


## ORIGINAL RESEARCH

# Complications of primary pediatric endoscopic sinus surgery for chronic rhinosinusitis: A 25-year single surgeon experience

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## Abstract

**Objective:** To report our experience on the complications of primary pediatric endoscopic sinus surgery (ESS).

**Methods:** Case series of pediatric ESS performed from 1991 to 2016 on children who failed maximal medical therapy and/or adenoidectomy. Inclusion criteria were children (age <12 years old) who underwent primary ESS with or without adenoidectomy for chronic rhinosinusitis (CRS) after failed maximal medical therapy and/or adenoidectomy. All patients underwent maxillary antrostomy ± partial or total ethmoidectomy. Patients with complicated acute rhinosinusitis were excluded. Complications reviewed included: skull base injury and CSF leak, orbital injuries (blindness, orbital hemorrhage, emphysema, periorbital swelling and bruising, fat exposure), and bleeding requiring intervention.

**Results:** A total of 352 patients underwent ESS between 1991 and 2016. There were no blindness or orbital hematoma reported, and no major nasal bleeding requiring intervention. The total number of complications was 31 (8.8%): 1 (0.3%) CSF leak, 3 (0.85%) orbital emphysema, 5 (1.4%) periorbital ecchymosis, and 22 (6.3%) lamina papyracea violation with orbital fat exposure.

**Conclusions:** Complications of primary pediatric ESS can be rare dependent on surgeon's experience, the most common being orbital injury.

Level of evidence: 4.

## KEYWORDS

adenoiditis, complications, endoscopic sinus surgery, maxillary antrostomy, pediatric CRS

## 1 | INTRODUCTION

Chronic rhinosinusitis (CRS) prevalence in the pediatric population has been reported between 2% and 4% in the literature.<sup>1</sup> The European Position Paper on Rhinosinusitis and Nasal Polyposis (EPOS 2020)<sup>2</sup>

and the International Consensus Statement on Allergy and Rhinology: rhinosinusitis 2021 (ICAR: rhinosinusitis 2021)<sup>1</sup> define CRS as two or more symptoms, one of which should be either nasal obstruction/blockage/congestion or nasal discharge ± facial pain/pressure or cough for >12 weeks with either endoscopic signs or computed

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tomography (CT) changes consistent with disease. The mainstay of treatment is medical therapy which consists of oral antibiotics, intranasal steroids, and nasal saline irrigations.<sup>1,2</sup> Surgery on the other hand might be required when medical therapy fails or in cases of complicated acute rhinosinusitis. Surgical interventions consist of adenoidectomy ± antral irrigation, balloon sinuplasty and endoscopic sinus surgery (ESS). Although ESS is the most effective of the surgical interventions (positive outcomes in 71%–100%),<sup>3,4</sup> it is likely underutilized due to the fear of complications given the smaller anatomy. However, minor complications have been reported in 1.1%–2% whereas major complications occur in 0.2%–0.6% of cases which are very comparable to adults.<sup>3,4</sup> In addition, the previous concern about facial growth was abated by Bothwell et al. and Senior et al.<sup>5,6</sup> Given its rarity, to our knowledge, no major updates on complications have been published since the systematic review by Makary et al. and Vlastarakos et al. in 2013.<sup>3,4</sup> Thus, the aim of this study is to report our experience on the complications of pediatric ESS over 25 years' time span.

## 2 | MATERIALS AND METHODS

Institutional review board of West Virginia University approved the conduct of this study. Since this is a retrospective review study, no informed consent was needed from the patients. We then queried our institutional registry for all pediatric CRS patients who underwent ESS by the senior author (HHR) between 1991 and 2016.

Inclusion criteria: patients between age 2 and 12 years who underwent primary ESS (±adenoidectomy) for uncomplicated CRS, after having failed maximal medical therapy and or adenoidectomy. Maximal medical therapy consisted of oral antibiotics (usually 21 days of weight-based amoxicillin-clavulanate or cefdinir [in penicillin allergy patients]), topical nasal steroid sprays and or systemic steroids, as well as allergy management if they had allergies. All patients underwent bilateral middle meatal antrostomies (MMA) ± partial or total ethmoidectomy. CRS was defined as at least 12 weeks of symptoms, which is consistent with consensus definitions for pediatric CRS from the most recent EPOS 2020 and ICAR: rhinosinusitis 2021.<sup>1,2</sup> Exclusion criteria: all patients with primary ciliary dyskinesia or immunodeficiency disorders since their surgical approach may have been different.

