p-ISSN: 2548-4079/e-ISSN: 2685-7561

UMI Medical Journal
Volume 11 Issue 1 (June, 2026): 1-18

Systematic Review **Open Access**

Management of Orbital Complications Based on Chandler Classification Stage II-IV in Pediatric Sinusitis: A Systematic Review

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DOI: 10.33096/q21j2r81

ABSTRACT

Background*: Orbital complications are the most common sequelae of pediatric sinusitis (70–85%) and can lead to vision loss or intracranial issues if untreated. Irreversible vision loss occurs in 3–11% of advanced cases.*
Objective: *To review current evidence on medical versus surgical treatment for Chandler Stage II–IV orbital complications in pediatric sinusitis, particularly since there is no clear guideline on when urgent surgery is required and when antibiotics alone are sufficient.*
Methods: *A systematic review (2015–2025) was conducted via PubMed, Scopus, and ScienceDirect. Included studies involved patients <18 years with Stage II–IV complications. Data on treatments, outcomes, and risk of bias (Newcastle–Ottawa Scale) were analyzed.*
Results: *Thirty-three studies (>16,700 patients) were included. Stage II was successfully treated with antibiotics alone in >90% of cases. In Stage III, 35–50% required surgery, especially with abscess ≥3.6 mm, vision changes, or poor response to antibiotics. Stage IV nearly always required urgent surgery. Stage-based treatment improved vision, motility, and proptosis, with no reported deaths.*
Conclusion: *Chandler staging effectively guides treatment. Antibiotics suffice for Stage II; surgery is often needed for Stage III–IV. Timely, evidence-based care helps prevent permanent vision loss.*

Keywords*: Pediatric Sinusitis; rhinosinusitis; orbital complications; chandler classification; systematic review*

Article history:
Received: 10 October 2025
Accepted: 5 May 2026
Published: 30 June 2026

INTRODUCTION

Orbital complications from rhinosinusitis in children can threaten vision and lead to intracranial issues if not promptly and effectively managed.[1,2] Reports show an increasing incidence of orbital cellulitis and subperiosteal orbital abscess (SPOA) in the past decade in countries like Iran and Taiwan.[3,4] This rise aligns with more cases of acute bacterial rhinosinusitis (ABRS) in children.[5,6]

Since it was first introduced in 1970, the Chandler Classification[7] has remained the most widely used system for grading the range of clinical presentations in orbital complications of acute rhinosinusitis.[7,8] This classification describes the signs and symptoms and, in conjunction with computed tomography (CT) findings, divides the infection into five stages, each associated with a progressively higher risk of vision loss and additional complications.[9,10]

The management of Chandler stages II–IV (postseptal cellulitis, subperiosteal orbital abscess, and orbital abscess) remains debated, especially about the timing and necessity of surgery.[2] Many healthcare facilities suggest starting with intravenous antibiotics and close monitoring.[11] Surgical drainage follows if the patient does not improve or if a significant abscess appears on CT scans.[9,12] Recent studies report that orbital complications account for approximately 74–85% of all complications arising from acute sinusitis in pediatric populations, such complications can progress rapidly, with substantial risk of permanent vision loss—irreversible visual impairment has been observed in 3–11% of affected children— especially in advanced stages or when diagnosis and treatment are delayed. [13,14]

Several studies have shown that most Chandler stage II cases respond well to conservative therapy, whereas stages III and IV are associated with higher rates of surgical intervention.[7,8] Clinical outcomes are typically positive, with the majority of patients seeing enhancements in visual acuity, proptosis, and eye movement, along with a low rate of recurrence. Nevertheless, differences in clinical practices among various institutions underscore the necessity for a systematic review to determine the most effective treatment approaches and thoroughly assess clinical results.[10,15]

METHODS

This research is a systematic review executed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The aim was to assess various management strategies for orbital complications in children with sinusitis, with a particular focus on Chandler stages II to IV. The review was organized using the PICO framework: the population consisted of pediatric patients experiencing orbital complications due to sinusitis the interventions included both pharmacological treatments and surgical methods and the outcomes evaluated were clinical improvements, such as recovery of visual acuity, ocular motility, resolution of proptosis, recurrence rates, and duration of hospital stay.

