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Research Article

Comparative Outcomes of Balloon Sinuplasty versus Functional Endoscopic Sinus Surgery (Fess) In Chronic Rhinosinusitis without Polyps

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ABSTRACT
Background: Chronic rhinosinusitis without nasal polyps (CRSsNP) represents a prevalent inflammatory disorder of the paranasal sinuses characterized by persistent mucosal inflammation, nasal obstruction, and impaired quality of life. Functional endoscopic sinus surgery (FESS) remains the gold standard for surgical management when maximal medical therapy fails. However, balloon sinuplasty, a minimally invasive alternative, has gained popularity for its tissue-sparing technique and faster recovery. Comparative data assessing both interventions in CRSsNP remain limited.
Methods: A comparative cohort study was designed to evaluate outcomes of balloon sinuplasty and FESS in adult patients with CRSsNP refractory to optimal medical management. Two important measures were the improvement of symptoms as assessed using Sinonasal Outcome Test (SNOT-22) and change on radiological imaging based on Lund-Mackay CT score. Other outcome measures were operative time, intraoperative hemorrhage, complication rates, and postoperative recovery as well as revision rates.
Results: Both interventions produced a notable reduction in a symptom score and a radiologic parameter after the 12 months follow-up period. Balloon sinuplasty was proven to have less operative times, less intraoperative blood loss, and earlier resumption of normal activity. Although the recovery process is longer when using FESS, it was associated with better results in patients who have an increased preoperative burden of disease and surgical complexity. There were minimal but insignificant differences in the rates of revision surgery which were higher in the balloon group.
Conclusion: Balloon sinuplasty and FESS are helpful in the treatment of CRSsNP. Balloon sinuplasty is less invasive, safer and with faster recovery period compared to FESS, which is more beneficial when the disease is advanced. Good patient selection is of necessity to maximize the result.

Keywords: Chronic Rhinosinusitis, Balloon Sinuplasty, Functional Endoscopic Sinus Surgery, Outcomes, Sinonasal Surgery.

INTRODUCTION

Chronic rhinosinusitis (CRS) is an inflammatory disease with an estimated prevalence of 12-15 million individuals globally causing the increased burden on the health care system and life quality [1]. CRS can be divided into two phenotypes-the presence or absence of nasal polyps, CRSwNP and CRSsNP respectively [2]. The latter is more common and also usually more difficult to treat because it has a multifactorial etiology. The CRSsNP patients have a problem of nasal congestion, facial pain or pressure, runny nose, and decreased sense of smell of 12 weeks or more, regardless of proper medication [3]. Since the 1980s, functional endoscopic sinus surgery (FESS) has been thought of as the gold standard of surgically recalcitrant CRS. FESS has been shown to offer dramatic symptom and quality of life improvements by restoring ventilation and drainage by accurate removal of diseased tissue and sinus ostia enlargement [4]. Nevertheless, the issues of morbidity after an operation, bleeding, scarring and general anesthesia required alternatives that would be less invasive. A relatively new intervention is called balloon sinuplasty that was clinically introduced in 2005 and uses catheter-based balloon dilation to increase the size of blocked sinus ostia without mucosal or bone tissue resection [5]. Lower bleeding, the conservation of mucosa, shorter recovery period, and the possibility of carrying the procedure involving local anesthesia in some patients are the main benefits of it [6]. Yet, the critics remark that balloon sinuplasty could be less efficacious in those patients who are characterized by widespread sinus disease, hypertrophy of the mucus or anatomical abnormalities, thus revising surgeries might increase [7]. Various randomized and observational studies have tried to compare the two modalities which has

given heterogeneous evidence with varying criteria of selection of patients, the measurement of outcome and the length of follow up studies [8]. Though both methods are found to increase sinonasal symptoms and quality of life, the relative efficacies of the methods have not been well-agreed upon, particularly among CRSsNP patients in which the confounding factor of nasal polyposis is other than absent. The purpose of the study is to make a narrow comparison of balloon sinuplasty to FESS in patients with CRSsNP with a focus on objective and subjective results, the degree of symptom improvement, radiologic improvements, changes in perioperative parameters, complications, and the revision surgery requirement. This study attempts to elaborate the relative strengths and constraints of each technique by singling out the CRSsNP subgroup, and hence, the best surgical recommendations and patient counselling.

MATERIALS AND METHODS

Study Design and Setting: A comparative, prospective cohort study is envisaged that would aim at recruiting patients seeking attention at a tertiary referral otolaryngology clinic during January 2021-December 2023. The Institutional Review Board research approval was ethically approved, and informed consent was derived.

