Pediatric Odontogenic Sinusitis: A Focused Review of Clinical Features, Surgical Management Comparisons, and Interdisciplinary Care at the Dental–Otorhinolaryngology Interface

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Abstract

Pediatric odontogenic sinusitis (PODS) is a rare but clinically significant condition at the intersection of dentistry and otorhinolaryngology. Defined as maxillary sinusitis arising from adjacent dental pathology, PODS remains underrepresented in paediatric rhinosinusitis guidelines despite a complication rate exceeding 80% in reported series. Its aetiology in children differs fundamentally from adults, being driven predominantly by pulpitis, periodontal abscesses, and ectopic teeth rather than implant-related disease. Diagnosis relies on contrast-enhanced computed tomography and nasal endoscopy, interpreted jointly by otolaryngologists and dental specialists. Surgical options—encompassing intranasal endoscopic sinus surgery (ESS), the Caldwell-Luc procedure, dental extraction, and combined approaches—are compared with respect to success rates, complication profiles, and the evolving evidence favouring single-stage combined ENT–dental intervention. Antibiotic therapy alone is insufficient as monotherapy. This review synthesises current evidence to propose an interdisciplinary management framework tailored to the paediatric airway-dental continuum.

Keywords: *pediatric odontogenic sinusitis, PODS, endoscopic sinus surgery, Caldwell-Luc, dental extraction, interdisciplinary, otorhinolaryngology, maxillary sinusitis complications*

1. Introduction

Rhinosinusitis is one of the most common diagnoses in paediatric primary care, accounting for approximately 2% of all annual outpatient visits and emergency department consultations in children [1]. Its standard aetiology encompasses viral upper respiratory tract infections, adenoid hypertrophy, cystic fibrosis, and primary ciliary dyskinesia [2]. A dental origin, however, is conspicuously absent from most paediatric guidelines. The European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS) and the American Academy of Pediatrics (AAP) guidance on acute bacterial sinusitis do not address odontogenic pathology as a causative mechanism, except from a microbiological standpoint noting the presence of anaerobic bacteria in purulent maxillary aspirates [3, 4].

In adults, odontogenic sinusitis (ODS) accounts for 25–40% of all maxillary sinus disease and up to 75% of unilateral maxillary opacification on computed tomography (CT) [5]. An international multidisciplinary consensus statement published in 2022 formalised its diagnostic criteria and established a structured dual-specialty approach [6]. The paediatric counterpart—paediatric odontogenic sinusitis (PODS)—remains poorly characterised. The first systematic review dedicated to PODS, published in 2024 by Rosso and colleagues at the University of Milan, identified only 41 patients across 20 studies spanning eight decades of literature [7]. Despite the rarity of reported cases, the complication rate was striking: 83% of patients developed orbital or intracranial complications, and one child died [7]. This disproportion between case volume and complication severity underscores the urgency of improving awareness, diagnosis, and coordinated management.

The present review synthesises evidence on the clinical features, diagnostic approach, surgical management options, and comparative outcomes of PODS, with particular emphasis on the evidence for different surgical strategies and the rationale for interdisciplinary dental-ENT co-management. The article follows an IMRAD structure with a focused methods section, an evidence-based results/discussion synthesis, a surgical comparison table, and a clinically actionable conclusion.

2. Methods

A narrative review was conducted using PubMed/MEDLINE, Embase, Scopus, and the Cochrane Library. Keywords employed included: 'pediatric odontogenic sinusitis', 'PODS', 'odontogenic sinusitis children', 'endoscopic sinus surgery children', 'Caldwell-Luc procedure pediatric', 'dental extraction sinusitis outcomes', 'combined ESS dental surgery', 'intracranial complications sinusitis pediatric', 'orbital cellulitis odontogenic sinusitis', and 'pediatric rhinosinusitis dental origin'. Searches covered publications from 1980 to May 2026 with priority given to systematic reviews, consensus statements, and prospective cohorts published from 2018 onward. The 2024 systematic review by Rosso et al. [7] provided the primary dataset on PODS-specific outcomes. Evidence from adult ODS literature was incorporated where paediatric data were absent, with explicit notation of generalisability limits. A total of 50 references are cited throughout the manuscript. A structured comparison of surgical approaches forms the core analytical contribution of this review.

3. Results and Discussion

3.1 Epidemiology and Clinical Presentation

Available data on PODS derive almost exclusively from case reports and small case series, representing the lowest tier of clinical evidence (OCEBM Level IV) [7].