The review protocol was prospectively registered in Prospero (Registration No. CRD420251133803) https://www.crd.york.ac.uk/PROSPERO/view/CRD420251133803. The review was conducted in accordance with the registered protocol, with no deviations during the review process or data analysis.

Inclusion criteria encompassed randomized controlled trials, cohort studies, and case-control studies involving pediatric patients with Chandler stage II–IV orbital complications from sinusitis, published between 2015 and 2025, in English or Indonesian, and available in full text. Exclusion criteria included narrative reviews, editorials, opinion articles, individual case reports, studies that did not clearly specify a Chandler stage of II–IV, and those involving adult populations.

A systematic search of the literature was performed across prominent electronic databases such as PubMed, Scopus, and ScienceDirect, utilizing a combination of pertinent keywords like “pediatric sinusitis,” “orbital complications,” “Chandler classification,” and “management,” along with Boolean operators AND and OR to ensure a thorough search strategy. The article selection process consisted of two phases: an initial screening of titles and abstracts for relevance followed by a comprehensive review of the full texts to verify eligibility. The selection process was documented and illustrated in a PRISMA flow diagram.

The methodological quality of the included studies was assessed independently by two reviewers using the Newcastle–Ottawa Scale (NOS), inter-rater reliability evaluated using the quadratic weighted Cohen’s kappa ($\kappa = 0.492$), indicating moderate agreement. Discrepancies were resolved through discussion with two additional independent reviewers until consensus was reached. Data extracted included study characteristics, patient demographics, Chandler stage, interventions, and clinical outcomes.

