent surgery due to an inadequate response to medical treatment. In all Chandler Stage III cases, abscess drainage through the medial orbital wall was performed using functional endoscopic sinus surgery, and one patient additionally underwent frontal sinus trephination. In addition to the orbital complications, one patient with an epidural empyema, frontal subperiosteal abscess, and frontal osteomyelitis underwent combined surgery with the neurosurgery team, and the corresponding CT and magnetic resonance imaging (MRI) findings are shown in Figure 1. Evaluation of visual function showed that impairment was confined to the Chandler Stage III group, affecting three of five patients, whereas none of the Stage II patients were affected (p = 0.012), as shown in Figure 2. Extraocular movement limitation was also significantly more

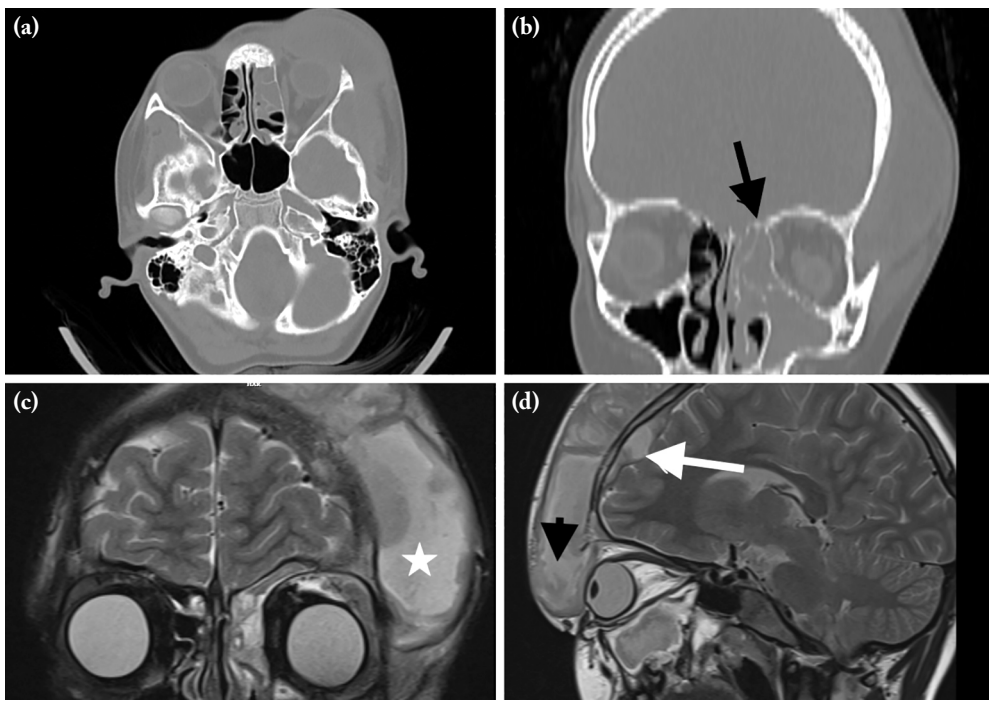

Figure 1. **(a)** Axial CT image. **(b)** Coronal CT image. **(c)** Coronal MRI image. **(d)** Sagittal MRI image. Radiological images of a patient with left-sided acute pansinusitis (b, black arrow) complicated by a preseptal abscess causing orbital compression (d, black arrowhead), an extensive frontoparietotemporal subperiosteal abscess (c, asterisk), a frontal epidural empyema (d, white arrow), and imaging findings suggestive of frontal osteomyelitis (b).
MRI, magnetic resonance imaging; CT, computed tomography.

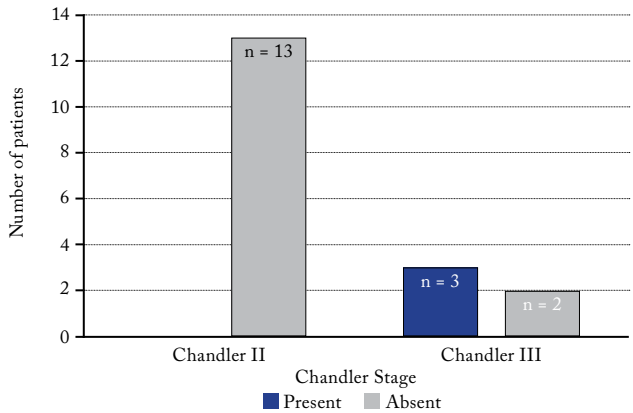

Figure 2. Visual impairment according to Chandler Stage (p = 0.012).