The 2024 systematic review by Rosso et al. analysed 41 paediatric patients with a mean age of 11 years (SD ±4.19 years) across 20 studies, with a striking 3:1 male predominance—a finding opposite to adult ODS epidemiology [7]. Acute bacterial sinusitis affects approximately 6–7% of children presenting with respiratory symptoms [4], but the proportion attributable to odontogenic origins is unknown due to the absence of dedicated epidemiological studies.

Clinical presentation is non-specific, overlapping substantially with routine rhinosinusitis: facial pain and swelling, purulent nasal discharge, and fever predominate [7, 8]. Foul-smelling unilateral nasal discharge—well-validated as a clinical predictor of ODS in adults [6]—is likely under-recognised in children because dental pain is frequently absent, and parents and primary care physicians rarely connect sinus symptoms to dental disease. Dental-origin clues that should heighten suspicion include unilateral disease refractory to standard antibiotic therapy, a history of recent dental trauma or endodontic treatment, the presence of an ectopic or supernumerary tooth, or persistent purulent nasal discharge despite adequate ENT management [3, 7, 9].

Unlike adult ODS—where iatrogenic causes (dental implants, sinus lift, tooth extraction) account for 65.3% of cases [10]—PODS in the reviewed literature was driven predominantly by pulpitis (9/41, 22%), periodontal abscess (9/41, 22%), and ectopic/supernumerary teeth (9/41, 22%), followed by complications of extraction (4/41, 10%) and prior endodontic treatment (5/41, 12%) [7]. This aetiological profile reflects the rarity of implant procedures in children and the predominance of classical carious and developmental dental disease, reinforcing the importance of paediatric dentistry input in PODS assessment [11].

3.2 Pathophysiology and Microbiology

The pathophysiological mechanism of PODS exploits the proximity of the maxillary posterior dental roots—particularly upper first and second permanent molars—to the floor of the maxillary sinus. In children, the maxillary sinus continues to pneumatise through adolescence, meaning that the spatial relationship between developing dental roots and sinus floor is dynamic and variable by age [12]. Periapical or periodontal infection breaches the Schneiderian membrane (sinus mucoperiosteum), introduces oral polymicrobial flora into the sterile sinus cavity, and initiates a chronic anaerobic sinusitis phenotype distinct from typical rhinogenic disease [5, 6].

The microbiological signature of ODS is dominated by anaerobic Gram-negative bacilli—Fusobacterium, Prevotella, Peptostreptococcus, and Porphyromonas—often with alpha-haemolytic Streptococcus as an aerobic co-pathogen [13]. These organisms exhibit β-lactamase production, explaining the frequent failure of narrow-spectrum antibiotics and the preference for amoxicillin-clavulanate as empirical first-line therapy [13, 14]. In PODS specifically, concurrent therapy most commonly comprised antibiotic combinations such as amoxicillin-metronidazole-gentamicin, clindamycin-ceftriaxone, and vancomycin-meropenem-metronidazole [7]. This polymicrobial, anaerobic profile also explains the particularly high rate of suppurative complications (orbital and intracranial) seen in PODS compared to routine paediatric sinusitis [7, 15].

3.3 Diagnosis: Imaging, Endoscopy, and Dental Assessment

Correct diagnosis of PODS requires collaboration between otolaryngologists and dental specialists. The 2022 international ODS consensus [6] outlined a two-step approach: (A) clinical suspicion triggered by unilateral maxillary disease, foul odour, or anaerobic microbiology; (B) confirmation by nasal endoscopy (ENT role) and dental radiological assessment (dental role). In the paediatric cohort reviewed by Rosso et al., CT imaging was the dominant modality, employed in 32/41 patients (78%), while plain radiography was used in 24/41 (59%), nasal endoscopy in only 2/41 (5%), and orthopantomography in 4/41 (10%) [7]. This low endoscopy rate reflects both historical practice and the challenges of performing nasal endoscopy in young children, but represents a recognised diagnostic gap.

CT scanning without contrast is the ACR-recommended modality for persistent or chronic sinusitis in children, and with IV contrast when orbital or intracranial complications are suspected [16]. CBCT (cone-beam CT) offers reduced radiation dose for dental root assessment and should be considered in PODS where periapical involvement is clinically suspected [17]. Key CT features of ODS include unilateral maxillary opacification, sparing of the posterior ethmoid and sphenoid sinuses (distinguishing it from bilateral CRS), mucosal thickening, and—in selected cases—the presence of a radio-opaque foreign body, root tip displacement, or periapical lucency adjacent to the sinus floor [5, 6, 18]. In children with ectopic or supernumerary teeth—a distinctly paediatric cause of PODS—OPT and CT provide complementary information on tooth position relative to the sinus [7, 19].

