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# DESCRIPTIVE STUDY OF SYMPTOMS IMPROVEMENT FOLLOWING ENDOSCOPIC SINUS SURGERY FOR CHRONIC RHINOSINUSITIS

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## ABSTRACT

**Background:** Chronic rhinosinusitis (CRS) is a chronic inflammatory disorder that significantly impairs quality of life. Functional Endoscopic Sinus Surgery (FESS) is the standard treatment for medically refractory CRS, and the Sino-Nasal Outcome Test-22 (SNOT-22) is widely used to assess postoperative symptom improvement. **Materials and Methods:** A prospective observational descriptive study was conducted at the Upgraded Institute of Otorhinolaryngology, Rajiv Gandhi Government General Hospital, Chennai, from 2023 to 2024. Eighty-four patients aged 15–60 years with CRS who underwent FESS were followed for three months. Symptom severity and health-related quality of life were assessed using SNOT-22 before surgery and at 1 and 3 months postoperatively. Associations between postoperative improvement and age, gender, Lund–Mackay CT score, and comorbidities were evaluated. **Result:** The mean age was 37.92 ± 12.10 years, and 57 (67.9%) participants were male. Mean SNOT-22 scores decreased significantly from 57.82 ± 10.95 preoperatively to 33.65 ± 10.20 at 1 month and 21.31 ± 10.65 at 3 months (both $p<0.001$). The mean improvement at 3 months was 36.51 points with a 63.15% improvement and a very large effect size (Cohen's d=3.379). Minimal clinically important difference was achieved in 83 (98.8%) patients at 1 month and all 84 (100%) patients at 3 months. Postoperative improvement showed no significant association with age (p=0.516), gender (p=0.133), Lund–Mackay CT score (r=0.182, p=0.098), diabetes mellitus (p=0.960), allergic rhinitis (p=0.506), or smoking (p=0.367). **Conclusion:** FESS produced significant and clinically meaningful improvement in symptoms and quality of life in patients with CRS, irrespective of age, gender, radiological severity, or selected comorbidities.

## INTRODUCTION

Chronic rhinosinusitis (CRS) is a common, multifactorial inflammatory disorder of the nasal cavity and paranasal sinuses characterized by persistent mucosal inflammation lasting for more than 12 consecutive weeks and presenting clinically with symptoms such as nasal obstruction or congestion, nasal discharge (anterior or posterior), facial pain or pressure, and reduction or loss of smell.[1,2] CRS represents a significant global health burden, affecting approximately 5–12% of the adult population worldwide.[1,3] In India, CRS constitutes one of the most frequent causes for otorhinolaryngology outpatient visits and contributes substantially to patient morbidity, healthcare utilization, absenteeism from work, and deterioration in overall quality of life.[4] The chronic inflammatory milieu in CRS leads to mucosal edema, impaired mucociliary clearance, ostiomeatal complex obstruction, and secondary bacterial infections, thereby perpetuating a vicious cycle of inflammation and symptom persistence.[2] CRS is broadly classified into CRS with nasal polyps (CRSwNP) and CRS without nasal polyps (CRSsNP), with both subtypes demonstrating distinct inflammatory endotypes, clinical behavior, and response to treatment.[2,5]

The primary goals of CRS management are to control mucosal inflammation, eradicate infection, restore sinus ventilation and drainage, and alleviate symptoms to improve patient-reported quality of life.[2,6] Initial management strategies focus on optimal medical therapy, including intranasal corticosteroids, saline irrigation, short courses of systemic steroids, and antibiotics when indicated.[2,5] Despite advances in pharmacotherapy, a substantial proportion of patients fail to achieve adequate symptom control with medical management alone and continue to experience persistent or recurrent symptoms.[7-8] In such medically refractory cases, Functional Endoscopic Sinus Surgery (FESS) has emerged as the standard surgical intervention, aimed


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at restoring normal sinus drainage pathways, improving mucosal aeration, and enhancing the delivery of topical medications to the sinonasal mucosa.[6,9] Multiple studies have demonstrated that FESS is effective in reducing symptom burden, decreasing disease severity, and improving health-related quality of life in appropriately selected CRS patients.[6,10]

Assessment of surgical outcomes in CRS has progressively shifted from purely objective parameters such as endoscopic scores and radiological staging to include patient-reported outcome measures (PROMs), recognizing that symptom perception and quality of life are central to evaluating treatment success.[7,10] Radiological disease severity is commonly assessed using the Lund–Mackay computed tomography (CT) scoring system, which is the most widely accepted radiological staging method for chronic rhinosinusitis and has been investigated as a predictor of postoperative outcomes following Functional Endoscopic Sinus Surgery.[9,10] Among the available PROMs, the Sino-Nasal Outcome Test-22 (SNOT-22) has gained widespread acceptance as a validated, reliable, and disease-specific instrument for measuring symptom severity and health-related quality of life in CRS patients.[11] The SNOT-22 questionnaire comprises 22 items covering nasal, otologic, sleep, and emotional domains, each scored on a Likert scale from 0 to 5.11 Consequently, SNOT-22 has become a cornerstone outcome measure in clinical trials and observational studies evaluating the effectiveness of FESS in CRS.[10-12]