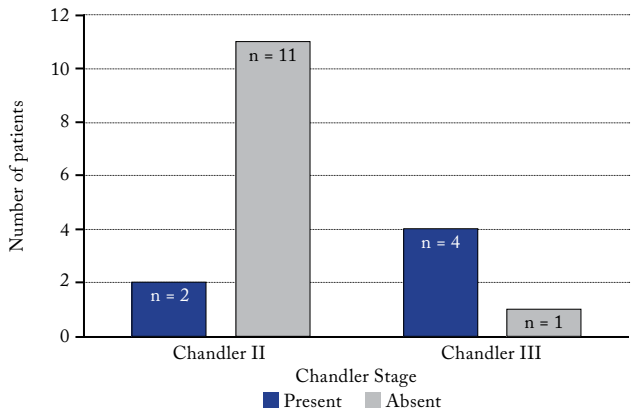

Figure 3. Extraocular movement limitation according to Chandler Stage (p = 0.022).

frequent in Stage III, occurring in four of five patients compared with two of 13 patients in Stage II (p = 0.022), as shown in Figure 3. Neither finding was observed in the Chandler Stage I group. No significant difference was observed between the groups in terms of sinus involvement on paranasal sinus CT (p > 0.05), as shown in Table 2.

DISCUSSION

Orbital complications are rare but potentially serious clinical complications of acute pediatric rhinosinusitis. The data obtained from the retrospective evaluation of 27 pediatric cases in this study are largely consistent with the findings in the literature but also reveal differences in certain clinical aspects.

In the large pediatric case series reported by Ryan et al.[6] involving 450 children, 50% of the cases were classified as preseptal cellulitis, while 35% were classified as orbital cellulitis. In contrast, in our study, preseptal cellulitis was observed less frequently (33%); orbital cellulitis (48%) and subperiosteal abscesses (19%) were observed more frequently. Consistent with our findings, Opoku-Buabeng and Yaw[7] reported orbital cellulitis as the most common orbital complication, accounting for 52.2% of all orbital complications associated with pediatric rhinosinusitis. These differences may reflect the higher proportion of complicated cases presenting to our clinic. Despite our center being a tertiary referral center for complicated cases, no orbital abscesses or other advanced orbital complications were observed in our cohort. Likewise, Zhao et al.,[4] in their systematic review and meta-analysis, reported a decreasing trend in Chandler Stage IV orbital abscess cases and noted that conservative management approaches have become increasingly prominent in studies published after 2010.

In our study, all patients in the Chandler Stage III group required surgical intervention, and these procedures were performed on average on the 3.6th day of hospitalization. This finding aligns with the emphasis in the literature on the "necessity of surgical drainage in patients unresponsive to medical treatment." Urgent surgical intervention is particularly required in cases accompanied by symptoms such as visual loss, severe ophthalmoplegia, proptosis, altered consciousness, and vomiting. Saltagi et al.[8]

Table 2. Comparison of sinus involvement between Chandler Stage II and III groups

	Groups				
	Chandler Stage II (n = 13)		Chandler Stage III (n = 5)		
Sinus involvement	Present	Absent	Present	Absent	p
Maxillary	10	3	4	1	0.701
Frontal	9	4	4	1	0.567
Ethmoid	11	2	5	0	0.510
Sphenoid	5	8	1	4	0.439

Fisher's exact test.

highlighted the importance of prompt evaluation by both otorhinolaryngology and ophthalmology specialists and stated that concerning ophthalmologic symptoms are major predictors of the need for surgical intervention. In their recent systematic review and meta-analysis, Adil et al.[9] recommended surgical intervention in patients with large abscess volumes or concerning ophthalmologic findings. They also reported that age was not a significant factor in surgical decision-making. Casanueva et al.[10] stated that age, Chandler stage, visual status, clinical progression, and CT findings should be considered in surgical decision-making. They also suggested that Chandler Stage III patients with preserved visual acuity and good general condition may be managed conservatively under close observation, whereas surgical intervention should be reserved for patients with an unfavorable clinical course or when clinically indicated. According to Saltagi et al.,[8] surgical intervention should be considered in patients with clinical deterioration, visual impairment, progressive ophthalmoplegia or proptosis, or a poor response to medical treatment.