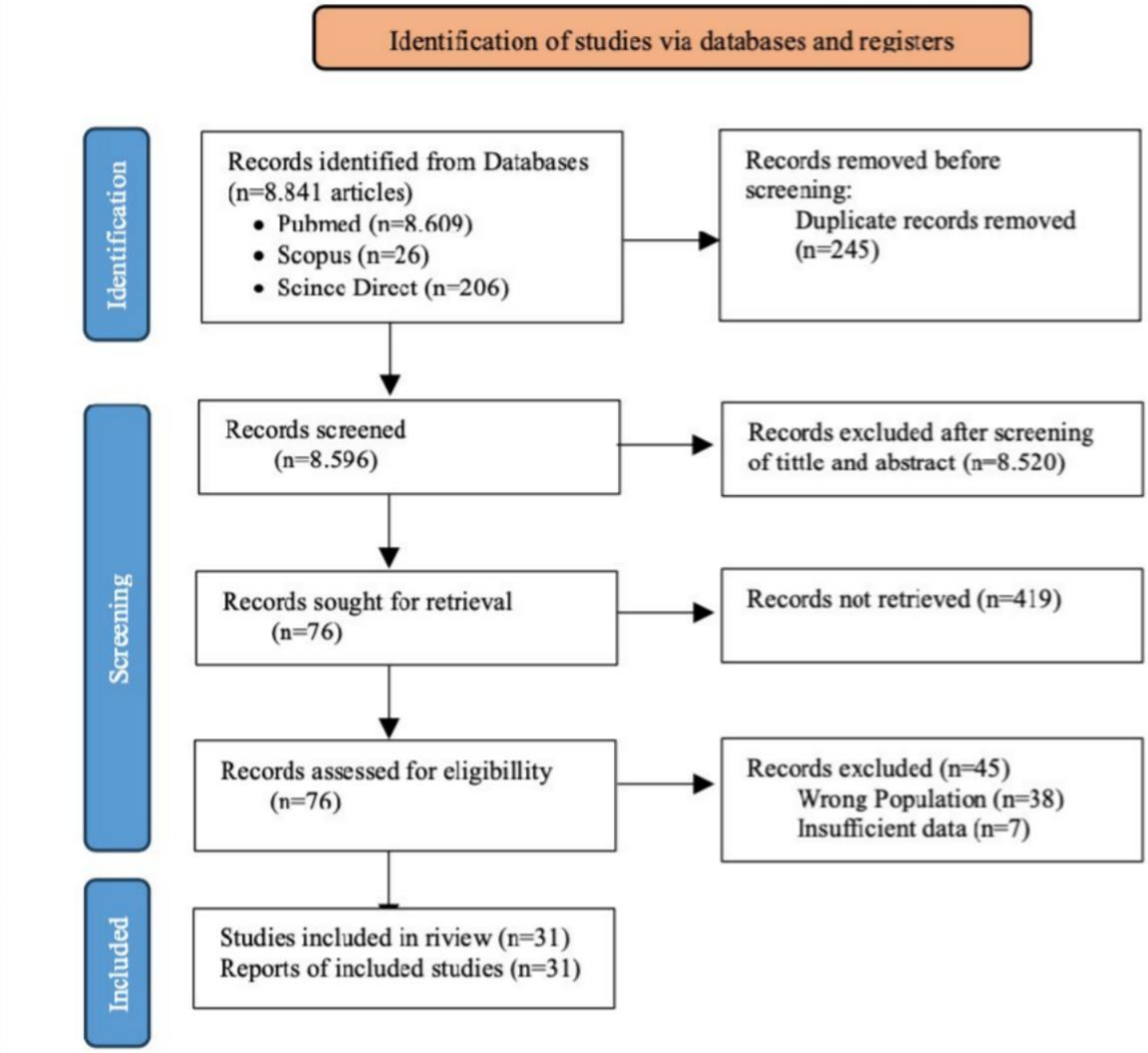

Figure 1. Diagram Prisma

p-ISSN: 2548-4079/e-ISSN: 2685-7561

UMI Medical Journal
Volume 11 Issue 1 (June, 2026): 1-18

RESULT

Table 1. Overview of Study Characteristics and Key Outcomes

Authors	Country	Design	Sample	Intervention (surgery)	Intervention (non surgery)	Chandler Stage	Management Strategy	Outcome	Score NOS
Asadigandomani et al. (2024) (5)	Iran	Retrospective study (Oct 2023–Mar 2024)	39	Surgical drainage in 19 patients	20 IV antibiotics	III	CT-based surgery indication (Harris criteria)	Clinical improvement in all patients	8/9
Villwock MR & Villwock JA (2020) (16)	USA	Retrospective cross-sectional study (2003–2012)	15,260	Sinus surgery in 1,103 patients	92.7% managed medically	II	Surgery for age >8, abscess, sinusitis	Clinical improvement in all patients	8/9
Sussman SM et al. (2021) (17)	USA	Retrospective cohort study	58	29 underwent FESS ± orbitotomy)	29 received IV antibiotics	III	Surgery after 48–72h failed medical therapy/ large abscess/ ocular signs	No difference in clinical outcome	8/9
Lu NE et al. (2024) (1)	USA	Retrospective chart review (2003–2017)	82	42 underwent drainage (transnasal/external)	40 treated with IV antibiotics	III	Abscess ≥3.6 mm or age >5 are higher surgery risk	Improvement motility overall good clinical outcomes	8/9
A. Kais et al. (2025) (18)	USA	Retrospective cohort study (2012–2022)	100	-	All received IV antibiotics and received corticosteroids.	III	acute sinusitis, postseptal disease	No difference in clinical outcome	8/9

Cheng J et al. (2017) (19)	USA	Cross-sectional analysis of (2012–2015)	57	57 patient underwent endoscopic sinus surgery (ESS)	-	≥III	All surgical; outcomes (<48h vs ≥48h)	No permanent vision loss	8/9
Trbojević T et al. (2023) (20)	Kroasia	Retrospective (2016–2020)	26	6 underwent surgery (ethmoidectomy ± antrostomy)	20 treated with IV antibiotics	I–V	CT + clinical severity treatment	Complete recovery in all patients	8/9
Mishra SK et al. (2024) (21)	India	Retrospective study (Mar 2021–Feb 2024)	20	4 underwent abscess drainage	16 treated with IV ± oral antibiotics	III-IV	CT-confirmed abscess surgery	75% achieved full recovery 25% had residual visual	8/9
Chang Y-S et al. (2017) (6)	Taiwan	Retrospective chart review (1988–2015)	83	46 underwent surgery.	26 Antibiotics IV	I-V	Higher Chandler stage for surgery	92.7% achieved complete recovery	5/9
Abtahi SM et al. (2020) (3)	Iran	Retrospective chart (2016–2019)	6	4 surgery	2 Antibiotic only	II	Non-medial/superior abscess surgery	Higher complication rate in surgical group	7/9
Jabarin B et al. (2019) (22)	Israel	Retrospective study (2005–2014)	123	36 children underwent surgical intervention	87 children were managed conservatively.	I-III	endoscopic surgery for failed medical therapy/large abscess	Toddlers with orbital complications respond conservative treatment.	8/9
Coudert A et al. (2018) (11)	France	Retrospective study (2009–2017)	48	34 underwent surgical drainage (endoscopic or external)	14 treated with antibiotics alone	III	SPOA IV cephalosporin + metronidazole	Clinical improvement in most patients	8/9