Several international studies have demonstrated significant reductions in SNOT-22 scores following FESS, indicating meaningful symptom improvement and enhanced quality of life.[6,10] However, the magnitude of symptom improvement varies widely among patients, suggesting that multiple preoperative factors may influence surgical outcomes.[7,9] Factors such as disease phenotype, presence of nasal polyps, extent of radiological disease, prior surgery, comorbid conditions, smoking status, and baseline symptom severity have all been proposed as potential predictors of postoperative outcomes.[7,8,10] Despite the growing body of literature on CRS outcomes, data from developing countries, particularly from the Indian subcontinent, remain limited, and there is considerable heterogeneity in reported outcomes due to variations in patient demographics, disease characteristics, healthcare access, and follow-up practices.[4,6] Therefore, the present study was undertaken to evaluate symptom improvement following Functional Endoscopic Sinus Surgery (FESS) using the Sino-Nasal Outcome Test-22 (SNOT-22), assess improvement in health-related quality of life, and determine the association of postoperative outcomes with age, gender, Lund–Mackay CT score, and associated comorbidities in patients with chronic rhinosinusitis.

**Aims and objectives**

**Aim**

To identify patients with chronic rhinosinusitis and to evaluate the pattern of symptom improvement following functional endoscopic sinus surgery (FESS) in CRS patients.

**Objectives**

- To evaluate the change in SNOT-22 score following Functional Endoscopic Sinus Surgery (FESS) in patients with chronic rhinosinusitis.
- To assess improvement in quality of life following FESS using the SNOT-22 questionnaire.
- To correlate postoperative outcome with age, gender, Lund-Mackay CT score and associated comorbidities.

## MATERIALS AND METHODS

This study was designed as a prospective observational descriptive study. The study was carried out at the Upgraded Institute of Otorhinolaryngology, Rajiv Gandhi Government General Hospital (RGGGH), Chennai, Tamil Nadu, India, which is affiliated with Madras Medical College. The study was conducted over one year following the approval from the Institutional Scientific and Ethical Committee. The research spanned the academic period 2023–2024, with patient recruitment initiated immediately after ethical clearance. Each participant was followed for a minimum of three months postoperatively to evaluate symptom improvement and treatment response.

**Study Population:** Participants included male and female patients aged 15 to 60 years who were clinically and radiologically diagnosed with chronic rhinosinusitis according to the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS 2020) diagnostic criteria. Eligible patients were those attending the outpatient department at RGGGH who were willing to provide informed written consent for participation and follow-up assessments.

A consecutive sampling technique was adopted. All eligible patients who fulfilled the inclusion and exclusion criteria during the study period and attended the ENT outpatient clinic were consecutively enrolled until the required sample size was achieved.

**Sample Size Calculation:** The sample size was calculated to detect a clinically meaningful improvement in the Sino-Nasal Outcome Test-22 (SNOT-22) score following Functional Endoscopic Sinus Surgery (FESS) in patients with Chronic Rhinosinusitis (CRS).

The sample size for the comparison of mean SNOT-22 scores was calculated using the standard formula for comparing two means:

$n = 2(Z\alpha/2 + Z\beta)^2\sigma^2 / d^2$

Where,

- $Z\alpha/2$ = Standard normal deviate corresponding to a 95% confidence level = 1.96


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- Zβ = Standard normal deviate corresponding to 80% statistical power = 0.84
- σ = Standard deviation of the SNOT-22 score = 20
- d = Clinically meaningful difference (effect size) in the SNOT-22 score = 9

Therefore, the minimum required sample size was 78 participants. Rounding up to the nearest whole integer to maintain statistical power, the final sample size was 86 participants to be included in the study.

**Inclusion and Exclusion Criteria**

Patients aged between 15–60 years, both males and females, clinically diagnosed with CRS presenting with at least two of the following symptoms persisting for more than 12 weeks: nasal obstruction/congestion, nasal discharge (anterior or posterior), facial pain/pressure, and reduction or loss of smell were included. Patients willing to undergo FESS and participate in postoperative follow-up assessments were enrolled.