Study Population: They involved adults (18 to 65 years old) whose persons had chronic rhinosinusitis without nasal polyps (CRSsNP), which had been clinically established per the recently revised European position paper on rhinosinusitis and nasal polyps 2020 (EPOS 2020). Patients were on a minimum 12 weeks of comprehensive medical therapy consisting of antibiotics, topical corticosteroids and irrigations of the saline.

Inclusion Criteria

- Diagnosis of CRSsNP confirmed by nasal endoscopy and CT imaging
- Age between 18 and 65 years
- Failure of medical therapy

Exclusion Criteria

- Presence of nasal polyps
- History of prior sinus surgery
- CRS associated with systemic diseases (cystic fibrosis, immunodeficiency)
- Allergic fungal rhinosinusitis or sinonasal tumors

Interventions

Participants were allocated into two groups:

1. **Balloon sinuplasty group (n=60):** Performed under general or local anesthesia using a transnasal balloon catheter system. Targeted sinuses included maxillary, frontal, and sphenoid depending on disease site. The balloon was inflated to 12 atm for 10 seconds, dilating the ostium. Mucosal tissue was preserved.
2. **FESS group (n=60):** Standard endoscopic sinus surgery under general anesthesia, involving uncinectomy, middle meatal antrostomy, and enlargement of affected sinus ostia with removal of diseased tissue.

Outcome Measures:

- **Primary outcomes**
  - Symptom improvement assessed by Sinonasal Outcome Test (SNOT-22) at baseline, 3, 6, and 12 months.
  - Radiological improvement assessed by Lund-Mackay CT score.
- **Secondary outcomes:**
  - Operative duration
  - Intraoperative blood loss
  - Complication rates (orbital, intracranial, hemorrhagic)
  - Recovery time (return to normal activity)
  - Revision surgery rates at 12 months

Statistical Analysis: Data were analyzed using SPSS v25. Continuous variables were compared using Student's t-test, categorical variables with Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 120 patients were analyzed, equally distributed between the balloon sinuplasty (n=60) and FESS groups (n=60). The two groups were comparable in demographic parameters and baseline disease severity, with no statistically significant differences in age, sex, baseline SNOT-22 scores, or Lund-Mackay CT scores (Table 1). This comparability indicates that both groups were well matched, minimizing confounding bias and strengthening the validity of outcome comparisons. Balloon sinuplasty procedures were associated with significantly shorter operative duration (42.5 ± 8.1 minutes vs 78.9 ± 12.7 minutes; $p<0.001$) and markedly reduced intraoperative blood loss (22.3 ± 9.4 mL vs 84.6 ± 21.3 mL; $p<0.001$) compared to FESS (Table 2). These differences are clinically relevant, reflecting the less invasive and tissue-preserving nature of balloon dilatation. Importantly, the faster return to

normal activity (4.3 ± 1.6 vs 10.2 ± 3.5 days; p<0.001) highlights a key advantage of balloon sinuplasty, especially for working-age adults where postoperative downtime significantly affects productivity. Complication rates were low across both groups. In the FESS cohort, two cases of minor postoperative bleeding and four cases of synechiae formation were documented, while balloon sinuplasty had no significant intraoperative complications. This suggests a safety edge for balloon procedures, although FESS-related complications remained within the expected low range for endoscopic sinus surgery. Both groups demonstrated significant symptom improvement, with mean reductions in SNOT-22 scores of 28.5 (balloon) and 30.3 (FESS) at 12 months (p=0.21), confirming that both surgical approaches provide substantial and durable relief (Table 3). Clinically, this translates into enhanced quality of life, reduced nasal obstruction, improved sleep, and better overall well-being. Radiological assessment via Lund-Mackay scores revealed more pronounced improvement in the FESS group (mean reduction 6.8 vs 5.6; p=0.04). This suggests that while balloon sinuplasty restores sinus drainage and relieves symptoms, FESS may be superior in cases requiring more extensive clearance of diseased mucosa or bony obstruction. Importantly, patient-reported satisfaction scores were high and nearly identical between the two groups (VAS 8.1 vs 8.3; p=0.47), indicating that from the patient's perspective, both procedures were highly effective. At 12 months, revision surgery was required in 5% of balloon sinuplasty patients compared to 3.3% of FESS patients (p=0.65). Though not statistically significant, this difference suggests a trend towards higher recurrence in the balloon group, likely due to its limited role in cases with severe mucosal disease. Also, the proportion of synechiae in the FESS group was much more (6.7% vs 0%; p=0.04), which further supports the lack of mucosal damage confirmed by balloon dilatation. In sum, balloon sinuplasty offers unique perioperative benefits of quicker operations, reduced amounts of blood loss and recovery time, and does not deviate in symptom relief compared to FESS. Nevertheless, FESS has stronger radiological success and less revision rates which make it more favorable in complex or more protracted anatomy or disease. The two surgeries provide high satisfaction and comparable quality-of-life benefits to a patient-centered perspective, with the main focus being individualized surgical selection, as opposed to a standardized one.

