COMPLICATIONS OF FUNCTIONAL ENDOSCOPIC SINUS SURGERY (FESS) IN PEDIATRIC PATIENTS: INCIDENCE, SPECTRUM, AND POTENTIAL RISK FACTORS

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Annotation. *This thesis analyzes the incidence, spectrum, and potential risk factors of complications following functional endoscopic sinus surgery (FESS) in pediatric patients. A retrospective analysis was conducted on 300 children aged 3–16 years who underwent FESS for chronic rhinosinusitis between 2010 and 2020. The results showed that 20.0% of patients had at least one documented complication; the most frequent were intraoperative bleeding (8.0%), postoperative epistaxis (6.0%), and synechiae formation (4.0%). Less common but clinically significant complications included orbital injury (1.5%), cerebrospinal fluid (CSF) leak (1.0%), and mucocele formation (0.5%). These findings were compared with several contemporary international studies, and the observed differences were attributed largely to methodological variation in complication definitions and follow-up periods rather than to poorer surgical safety. The study did not confirm male sex as an independent risk factor, whereas urgent surgery, bleeding disorders, very young age, asthma, and cystic fibrosis emerged as clinically relevant risk markers based on the broader evidence reviewed. In conclusion, FESS remains an effective and generally safe procedure for appropriately selected pediatric patients, though standardized complication classification, CT-based preoperative planning, mucosa-preserving technique, and structured postoperative follow-up are essential to further improving surgical safety.*

Keywords: *pediatric chronic rhinosinusitis; functional endoscopic sinus surgery; complications; epistaxis; synechiae; orbital injury; cerebrospinal fluid leak; surgical safety.*

Introduction. Pediatric chronic rhinosinusitis (PCRS) is a heterogeneous inflammatory condition characterized by persistent sinonasal symptoms and objective evidence of mucosal disease. The European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS 2020) and the pediatric clinical consensus statement emphasize stepwise

management: appropriate medical treatment, assessment of contributing disorders, and adenoid-directed surgery when indicated before consideration of endoscopic sinus surgery in uncomplicated cases [1,2]. Functional endoscopic sinus surgery (FESS), also termed pediatric endoscopic sinus surgery, is therefore generally reserved for carefully selected children with persistent disease despite adequate conservative management, or for patients with specific conditions such as cystic fibrosis, nasal polyposis, mucoceles, or complicated rhinosinusitis. The operation aims to restore ventilation and drainage, preserve healthy mucosa, and improve access for topical therapy rather than eradicate the underlying inflammatory tendency. Contemporary reviews report favorable symptom outcomes in selected children, but the small operative field and close relationship of the ethmoid labyrinth to the orbit and anterior skull base create a distinct safety profile [3,4].

Complications may be classified as minor or major and as intraoperative, early postoperative, or delayed. Minor events include self-limited bleeding, periorbital ecchymosis or emphysema, orbital fat exposure without functional deficit, crusting, infection, and synechiae. Major events include hemorrhage requiring transfusion or urgent intervention, orbital hematoma with visual compromise, extraocular muscle or optic nerve injury, cerebrospinal fluid (CSF) leak, intracranial injury, and meningitis. Delayed stenosis, adhesions, recurrent disease, and mucocele formation may necessitate revision surgery. Because published studies apply different definitions and follow-up periods, complication estimates should be interpreted according to the events actually captured.

Objective. To determine the incidence and spectrum of documented complications after FESS in pediatric patients with CRS, examine demographic and clinical characteristics potentially associated with adverse outcomes, and interpret the findings in the context of contemporary international evidence.

Materials and methods. A retrospective observational analysis included pediatric patients who underwent FESS for CRS between 2010 and 2020. Electronic medical records were reviewed for age, sex, comorbidities, and documented intraoperative and postoperative complications. The prespecified complication spectrum included bleeding, postoperative epistaxis, synechiae, orbital injury, CSF leak, and mucocele. Categorical variables were summarized as frequencies and percentages. Because the source dataset did not provide adjusted effect estimates or complete sex-stratified event counts, demographic differences were treated as descriptive and were not interpreted as independent risk factors.

Results. The analysis comprised 300 children aged 3-16 years, including 160 boys (53.3%) and 140 girls (46.7%). Sixty patients (20.0%) had at least one documented complication. The most frequently recorded events were intraoperative bleeding (8.0%), postoperative epistaxis (6.0%), and synechiae formation (4.0%). Less frequent but clinically important events were orbital injury (1.5%), CSF leak (1.0%), and mucocele formation (0.5%). Event-specific proportions were considered potentially overlapping because their sum exceeded the proportion of patients with any complication. Although boys were slightly more numerous in the cohort, the available aggregate data did not establish a statistically supported association between sex and complications.

Discussion. The observed overall frequency is higher than rates reported in several contemporary pediatric series. In an ACS-NSQIP-P analysis of 2,061 pediatric ESS procedures, 30-day complications occurred in 3.0%, unplanned reoperation in 2.6%, and readmission in 4.5% [5]. A 25-year single-surgeon series of 352 primary pediatric ESS procedures reported 31 complications (8.8%): lamina papyracea violation with orbital fat exposure in 6.3%, periorbital ecchymosis in 1.4%, orbital emphysema in 0.85%, and CSF leak in 0.3%; blindness, orbital hematoma, and major nasal bleeding requiring intervention were not observed [6]. In a nationwide analysis of 62,823 ESS procedures across age groups, the major complication rate was 1.0%, comprising hemorrhage requiring transfusion (0.76%), CSF leak (0.17%), and orbital injury (0.07%); children had relatively more orbital injury but fewer CSF leaks than adults [7]. These data support the general safety of modern FESS while confirming that rare events may have severe neurological or ophthalmological consequences.