3.4 Surgical Management: Approaches and Outcomes

Because antibiotic monotherapy rarely eradicates PODS—all 41 patients in the Rosso et al. cohort ultimately required surgical intervention [7]—surgical management constitutes the backbone of treatment. Four main surgical strategies have been employed in the paediatric literature: (1) intranasal endoscopic sinus surgery (ESS), including maxillary antrostomy; (2) the Caldwell-Luc (CL) procedure; (3) dental intervention alone (extraction or orthodontic management); and (4) combined ENT-dental approaches. Table 1 provides a structured comparison of these strategies.

Table 1. Comparison of Surgical Approaches for Pediatric Odontogenic Sinusitis

Approach	Patients (n)	Success Rate	Failure (n)	Key Indications	Limitations / Notes

Intranasal ESS (FESS/maxillary antrostomy)	18 (44%)	100% (18/18)	0	Primary for moderate-severe PODS; implant-related ODS; refractory cases after dental Tx	Requires general anaesthesia; learning curve; potential orbital/CSF leak risk
Caldwell-Luc (CL) procedure	8 (20%)	88% (7/8)	1	Historically used when endoscope unavailable; severe mucosal disease or irreversible changes	Invasive; risk of facial nerve damage, dental nerve injury, infraorbital hypoaesthesia; declining use
Dental extraction (tooth removal alone)	2 (5%)	50% (1/2)	1	First-line when dental source clearly identified (caries/periapical disease); low-severity PODS	High failure rate in established sinusitis; does not address sinus disease directly
Root canal therapy (endodontic Tx)	Limited (1 prior Tx)	~51% dental alone [adult]	N/A	Tooth preservation; apical periodontitis without extensive sinus involvement	Adult data only; 33–87% still require ESS; CBCT required to confirm root proximity
Combined surgery (ESS + dental/OAF closure/orbital)	6 (15%)	100% (6/6)	0	PODS with orbital or intracranial complications; OAF; implant removal; refractory combined disease	Technically demanding; requires coordinated multidisciplinary OR team
ESS + dental (concurrent single-stage)	N/A in PODS (~97% in adults)	~97% (adult data)	Low (reduced re-op)	ODS with OAF, infected graft, or peri-implantitis; reduces total anaesthetic exposures	Paediatric-specific RCT data lacking; adult consensus supports concurrent approach

3.4.1 Intranasal Endoscopic Sinus Surgery

ESS achieved a 100% complete response rate in PODS (18/18 patients), making it the most effective single-modality approach in the available literature [7]. In paediatric patients undergoing ESS for chronic rhinosinusitis of any aetiology, published success rates range from 77% to 100%, with an average of 88.4% [20]. For ODS in adults, maxillary antrostomy (MA) alone has achieved 100% resolution in prospective studies by Ungar et al. even when anterior ethmoid and frontal sinuses are also opacified on CT [21]. A multicentre prospective comparison by Craig et al. showed that MA alone and complete ESS yielded equivalent long-term symptomatic resolution (SNOT-22 improvement) in uncomplicated ODS, though complete ESS achieved faster clearance of anterior ethmoid purulence at nine days post-operatively (97.1% vs 71.4%, p=0.006) [22].

In complicated PODS—defined as sinusitis with orbital or intracranial extension—ESS guidelines recommend opening all involved sinuses [23]. A 2006 JAMA Otolaryngology series of 25 children with intracranial complications of sinusitis found that 21 underwent ESS and 13 required concurrent neurosurgical drainage, with only one death (4% mortality) and excellent neurological recovery in the majority [24]. The 2024 PODS systematic review documented that among the four patients who developed intracranial complications (subdural empyema), all required craniotomy in addition to sinusotomy, illustrating the escalating surgical complexity when diagnosis is delayed [7].

3.4.2 The Caldwell-Luc Procedure

The Caldwell-Luc (CL) procedure—a sublabial canine fossa approach providing wide-field access to the maxillary sinus—was the standard of care for chronic maxillary sinusitis before the endoscopic era. It was employed in 8 PODS cases (20%), with a 88% success rate [7]. Historically the dominant approach in the pre-endoscopy literature (particularly in the Blagojević series of 1969 [25]), CL has largely been superseded by FESS. A 1995 prospective randomised trial comparing CL with FESS found that 76.7% of FESS patients reported marked improvement versus 50.7% in the CL group, with zero subjective deterioration in the FESS cohort compared to 5.5% in the CL group [26]. A 2011 comparative study confirmed that FESS achieved 89% distinct symptom improvement at one year versus 44% with CL [27]. Today, CL is reserved as a last resort for severe, irreversible mucosal disease or cases unresponsive to FESS, due to risks including infraorbital hypoaesthesia, dental nerve injury, facial growth disruption, and oroantral fistula formation—concerns particularly salient in the still-growing paediatric maxilla [28].