Demographic data, comorbidities, and CT scan Lund-McKay<sup>7</sup> scores were collected. We reviewed all minor and major complications related to the ESS procedure. Minor complications were defined as epistaxis that did not require transfusion or intervention, and minor orbital injury. Minor orbital injuries included orbital emphysema, periorbital ecchymosis, and lamina papyracea violation with orbital fat exposure without any symptoms. Major complications included skull base injury with CSF rhinorrhea, blindness, orbital hematoma requiring decompression or canthotomy, and major epistaxis requiring transfusion and/or intervention.

To evaluate how surgeon's experience played a role in the frequency of complications, the number of complications were evaluated

**TABLE 1** Characteristics of children undergoing primary ESS

N = 352	Total (%)
Age (years)	6.5 (±2.6)
Female	140 (39.8%)
Allergic rhinitis	172 (48.9%)
Asthma	143 (40.6%)
CT score	10 (±4.3)
Surgery	
ESS	136 (38.6%)
ESS + adenoidectomy	216 (61.4%)
ESS type	
MMA	93 (26.4%)
MMA + ethmoidectomy	259 (73.6%)

Abbreviations: ESS, endoscopic sinus surgery; MMA, middle meatal antrostomy.

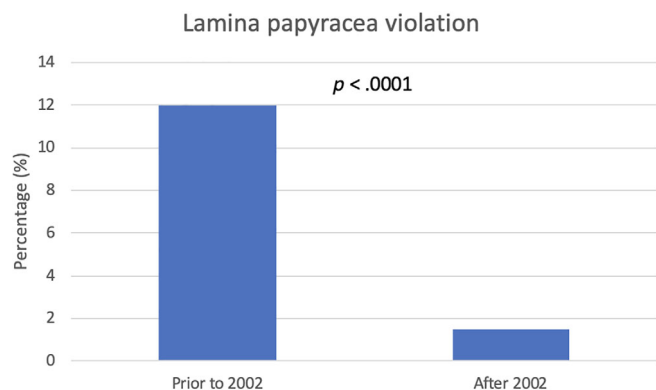
for the first 10 years (1991–2002) versus the second 15 years (2002–2016) of the primary surgeon's career.

Statistical analysis was performed using the Stata statistical software version 16.1 (StataCorp, College Station, TX). We calculated summary statistics for the outcome (complications) and independent variables. This included counts and percentages for categorical variables and means (±standard deviations) for continuous variables. We used the two-sided t-test for continuous variables, and chi-square test for categorical variables. A *p*-value <.05 was considered statistically significant.

## 3 | RESULTS

Three-hundred and fifty-two patients were included in this study. Table 1 summarizes the patient's demographics and associated characteristics. Average age was 6.5 years (±2.6, 2.0–12.9 years), 39.8% were female. One-hundred and thirty-six patients (38.6%) underwent ESS only (average age 7.8 ± 2.6, 32% female), whereas 216 patients (61.4%) underwent concomitant ESS and adenoidectomy (average age 6.5 ± 2.3, 44.4% female). Ninety-three patients had bilateral MMAs whereas 259 patients had bilateral MMAs and ethmoidectomy. Average CT LM score in all the cohort was 10 (±4.3, 2–23). Patients who had ESS had a CT score of 10 (±4.3, 2–22), and those who had concomitant ESS, and adenoidectomy had CT score of 10 (±4.3, 3–23). 48.9% of patients had allergic rhinitis, and 40.6% had asthma.

The total number of complications was 31 (8.8%). Minor orbital complications were the most common. These were divided into three categories: orbital emphysema (air in the orbit), periorbital ecchymosis, and violation of the lamina papyracea with orbital fat exposure. Out of the 352 patients who underwent ESS, there was a total of 30 cases where minor orbital injury happened (8.5%): 3 (0.85%) orbital emphysema, 5 (1.4%) periorbital ecchymosis, and 22 (6.3%) lamina papyracea violation with orbital fat exposure. Skull base injury and CSF rhinorrhea occurred in only one patient (0.3%). Injury occurred on the



**FIGURE 1** Violation of the lamina papyracea was significantly less prevalent after 2002

right side, in the lateral lamella of the cribriform plate. That was repaired with free mucosal graft from the middle turbinate in an overlay fashion and packed with absorbable surgical and gelfoam packing. Patient was observed in an overnight hospital stay, and unfortunately developed meningitis that required 7 days hospital stay. He was discharged home and on follow up he recovered completely with no further CSF rhinorrhea and complications. There were no blindness or orbital hematoma reported, and no major nasal bleeding requiring intervention or transfusion.