The difference between the present 20% estimate and international reports should not be interpreted automatically as poorer surgical safety. The current analysis included common minor events, whereas database studies often capture only events coded during a 30-day interval or complications requiring reintervention. Intraoperative bleeding is expected to some degree in FESS and should be counted as a complication only when a clinically meaningful threshold is met, such as impaired visualization, premature termination, packing or cautery beyond routine practice, transfusion, or return to the operating room. Similarly, a minor lamina papyracea breach without functional injury differs substantially from orbital hematoma, extraocular muscle trauma, or visual loss. A standardized severity grading system and explicit time windows are therefore essential for valid comparisons.

Bleeding and postoperative epistaxis together represented the dominant safety signal in this cohort. Preoperative evaluation should include a focused bleeding history,

review of anticoagulant or antiplatelet exposure, and laboratory testing when clinically indicated. In the NSQIP-P study, urgent or emergency surgery was independently associated with complications (odds ratio [OR] 3.81), while a history of bleeding disorder was associated with complications (OR 5.30) and markedly increased the odds of transfusion-requiring hemorrhage [5]. Children younger than 3 years also showed a higher risk of bleeding requiring transfusion. These findings suggest that age, surgical urgency, and coagulopathy are more evidence-based risk markers than sex alone.

Postoperative epistaxis is also a relevant driver of unplanned care. In a multicenter study of 3,669 ambulatory pediatric ESS cases, the 30-day readmission rate was 3.5%; epistaxis accounted for 17.2% of readmissions. Age below 3 years, asthma, and cystic fibrosis were associated with greater readmission risk [8]. Accordingly, discharge planning should include written instructions regarding bleeding, fever, escalating headache, clear unilateral rhinorrhea, periorbital swelling, diplopia, reduced vision, or altered mental status, with urgent reassessment for orbital or intracranial red flags.

Synechiae are a common delayed minor complication and a recognized cause of persistent obstruction or revision surgery. Their prevention depends on mucosa-preserving technique, avoidance of opposing raw surfaces, stable positioning of the middle turbinate, saline irrigation, topical intranasal corticosteroids when appropriate, and structured endoscopic follow-up. Evidence for routine office debridement in children remains less standardized than in adults because tolerance, anesthesia requirements, and underlying disorders vary. Revision series indicate that adhesions and stenosis or a missed maxillary sinus ostium are common findings when repeat surgery is required [9].

Orbital and skull-base complications require immediate recognition. Preoperative thin-section CT should be reviewed systematically for the integrity of the lamina papyracea, skull-base asymmetry and depth, ethmoid artery course, Onodi cells, sphenoid pneumatization, and the relationship of the optic nerve and internal carotid artery to the sphenoid sinus. Image guidance may improve orientation in selected complex, extensive, or revision procedures, but it does not replace detailed anatomical knowledge and meticulous technique. Sudden proptosis, a tense orbit, impaired ocular motility, afferent pupillary defect, or visual deterioration should trigger immediate ophthalmological assessment and decompression when orbital compartment syndrome is suspected. Intraoperative clear fluid or postoperative unilateral watery rhinorrhea warrants evaluation for CSF leakage and timely skull-base repair to reduce the risk of meningitis.

Limitations. The retrospective design is vulnerable to incomplete documentation and inconsistent classification of minor events. The available summary did not specify the institution, operative extent, surgeon experience, urgency, previous adenoidectomy, revision status, comorbidity distribution, exact follow-up period, definitions of bleeding and orbital injury, or whether individual patients had multiple events. Percentages were reported without exact event counts for every category, confidence intervals, or multivariable analysis. These limitations preclude causal inference and direct identification of independent risk factors. Before journal or conference submission, the underlying case-level dataset should be rechecked, mutually exclusive patient counts distinguished from total events, and sex-specific rates reported with an appropriate test and effect estimate.

Conclusion. FESS is an effective and generally safe option for appropriately selected children with medically refractory CRS, but both frequent minor events and rare sight- or life-threatening complications must be considered. In this cohort, 20.0% of patients had at least one documented event, primarily bleeding, postoperative epistaxis, or synechiae; this estimate is higher than most contemporary series and is likely influenced by broad inclusion of minor complications and methodological differences. The data do not support male sex as an independent risk factor. Evidence from larger studies instead highlights urgent surgery, bleeding disorders, very young age, asthma, and cystic fibrosis as clinically relevant markers for perioperative risk or readmission. Standardized outcome definitions, careful CT-based planning, mucosa-preserving surgery, hemostatic vigilance, and structured follow-up are central to improving pediatric FESS safety.

Keywords: pediatric chronic rhinosinusitis; functional endoscopic sinus surgery; complications; epistaxis; synechiae; orbital injury; cerebrospinal fluid leak.

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