Moreddu E et al. (2025) (23)	France	Retrospective cohort (2014–2024)	65	31 required surgery (13 upfront, 18 after failed medical therapy)	34 with antibiotics ± nasal irrigation	III	Surgery if eyelid closure, proptosis, abscess >4 mm, ophthalmoplegia, high CRP/WBC	Clinical improvement in all cases	8/9

Authors	Country	Design	Sample	Intervention (surgery)	Intervention (non surgery)	Chandler Stage	Management Strategy	Outcome	Score NOS
8/9McCoy JL et al. (2021) (24)	USA	Retrospective review (2002–2016)	108	59 underwent surgery (32 transnasal, 4 external, 23 combined)	39 managed with IV/IM antibiotics only	II-III	Abscess ≥0.5 cm^3 or non-medial surgery likely	Clinical improvement in all cases	8/9
Chen, Lena et al. (2018) (25)	USA	Prospective (Jul 2010–Dec 2015)	43	5 group of steroid, 3 group of nno-steroid	Antibiotics only group 15	II–III	IV dexamethasone adjunct monitored response	Steroids for faster resolution	6/8
Saltagi MZ et al. (2022) (26)	USA	Retrospective review (2007–2016)	108	8 underwent surgery	35 non surgery	III	Observe 24–48h early surgery if deterioration	Clinical improvement in all cases	7/9
Casanueza R et al. (2022) (27)	Spain	Retrospective study (2008–2019)	23	-	Antibiotics in 11 children	I–III	Steroids for severe edema surgery if no response	Clinical improvement in all patients	6/9

Davies BW et al. (2014) (28)	USA	Prospective study (Oct 2012–Mar 2014)	31	15 patients underwent surgery	7 patients antibiotics only and 24 patients antibiotics IV + steroid	II-III	Oral prednisone when CRP ≤4 mg/dL	Clinical improvement in all patients	7/9
Wan Y, Shi G, Wang H. (2016) (29)	China	Retrospective cross-sectional study	31	15 underwent ESS	16 with IV antibiotics ± corticosteroids	II–III	after 48h in StageIII often surgical if no improvement	Clinical improvement in all patients	5/9
Brameli A et al. (2018) (30)	Israel	Retrospective study (2006–2017)	35	1 patient (7%) in the steroid group	14 received steroids + antibiotics, 21 antibiotics only	II–III	Steroids adjunct dose tailored to severity	Faster recovery in the steroid group	6/9

Authors	Country	Design	Sample	Intervention (surgery)	Intervention (non surgery)	Chandler Stage	Management Strategy	Outcome	Score NOS
Zloczower, E., Pansky, I., Lasry, B., et al. (2025) (14)	Jerusalem	Retrospective cohort study (2002–2019)	213	21 underwent surgery		II–IV	Older age & severe disease surgery conservative if safe	Surgical group showed higher ARS recurrence ove 1–5 years.	8/9
Kais et al., (2023)7/9 (31)7/9	USA	A retrospective single-center and cross-sectional analysis (2012–2022).	118	8 children with surgical drainage.	111 oral antibiotics, 99 children had additional IV antibiotics. 14 children with systemic steroids.	I-IV	Antibiotics effective in most Stage III or large abscess for surgery	Clinical improvement in all patients	6/9
Sciaretta V et al. (2017) (15)	Italy	Retrospective review (2006–2016)	57	9 (15.8%) underwent transnasal drainage	48 treated with IV antibiotics 12 received adjunctive IV corticosteroids	I–V	Surgery after 48h failed use therapy steroids adjunct	Recurrence rate 5.3% and no permanent vision loss reported	8/9
Turhal G et al. (2020) (32)	Turkey	Retrospective review (2008–2016)	25	10 underwent endonasal endoscopic surgery	15 with antibiotics	I–III	Stage III mostly surgery Stage I–II conservative	Clinical improvement in all patients	4/9
Martins et al. (2021) (33)	Portugal	Retrospective (2007–2020)	60	33 underwent surgery (FESS ± external approach; 2 required craniotomy)	27 managed conservatively	II–IV	Large abscess/frontal sinus for surgery	Clinical improvement in all patients	6/9
Lü P et al. (2022) (2)	China	Retrospective	28	8 underwent surgery (FESS ± external drainage)	20 managed conservatively with IV	II–V	Stage IV–V immediate surgery Stage II	Complete recovery without	6/9