3.4.3 Dental Interventions: Extraction, Root Canal, and Apicoectomy

Dental source control constitutes the aetiological cornerstone of ODS management: without elimination of the causative dental focus, sinus disease invariably recurs. In the PODS cohort, dental extraction alone was employed in only 2 cases with a 50% success rate [7], reflecting the well-established principle that tooth removal, while necessary, may be insufficient to resolve established sinus infection. In adult ODS, dental extraction alone achieves complete resolution in 51–77% of cases in prospective studies [29, 30]; higher Lund-Mackay CT scores, smoking, and proximity of the periapical lesion to the sinus floor are independent predictors of treatment failure necessitating subsequent ESS [30].

Root canal therapy (endodontic treatment) provides tooth preservation and resolves the periapical source without extraction. A 2025 case report confirmed complete resolution of ODS six months after root canal treatment of an infected upper first molar, with no residual sinus disease on CBCT [31]. The American Academy of Endodontics 2018 position statement recommended endodontic therapy as first-line management in apical periodontitis-related ODS [32]. In paediatric patients, where tooth preservation and maintaining arch integrity are developmental priorities, root canal therapy is strongly preferred over extraction for permanent molars when the tooth is restorable. Apicoectomy—surgical resection of the root apex with retrograde filling—represents a further dental surgical option for failed endodontic treatment, with a reported case of complete periapical healing in a 16-year-old following apicoectomy for maxillary incisor root infection [33].

3.4.4 Combined and Concurrent Surgical Approaches

Combined surgical approaches—simultaneous or staged ESS with dental/oral surgical intervention—were employed as primary treatment in 6/41 PODS patients, achieving 100% success in all cases including those with orbital and intracranial involvement [7]. In adult ODS, concurrent single-stage ESS and dental treatment has emerged as the preferred strategy for complex disease. A 2025 retrospective series of 96 adult ODS patients demonstrated that combined surgery significantly reduced reoperation rates (p=0.003), particularly for periodontal and endodontic origins (p=0.002) [34]. Expanded series by Kocum et al. (n=364) reported a 97% success rate with concurrent single-stage management [35]. In ODS with oroantral fistulas, concurrent ESS and OAF closure reduced time to resolution by 50% compared to OAF closure alone (10 vs 20 days, p=0.001) [36].

For paediatric patients, combined approaches carry the additional benefit of reducing total anaesthetic exposures—a major concern given evidence that repeated general anaesthetics in early childhood are associated with neurodevelopmental risk [37]. Coordinated single-encounter procedures are explicitly endorsed by the American Society of Anesthesiologists, the NHS GIRFT programme, and paediatric hospital consortia [38, 39]. In PODS specifically, cases involving ectopic teeth—the third most common aetiology—often require both endoscopic sinus clearance and orthodontic-surgical removal of the ectopic tooth, making a combined approach not only preferable but logistically necessary [7, 19].

3.5 Complications: A Paediatric-Specific Risk Profile

The most clinically alarming finding in PODS is the extraordinarily high complication rate: 34/41 patients (83%) experienced at least one complication [7]. Orbital cellulitis was by far the most common (20/41, 49%), followed by subdural empyema (4/41, 10%), cerebral abscess, cerebritis, orbital abscess, and seizure [7]. One child died, yielding a case-fatality rate of approximately 2.4% within this literature [7]. These rates exceed those documented in adult ODS series, where orbital complications occur in roughly 70% of complicated cases but severe intracranial spread is less frequent [23]. The higher complication rate in children reflects the thinness of the lamina papyracea in the paediatric orbit, more robust immune-driven inflammatory responses, and the delayed recognition of a dental source in a clinical setting that defaults to viral or adenoid-related aetiology [7, 40].

When orbital complications are identified, coordinated management between otolaryngology and ophthalmology is mandatory. A 2024 case report described a paediatric patient with simultaneous orbital and intracranial complications managed by ESS, orbital drainage, and craniotomy, with complete recovery [41]. Paediatric sinusitis complicated by intracranial involvement should be managed with intravenous antibiotics for 48 hours followed by urgent ESS if no improvement, with neurosurgical drainage for inaccessible abscesses [23]. The broader otolaryngology-dental collaborative principle—that failure to identify and treat the dental focus in PODS invariably leads to recurrence or escalating complications—is borne out by cases where antibiotic therapy and adenoidectomy were attempted first without dental clearance, only to fail [43].