As none of the patients in the Chandler Stage III group, and the majority of those in the Stage II group, had received antibiotic therapy before presentation, the delayed initiation of treatment may have contributed to disease progression. However, due to the retrospective nature of this study, a direct causal relationship cannot be confirmed. While routine antibiotic therapy is not recommended for all cases of acute rhinosinusitis, identifying patients who may benefit from treatment early on remains crucial. Clinicians must carefully identify patients who require early antibiotic therapy while avoiding unnecessary antibiotic use.

In our study, visual impairment was observed exclusively in the Chandler Stage III group, which is consistent with the mechanisms of increased intraorbital pressure and abscess-related compression described in previous studies. Visual impairment may result from direct abscess compression, septic optic neuritis, impaired venous drainage, or other vascular complications.[11] In our study, the limitation of extraocular movements was also found at a significantly higher rate in the Chandler Stage III group.

Radiological imaging plays a critical role in the diagnosis of these conditions. The literature recommends contrast-enhanced paranasal CT and/or MRI for cases that do not respond clinically or worsen within 24-48 h.[5] In our study, PNSCT was performed in 24 patients (89%) and was effective in establishing a definitive diagnosis and, in particular, allowed for appropriate staging according to the Chandler classification. We believe that the high imaging rate observed in our study may be attributable to our institution's role as a tertiary referral center and the higher proportion of complicated cases. In their study, Lohnherr and Baumann[12] preferred MRI as the initial imaging modality and performed CT only in patients requiring surgical intervention. They highlighted that this approach could reduce unnecessary radiation exposure in the pediatric population. The patient whose radiological findings are shown in Figure 1 presented late with marked proptosis and extensive swelling extending from the frontal to the parietal and temporal regions. Urgent CT and MRI were obtained and demonstrated an associated intracranial complication. Since the Chandler classification is intended specifically for orbital complications, and no orbital abscess or cavernous sinus involvement was identified, the patient was classified as Chandler Stage III. Combined surgical management was performed in collaboration with the neurosurgery team. This patient had a longer hospital stay and follow-up period than the other patients in the cohort.

Additionally, the evaluation of inflammatory markers, such as CRP and WBC, showed clinically relevant differences in our study. The initial WBC count and duration of fever were significantly higher in the Chandler Stage III group, reflecting a more severe inflammatory process in these patients. Although a difference was observed in the initial CRP levels, it did not reach statistical significance.

Regarding sinus involvement, the radiological findings did not show significant differences between the groups. This finding may suggest that the depth of infection and systemic response are more decisive factors in the development of complications than the anatomical region where the infection spreads.

This study has several limitations, including its retrospective, single-center design and relatively small sample size. In addition, no Chandler Stage IV or V cases were identified, limiting the assessment of more advanced orbital complications. Furthermore, imaging and treatment decisions were not based on a standardized protocol, and long-term ophthalmological outcomes could not be evaluated in all patients. The small sample sizes across the Chandler stages may have limited the statistical power of the analyses and increased the risk of type II error. Therefore, the findings should be interpreted cautiously and validated in larger cohorts. Another limitation is the lack of standardized microbiological data in all patients, which restricted detailed analysis of pathogen distribution and antibiotic susceptibility patterns.