One-hundred and fifty-eight ESS (43 ESS, 115 ESS, and adenoidectomy) cases were performed before 2002 compared to 194 ESS (93 ESS, 101 ESS, and adenoidectomy) after 2002. The average age of patient who underwent ESS prior to 2002 was 6.5 years ( $\pm 2.4$ , 2–12.3 years), compared to 7.5 years ( $\pm 2.4$ , 2.3–12.9 years) for children who underwent ESS after 2002 ( $p = .0003$ ). Prior to 2002, 19 patients (12%) had lamina papyracea violation compared to only 3 patients (1.5%) had orbital fat exposure after 2002 ( $p < .0001$ ) (Figure 1).

## 4 | DISCUSSION

Pediatric ESS offers a surgical alternative in the treatment of refractory CRS in children, with a success rate ranging from 82% to 100% in patients who failed medical treatment.<sup>3,4</sup> Prior studies demonstrated that it is safe with a low complication rate, estimated to be around 1.4%.<sup>3,4</sup> This is similar to the complications profile in adults. In adults undergoing primary ESS, the general complication rate ranges from 0.36% to 5.8%, with minor and major complications occurring in 5.7% and 1.5%, respectively.<sup>8–10</sup> In children, minor and major complications in primary ESS have been reported to be around 2% and 0.6%, respectively.<sup>4</sup>

Minor orbital injuries were the most reported complications in children undergoing ESS. In one systematic review, there was five orbital injuries out of the six complications reported in 440 pooled patients (1.1%).<sup>3</sup> Another systematic review also showed six orbital injuries out of 1000 pooled patients (0.6%).<sup>4</sup>

Our study is the largest single surgeon single center published series on the complications of pediatric ESS with 352 patients. Minor orbital injuries were the most common complications in our series. Symptomatic injuries (periorbital emphysema and ecchymosis) were low at 0.3% and 0.85%, respectively. This is consistent with what has been published in the literature. However, in this series, we also report on all the cases with asymptomatic lamina papyracea violation which came at 6.5%. These cases are usually not reported since there is no direct clinical sequela to the patient. It is important to understand that children are at much higher risk of orbital injuries due to their smaller anatomy. Our rate of major complications is consistent with what has been published. We had no major orbital injuries (hematoma, blindness, visual changes), and only one skull base injury with CSF rhinorrhea.

The distance between the lamina papyracea and medial inferior orbital wall directly adjacent to it (semilunar hiatus and ethmoidal infundibulum) is an important factor to consider during MMA. This is of less importance in adults since the anatomy of the sinuses is well developed. However, it can become an issue in cases with hypoplastic maxillary sinus where the lamina can be in tight contact with the orbit behind it which puts the orbit at higher risk for injury. Similarly, in children, the relationship between the lamina papyracea and the orbit is always at risk due to small distance.

This study also highlights the importance of surgeon's experience in decreasing the number of complications. The number of orbital injuries were significantly lower later in the surgeon's career. This is likely technique related in approaching the maxillary antrostomy.

Our study has several inherent limitations. It was a retrospective review performed of surgeries performed at a single institution of surgeries performed by a single surgeon. Therefore, recall bias is an essential limitation. This was minimized by an extensive review of a well maintained and updated database of all children who underwent ESS over 25 years period. Another limitation is generalizability of the results since these cases were performed by a single surgeon. Surgeon experience and comfort level are the most important factors to prevent complications in ESS. This series shed the light on the importance of orbital injuries in children undergoing ESS. These injuries can happen in higher incidence, and care should always be considered when proceeding with basic antrostomy.

## 5 | CONCLUSION

In highly experienced hands, low rates of major and minor complications are possible in primary pediatric ESS. Our results show that complications rates decrease with greater experience. These favorable results may not be replicated in low-frequency surgical settings or in children with advanced disease or cystic fibrosis, or those undergoing revision surgery.

## CONFLICT OF INTEREST

No conflicts of interest reported.

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