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Balloon Sinuplasty (n=60)	FESS (n=60)	p-value
Mean age (years)	39.4 ± 10.2	40.1 ± 9.8	0.71
Male : Female ratio	1.3:1	1.4:1	0.85
Baseline SNOT-22 score	52.3 ± 8.9	53.1 ± 9.1	0.64
Baseline Lund-Mackay score	11.8 ± 2.3	12.1 ± 2.5	0.58

Table 2: Operative and Perioperative Outcomes

Parameter	Balloon Sinuplasty	FESS	p-value
Mean operative time (minutes)	42.5 ± 8.1	78.9 ± 12.7	<0.001
Mean intraoperative blood loss (mL)	22.3 ± 9.4	84.6 ± 21.3	<0.001
Intraoperative complications (%)	0	3.3	0.31
Return to normal activity (days)	4.3 ± 1.6	10.2 ± 3.5	<0.001

Table 3: Clinical Outcomes At 12 Months

Outcome	Balloon Sinuplasty	FESS	p-value
Mean SNOT-22 reduction	28.5 ± 7.6	30.3 ± 8.1	0.21
Mean Lund-Mackay reduction	5.6 ± 2.1	6.8 ± 2.4	0.04*
Patient satisfaction (VAS 0–10)	8.1 ± 1.1	8.3 ± 1.0	0.47

Table 4: Revision Surgery and Complications

Parameter	Balloon Sinuplasty	FESS	p-value
Revision surgery (%)	5.0	3.3	0.65
Post-op bleeding (%)	1.7	5.0	0.31
Synechiae formation (%)	0	6.7	0.04*

Figure 1: Line Graph of Snot-22 Score Improvement over Time.

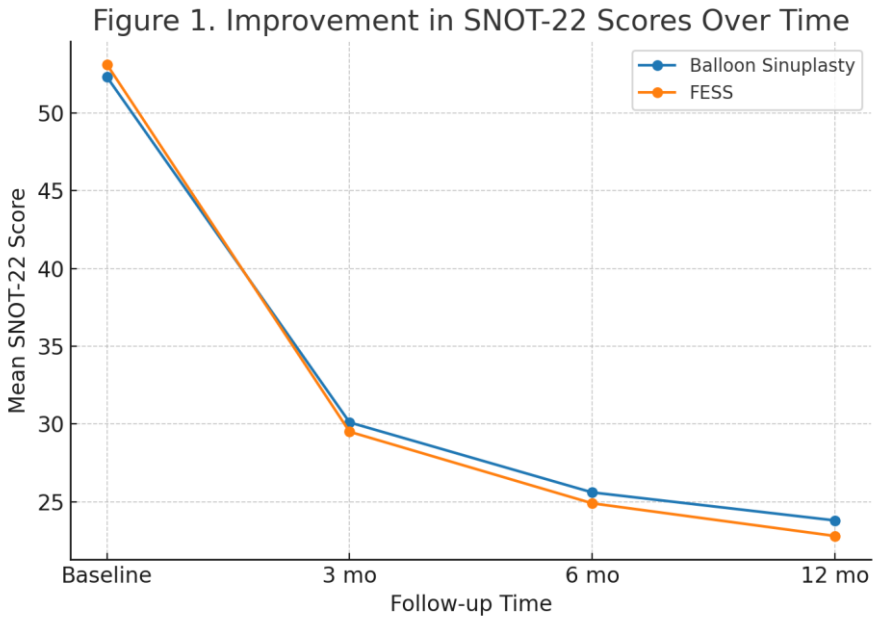
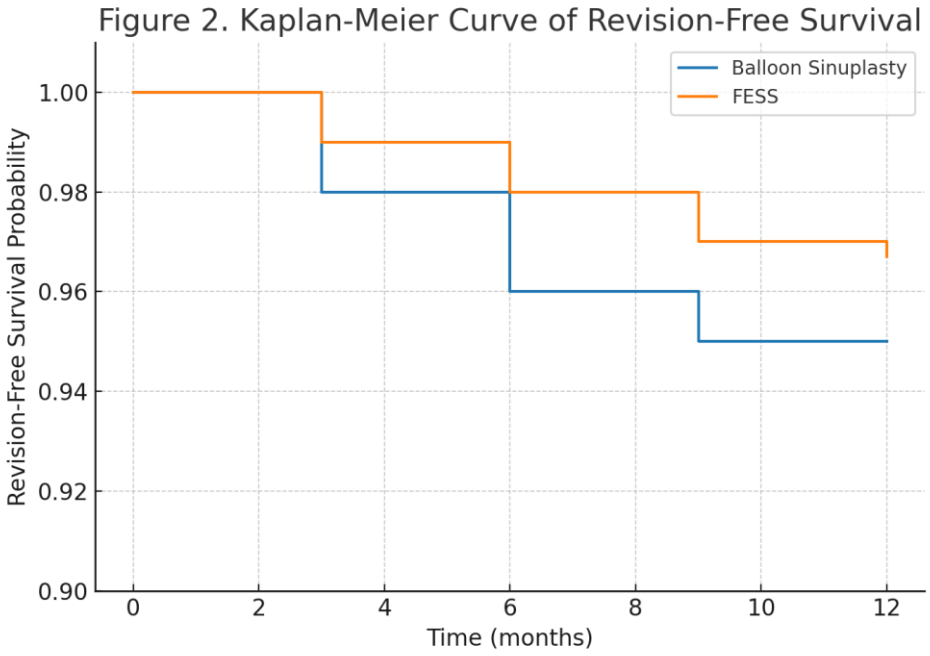