In conclusion, orbital complications secondary to acute rhinosinusitis are serious clinical conditions in pediatric populations that carry a significant risk of morbidity and, albeit rarely, mortality. In our study, patients in the Chandler Stage III group, in particular, showed longer hospital stays, higher leukocyte counts, and a need for surgical intervention. Our findings support current recommendations that surgical intervention should be considered in patients diagnosed with orbital cellulitis or subperiosteal abscesses who do not achieve clinical improvement within the first 24-48 h after initiating medical treatment. Urgent drainage may be required in the presence of serious symptoms such as visual impairment, proptosis, ophthalmoplegia develop or altered mental status. In our cohort, CT was valuable for confirming the diagnosis and facilitating accurate staging according to the Chandler classification when interpreted together with clinical findings. Collaboration between ophthalmology and otolaryngology clinics through a multidisciplinary approach is critical for the early diagnosis and effective management of complications. Early diagnosis, accurate staging, multidisciplinary management, and timely surgical intervention are essential to prevent long-term sequelae and vision loss.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Author Contributions: A.A.C., H.Ç., Y.E.Y.K.: Idea/concept, data collection and/or processing, writing the article, literature review; A.A.C., H.Ç.: Design, critical review; A.A.C.: Control/supervision; A.A.C., Y.E.Y.K.: Analysis and/or interpretation; H.Ç.: Materials.

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

AI Disclosure: The authors declare that artificial intelligence (AI) tools were not used. or were used solely for language editing. and had no role in data analysis. interpretation. or the formulation of conclusions. All scientific content. data interpretation. and conclusions are the sole responsibility of the authors. The authors further confirm that AI tools were not used to generate. fabricate. or 'hallucinate' references. and that all references have been carefully verified for accuracy.

REFERENCES

1. Moloney JR, Badham NJ, McRae A. The acute orbit. Preseptal (periorbital) cellulitis, subperiosteal abscess and orbital cellulitis due to sinusitis. J Laryngol Otol Suppl 1987;12:1-18.
2. Luk HG, Rose AS. Orbital complications of acute sinusitis in pediatrics: A narrative review. Ear Nose Throat J 2025;8:1455613251366039. doi: 10.1177/01455613251366039.
3. Chandler JR, Langenbrunner DJ, Stevens ER. The pathogenesis of orbital complications in acute sinusitis. Laryngoscope 1970;80:1414-28. doi: 10.1288/00005537-197009000-00007.
4. Zhao EE, Koochakzadeh S, Nguyen SA, Yoo F, Pecha P, Schlosser RJ. Orbital complications of acute bacterial rhinosinusitis in the pediatric population: A systematic review and meta-analysis. Int J Pediatr Otorhinolaryngol 2020;135:110078. doi: 10.1016/j.ijporl.2020.110078.
5. Wald ER, Applegate KE, Bordley C, Darrow DH, Glode MP, Marcy SM, et al. Clinical practice guideline for the diagnosis and management of acute bacterial sinusitis in children aged 1 to 18 years. Pediatrics 2013;132:e262-80. doi: 10.1542/peds.2013-1071.
6. Ryan JT, Preciado DA, Bauman N, Pena M, Bose S, Zalzal GH, et al. Management of pediatric orbital cellulitis in patients with radiographic findings of subperiosteal abscess. Otolaryngol Head Neck Surg 2009;140:907-11. doi: 10.1016/j.otohns.2009.02.014.
7. Opoku-Buabeng J, Yaw Lartey S. Orbital complications of sinusitis in children in Komfo Anokye Teaching Hospital. ENT Updates 2017;7:38-41.
8. Saltagi MZ, Rabbani CC, Patel KS, Wannemuehler TJ, Chundury RV, Illing EA, et al. Orbital complications of acute sinusitis in pediatric patients: Management of Chandler III patients. Allergy Rhinol (Providence) 2022;13:21526575221097311. doi: 10.1177/21526575221097311.
9. Adil EA, Muir ME, Kawai K, Dombrowski ND, Cunningham MJ. Pediatric subperiosteal abscess secondary to acute sinusitis: A systematic review and meta-analysis. Laryngoscope 2020;130:2906-12. doi: 10.1002/lary.28570.
10. Casanueva R, Villanueva E, Llorente JL, Coca-Pelaz A. Management options for orbital complications of acute rhinosinusitis in pediatric patients. Am J Otolaryngol 2022;43:103452. doi: 10.1016/j.amjoto.2022.103452.
11. Bhargava D, Sankhla D, Ganesan A, Chand P. Endoscopic sinus surgery for orbital subperiosteal abscess secondary to sinusitis. Rhinology 2001;39:151-5.
12. Lohnherr V, Baumann I. Orbital complications of sinusitis in children - Retrospective analysis of an 8.5 year experience. Int J Pediatr Otorhinolaryngol 2024;177:111865. doi: 10.1016/j.ijporl.2024.111865.