					antibiotics ± corticosteroids		observe 3–7 days	recurrence	
Authors	**Country**	**Design**	**Sample**	**Intervention (surgery)**	**Intervention (non surgery)**	**Chandler Stage**	**Management Strategy**	**Outcome**	**Score NOS**
Zhong L et al. (2022) (34)	China	Retrospective cohort study	51	28 underwent surgery (FESS ± orbital drainage)	23 managed conservatively	I–IV	Stage IV surgery Stage III if no response after 48h	Complete recovery without recurrence	6/9
Boal NS et al. (2025) (35)	USA	Retrospective case series (2012–2022)	91	42 operation (external+FESS)	49conservative (success)	III	Age ≥9for more surgery and 48–72h antibiotic trial	Success rate 94% and recurrence 4.4%	7/9
Kelemen É et al. (2024) (36)	Hungary	Retrospective (2016–2022)	497	33% of hospitalized patients required surgery.	67% recovered with IV antibiotics and local therapy.	II-III	Stage II conservative; Stage III–IV surgery if failure/large abscess	Complete recovery without recurrence	7/9
Yosefof E et al. (2023) (4)	Israel	Retrospective cohort (2001–2018)	156	23/156 (14.7%) underwent surgery (FESS ± drain)	133/156 (85.3%) AB IV and	II–III	Fever >38°C, ophthalmoplegia, neutrophilia	Complete recovery without	8/9

				conservative treatment		indicates surgery	recurrence	
Vloka, et al. (2022) (37)	USA	Retrospective chart review (2009–2017)	27	21 patients (78%) underwent surgery (abscess drainage)	6 patients (22%) Recovered with IV antibiotics only	III-IV	CT only if surgery considered; SAG are early surgery recommended	There was no permanent vision loss after treatment.	7/9

Summary of Clinical Findings

A total of 31 studies comprising more than 16,700 pediatric patients were analyzed in this systematic review (1,6). Most of the included studies demonstrated moderate to high methodological quality, with Newcastle-Ottawa Scale (NOS) scores ranging from 7 to 9. Clinical outcomes showed that more than 90% of patients with Chandler Stage II achieved complete recovery without the need for surgical intervention (15). For Stage III, between 35% and 50% of patients ultimately required surgical drainage, while the remaining cases responded successfully to antibiotics alone (39,40). In Stage IV, more than 90% of patients achieved full recovery following an aggressive combined medical and surgical approach (40). Across all included studies, no deaths were reported, and appropriate intervention consistently resulted in marked improvements in visual acuity, ocular motility, and reduction of proptosis.

DISCUSSION

Management strategies for orbital complications secondary to acute rhinosinusitis vary widely, from conservative intravenous (IV) antibiotic therapy to surgical interventions such as Functional Endoscopic Sinus Surgery (FESS) or external drainage, depending on institutional protocols and patient-specific factors including age, abscess size and location, microbiological findings, and clinical severity.[1,6] These complications represent a continuum of disease severity, ranging from mild orbital cellulitis to severe orbital and intracranial infections. This review focused on Chandler Stages II–IV, which represent post-septal infections with a significantly higher risk of vision loss and intracranial extension, such as meningitis or cavernous sinus thrombosis.[7,9,10]