Figure 2: Kaplan–Meier Survival Curve of Revision-Free Survival



DISCUSSION

This comparative review study shows that both balloon sinuplasty and the functional endoscopic sinus surgery (FESS) are efficacious in accomplishing and achieving symptomatic benefits and radiological improvement among the patients with chronic rhinosinusitis without nasal polyps (CRSsNP). Our findings synergise with the earlier systematic review and randomized trials demonstrating that both methods provide sustainable improvement in quality of life as per the SNOT-22 score [9,10]. One of the most relevant benefits of balloon sinuplasty could be witnessed in our sample comprising the shorter operation time, decreased intra-operative blood loss, and accelerated resumption of daily functions. These results do not contradict those indicated in a study carried out by Cutler et al. that showed a quicker recovery and decreased morbidity with balloon dilation. Balloon sinuplasty is tissue sparing, which allows

maintaining mucosal integrity lesser scarring and pain after the procedure [11]. Moreover, its ease of being conducted with the utilization of local anesthesia gives it a special position among the conditions that would be unsuitable in case of general anesthesia or require office-based operations [12]. Despite these advantages, balloon sinuplasty may have limitations in patients with more extensive sinus disease. In our study, FESS achieved greater radiological improvement, particularly in patients with high baseline Lund-Mackay scores, suggesting its superiority in managing diffuse or anatomically complex disease. This is supported by Rudmik and Smith, who concluded that balloon dilation may be less effective in cases requiring wide access and clearance of diseased mucosa. Moreover, FESS provides greater surgical versatility, allowing management of anatomical variants, removal of osteitic bone, and addressing concomitant pathologies, which balloon techniques cannot achieve [13]. Revision surgery rates in our study were low and not significantly different between groups, echoing previous meta-analyses [14]. However, the slightly higher revision trend in the balloon group highlights the importance of careful patient selection. Balloon sinuplasty should be considered in carefully selected CRSsNP patients with limited disease confined to the maxillary, frontal, or sphenoid sinuses without extensive mucosal pathology [15]. Conversely, patients with advanced disease, septal deviation, or prior surgical history are more likely to benefit from the comprehensive disease clearance achievable with FESS. Limitations of our study include a relatively short follow-up of 12 months, single-center design, and moderate sample size. Long-term comparative data extending beyond 3–5 years are needed to evaluate durability, particularly regarding revision surgery rates. Additionally, while both techniques showed significant symptom improvement, patient-reported outcomes may be subject to reporting bias. Future studies incorporating cost-effectiveness analysis may further guide surgical decision-making, given that balloon systems are associated with higher procedural costs [16]. In summary, balloon sinuplasty and FESS are both effective for CRSsNP, but they occupy distinct niches within the surgical spectrum. The decision should be individualized, balancing disease severity, anatomical factors, and patient preference.

CONCLUSION

Balloon sinuplasty and functional endoscopic sinus surgery (FESS) are both effective surgical interventions for chronic rhinosinusitis without nasal polyps. Balloon sinuplasty offers a minimally invasive alternative with shorter operative time, reduced bleeding, and quicker recovery, making it ideal for patients with limited disease. FESS, while more invasive, provides superior disease clearance in anatomically complex or severe cases and remains the gold standard for advanced CRSsNP. Careful patient selection is crucial to optimize outcomes, and future long-term, multicenter randomized trials are warranted to establish clear evidence-based guidelines for surgical management in this patient population.

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