3.6 Interdisciplinary Management Framework

Given the complexity of PODS—spanning dental pathology, sinus disease, and potentially life-threatening orbital or intracranial spread—a structured multidisciplinary care pathway is essential. The core team should include a paediatric otolaryngologist, a paediatric dentist (for primary dentition management and caries prevention), an orthodontist (for ectopic teeth), and an oral and maxillofacial surgeon (for complex dental-sinus procedures). Ophthalmology should be available on-call for cases with periorbital signs, and neurosurgery for any intracranial change [7, 23, 42].

The proposed clinical pathway begins with PODS suspicion in any child with unilateral sinusitis refractory to two or more antibiotic courses, foul nasal discharge, or sinus symptoms in the context of a known dental pathology. CT of the paranasal sinuses (without contrast for uncomplicated disease; with contrast if orbital signs are present) should be performed, followed by nasal endoscopy and dental examination. If an odontogenic source is confirmed, management follows a tiered algorithm: (1) dental source control (extraction or root canal therapy) as primary treatment for mild PODS without sinus complication; (2) ESS (maxillary antrostomy with or without ethmoidectomy) as primary treatment for moderate-severe PODS or failed dental management; (3) concurrent single-stage dental-ENT surgery for PODS with orbital involvement, oroantral fistula, or ectopic tooth requiring surgical removal. Antibiotic therapy with amoxicillin-clavulanate (or clindamycin in penicillin-allergic patients) provides adjunctive support throughout but is never curative as monotherapy [13, 14, 29].

Table 2. Proposed Tiered Interdisciplinary Management Framework for PODS

Tier	Severity / Indication	Primary Treatment	Concurrent Therapy	Responsible Team
1 – Conservative	Mild PODS; isolated periapical disease; minimal sinus opacification (LMS ≤4)	Dental extraction or root canal therapy; nasal saline irrigation	Amoxicillin-clavulanate 7–10 days; intranasal corticosteroids	Paediatric dentist + ENT (monitoring)
2 – ESS-First	Moderate PODS; failed dental Tx; LMS >4; ethmoid or frontal involvement	Maxillary antrostomy ± ethmoidectomy; dental clearance within same admission	IV antibiotics pre/peri-op; post-op oral amoxicillin-clavulanate	Paediatric ENT + paediatric dentist/OMFS
3 – Combined Single-Stage	PODS with orbital cellulitis; OAF; ectopic tooth; implant removal needed	Concurrent ESS + dental/OAF surgery in single GA encounter	IV broad-spectrum antibiotics; ophthalmology consultation	ENT + OMFS/orthodontics + ophthalmology (on-call)
4 – Escalated Care	Intracranial extension; subdural empyema; cerebral abscess; visual compromise	ESS + neurosurgical drainage + orbital decompression as required	IV vancomycin + metronidazole + ceftriaxone; ICU level care	ENT + neurosurgery + ophthalmology + paediatric ICU + infectious disease

Postoperative follow-up should include nasal endoscopy at 4–6 weeks and dental review at three months. Persistent foul odour two weeks after dental treatment has been identified as a clinical predictor of residual sinusitis requiring ESS in adult series [30], and should prompt early reassessment in children. Long-term dental prevention—including fluoride varnish, fissure sealants, and targeted caries management—constitutes the most impactful strategy for reducing recurrent PODS risk [44, 45].

4. Conclusion

Paediatric odontogenic sinusitis occupies a uniquely hazardous position at the crossroads of dental disease and sinonasal pathology. Its rarity in the literature belies a complication profile—orbital cellulitis in half of reported cases, intracranial spread in one in six, and a fatality rate that no routine sinusitis should carry—that demands the highest clinical vigilance. The absence of PODS from both the EPOS paediatric rhinosinusitis guidelines and the AAP acute bacterial sinusitis guidance is a systemic oversight that this evidence base compels us to address. Surgical management, compared across the four principal approaches, converges on two clear findings: intranasal ESS and combined ENT-dental procedures achieve the highest and most durable success rates, while Caldwell-Luc procedures are now largely historical in uncomplicated cases, and dental treatment alone is insufficient for established PODS. The single most consequential intervention available to clinicians is to ask, in every child with unilateral, refractory, or foul-smelling sinusitis: 'Is there a tooth behind this sinus?' Embedding that question into both otolaryngology and paediatric dentistry practice—through shared referral pathways, coordinated CT protocols, and multidisciplinary care teams—will transform a condition that kills and blinds children into one that is reliably diagnosed, surgically cured, and preventably rare.

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