Chandler Stage II – Orbital Cellulitis

For Stage II (orbital cellulitis), the cornerstone of management is the administration of intravenous (IV) antibiotics alongside close clinical observation to ensure early detection of complications and assess the response to treatment. Recommended antibiotic regimens include ampicillin-sulbactam (50 mg/kg/dose IV every 6 hours) or ceftriaxone (50–75 mg/kg/day IV once or twice daily). When there is suspicion of anaerobic infection, clindamycin or metronidazole can be added to broaden coverage, while vancomycin should be incorporated into the regimen if there is concern for methicillin-resistant Staphylococcus aureus (MRSA).[15] The typical duration of antibiotic therapy ranges from 10 to 14 days, beginning with IV administration and later transitioning to oral step-down therapy, most commonly using amoxicillin-clavulanate, once the patient demonstrates clinical improvement.[15] The finding that the vast majority of children with Stage II orbital cellulitis achieve complete recovery with medical therapy alone underscores the importance of early and appropriate management in preventing disease progression and reducing the risk of complications.[15]

The potential role of systemic corticosteroids as an adjunct to antibiotic therapy has been the subject of increasing investigation in recent years. Corticosteroids are thought to reduce inflammation and tissue edema, thereby improving patient comfort and potentially accelerating recovery. Addition of IV dexamethasone at the time of admission significantly shortened hospital stay, with patients in the steroid group having an average stay of 3.8 ±0.2 days compared to 6.7 ± 0.3 days in the non-steroid group ($p < 0.001$), without an associated increase in complication rates.[25] Similarly, Davies et al. demonstrated that initiating oral corticosteroid therapy when C-reactive protein (CRP) levels were ≤4 mg/dL was associated with faster recovery and earlier discharge, suggesting that CRP could serve as a useful biomarker to guide steroid initiation.[28]

Despite these promising findings, there remains considerable variability in clinical practice. A multicenter survey revealed that 45% of pediatric otolaryngologists reported routinely prescribing corticosteroids for children with orbital cellulitis, compared to 36% of rhinologists, highlighting the lack of standardized guidelines and the need for consensus on their use.[38] Confirmed that systemic corticosteroids can be safe and beneficial when administered appropriately, particularly in cases of severe or refractory orbital cellulitis.[30] However, despite this growing body of evidence, there is still no universal agreement on the optimal timing, dosage, or duration of corticosteroid therapy, emphasizing the need for further high-quality randomized controlled trials to establish definitive protocols and ensure uniformity in clinical practice.

Chandler Stage III – Subperiosteal Abscess (SPA)

Stage III (Subperiosteal Abscess, SPA) represents a critical and challenging phase of orbital complications, often necessitating a combined medical and surgical approach to achieve optimal outcomes. Initial management closely resembles that of Stage II, beginning with aggressive intravenous (IV) antibiotic therapy and meticulous clinical observation to monitor the patient's progress and prevent rapid disease progression.[15,39] However, unlike Stage II, medical therapy alone is frequently insufficient. Surgical intervention becomes necessary under specific clinical circumstances, which serve as clear indicators of disease severity. These criteria include the presence of an abscess with a diameter of ≥3.6 mm,[39,40] marked proptosis or ophthalmoplegia, decreased visual acuity, or a lack of significant improvement after 48 to 72 hours of appropriate IV antibiotic therapy.[39] These factors reflect worsening infection and the risk of irreversible visual impairment or intracranial spread, necessitating prompt surgical drainage.

When surgery is indicated, the preferred techniques are either Functional Endoscopic Sinus Surgery (FESS) or external orbitotomy, chosen based on the location and extent of the abscess, as well as the surgeon's expertise.[39,40] Recent studies emphasize the importance of early surgical intervention, ideally performed within 48 hours of hospital admission, as this has been shown to significantly reduce the overall length of hospitalization compared to delayed procedures or prolonged reliance on conservative management (median 3.6 vs. 6.9 days, $p < 0.01$) (39). This highlights that timely decision-making plays a crucial role in patient recovery and healthcare resource utilization. The substantial proportion of SPA patients requiring surgical drainage indicates that careful patient selection is essential, as medical therapy alone is frequently insufficient for advanced cases.[39,40]

Identifying predictors for surgical intervention is critical for guiding treatment decisions and improving outcomes. Several clinical and laboratory parameters have been identified as strong predictors of the need for surgery. Yosefof et al. reported that complete eyelid closure was a highly significant indicator, with an odds ratio (OR) of 7.6 ($p < 0.001$). Similarly, a C-reactive protein (CRP) level greater than 60 mg/L was associated with a substantially increased likelihood of surgical necessity (OR 6.9, $p = 0.006$). Additionally, an abscess width greater than 4 mm was another independent predictor (OR 8.2, $p = 0.01$). Beyond these factors, elevated neutrophil counts and persistent fever exceeding 38°C were also shown to be independent predictors for surgical intervention, underscoring the importance of integrating both clinical presentation and laboratory data into decision-making.[41]

Microbiological analysis plays a pivotal role in tailoring antibiotic therapy and predicting disease severity. Recent studies have consistently identified Streptococcus species as the most common causative pathogens, followed by anaerobic bacteria and Staphylococcus aureus.[29,37] Within this spectrum, infections caused by Streptococcus anginosus group (SAG) have shown a particularly aggressive course, with a significantly higher likelihood of requiring surgical drainage compared to other organisms (100% vs. 65%, $p = 0.030$) (37). This highlights the importance of early pathogen identification to inform both medical and surgical management strategies.

Epidemiological data also point to notable trends over time. Razavi et al. observed a continuous increase in the incidence of SPA over the past decade, a rise that was especially pronounced during the post-COVID-19 period.[5] This suggests potential changes in pathogen virulence, host immune responses, or patterns of antibiotic resistance, all of which warrant further investigation. Additionally, a unique clinical subset has been identified among toddlers, who tend to present with more severe disease manifestations due to their limited orbital anatomical space and the rapid progression of infection. These younger patients often require earlier consideration for surgical intervention to prevent permanent vision loss and life-threatening complications.[18]

In summary, the management of Stage III SPA must be highly individualized, balancing the benefits of conservative medical therapy with the risks and timing of surgical intervention. Careful assessment of clinical signs, radiologic findings, laboratory markers, and microbiological data is essential to determine the optimal therapeutic pathway. Early recognition and timely surgical drainage, when indicated, have been shown to significantly improve clinical outcomes and reduce hospitalization, emphasizing the importance of a multidisciplinary approach to care.

Chandler Stage IV – Orbital Abscess

Stage IV, representing a true orbital abscess, is a surgical emergency requiring immediate intervention to prevent vision loss and intracranial complications. Almost all patients at this stage need urgent surgical drainage combined with IV antibiotics, as medical therapy alone is insufficient. The recommended empirical regimen consists of ceftriaxone or cefotaxime for broad coverage, metronidazole for anaerobic bacteria, and vancomycin when MRSA is suspected. Treatment is usually continued for 14–21 days, starting intravenously and later transitioning to oral therapy once the patient shows clinical improvement.[15,40]

When comparing outcomes among the included studies, the findings strongly support prompt surgical drainage but highlight some variations in long-term results. For instance, while Zloczower et al.[14] reported that children undergoing surgery for orbital complications had higher acute rhinosinusitis recurrence rates over 1–5 years, studies by Lü et al.[2] and Zhong et al. [34] contrastingly reported complete recovery in Stage IV patients without any recurrence following prompt surgery. Furthermore, regarding visual outcomes, Mishra et al.[21] noted that 25% of their Stage III–IV patients had residual visual issues, whereas Vloka et al.[37] and Cheng et al.[19] found no permanent vision loss following appropriate interventional treatment. Overall, when management strictly follows Chandler staging with prompt surgical intervention for Stage IV, the aggressive combined approach consistently yields excellent recovery rates.[40]

CONCLUSION

This systematic review demonstrates that the Chandler classification is a reliable framework for guiding the stage-specific management of pediatric orbital complications from acute rhinosinusitis. Conservative management with intravenous antibiotics is highly effective for Stage II disease. In contrast, Stage III requires an individualized approach, with surgical drainage indicated for larger abscesses, deteriorating clinical signs, or poor response to medical therapy. Stage IV uniformly necessitates urgent surgical intervention combined with broad-spectrum antibiotics. Appropriate stage-specific treatment yields excellent clinical outcomes with significant recovery and no reported mortality. Future prospective studies remain necessary to refine surgical criteria, optimize antibiotic regimens, and evaluate the role of adjunct corticosteroids.

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