Patients not willing to undergo surgery or to participate in the study, patients who had undergone previous sinonasal or endoscopic sinus surgery, patients with underlying systemic disorders that could affect outcomes such as granulomatous diseases, cystic fibrosis, autoimmune disorders, or sinonasal malignancies, and patients presenting with sleep dysfunction as a primary diagnosis or severe medical comorbidities precluding anesthesia were excluded.

**Methods:** After obtaining informed consent, each participant underwent detailed history-taking and clinical examination including diagnostic nasal endoscopy. Computed tomography (CT) of the paranasal sinuses (axial and coronal views) was performed to confirm the diagnosis and determine the extent of disease according to the Lund-Mackay scoring system.

Functional endoscopic sinus surgery was performed under general anesthesia using standard Messerklinger's technique with rigid nasal endoscopes. All procedures were carried out in the dedicated ENT operating theatre at RGGGH by experienced ENT surgeons under aseptic precautions. The surgical steps included uncinectomy, middle meatal antrostomy, anterior and posterior ethmoidectomy, and frontal recess clearance as per disease extent.

Postoperatively, all patients received a standardized medication regimen comprising hypertonic saline nasal irrigation twice daily, intranasal corticosteroid spray for mucosal inflammation control, and broad-spectrum antibiotics for seven days. Patients were followed up at one month and three months post-surgery for symptom reassessment and endoscopic evaluation. Debridement was performed when required to remove crusts and prevent synechiae formation.

The SNOT-22 is a validated, disease-specific instrument for measuring health-related quality of life in CRS patients. It consists of 22 items representing physical, functional, and emotional symptom domains, each scored on a Likert scale from 0 (no problem) to 5 (worst problem). The total score thus ranges from 0 to 110, with higher scores indicating more severe symptoms.

The same investigator administered the SNOT-22 questionnaire at each visit to ensure consistency and minimize interviewer bias. The collected responses were converted into quantitative scores for statistical comparison.

Data collection was carried out using a structured proforma specifically designed for the study. Each patient's demographic information, clinical history, comorbidities, radiological findings, and surgical details were recorded. Preoperative and postoperative SNOT-22 scores were documented during clinical visits at baseline, one month, and three months following surgery

**Statistical Analysis:** Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. Changes in SNOT-22 scores were analyzed using the paired t-test. Independent samples t-test and one-way ANOVA were used to compare postoperative SNOT-22 improvement between gender, comorbidity, and age groups. Pearson's correlation coefficient was used to assess the association between Lund–Mackay CT score and postoperative SNOT-22 improvement. Effect size was calculated using Cohen's d. A two-tailed $p<0.05$ was considered statistically significant.

## RESULTS

The study included 84 participants with a mean age of 37.92 ± 12.10 years. The largest age group was 18–30 years (28, 33.3%), followed by 31–40 years (21, 25.0%), 51–60 years (18, 21.4%), and 41–50 years (17, 20.2%). There were 57 (67.9%) males and 27 (32.1%) females. Most participants were from urban areas (58, 69.0%) and were employed (34, 40.5%). Allergic rhinitis was the most common comorbidity (26, 31.0%), followed by hypertension (17, 20.2%), diabetes mellitus (15, 17.9%), smoking (11, 13.1%), and bronchial asthma (10, 11.9%). The mean Lund–Mackay CT score was 13.69 ± 4.86 [Table 1].

**Table 1: Baseline Characteristics of Study Participants (n=84)**

| Characteristic | Category | N(%) |
|---|---|---|
| Age group (years) | 18–30 | 28(33.3%) |
| | 31–40 | 21(25.0%) |
| | 41–50 | 17(20.2%) |
| | 51–60 | 18(21.4%) |


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| | | |
|---|---|---|
| Gender | Male | 57(67.9%) |
| | Female | 27(32.1%) |
| Residence | Urban | 58(69.0%) |
| | Rural | 26(31.0%) |
| Occupation | Employed | 34(40.5%) |
| | Homemaker | 23(27.4%) |
| | Unemployed | 14(16.7%) |
| | Student | 13(15.5%) |
| Comorbidities* | Allergic rhinitis | 26(31.0%) |
| | Hypertension | 17(20.2%) |
| | Diabetes mellitus | 15(17.9%) |
| | Smoking | 11(13.1%) |
| | Bronchial asthma | 10(11.9) |

*Comorbidity percentages are not mutually exclusive; patients may have more than one comorbidity.

Nasal obstruction was the most common presenting symptom, reported by (92.9%) patients, followed by nasal discharge (78.6%), postnasal drip (73.8%), facial pain/pressure (54.8%), headache (45, 53.6%), loss of smell/taste (45, 53.6%), and sneezing (40, 47.6%) [Table 2].

**Table 2: Clinical Symptoms at Presentation**

| Symptom | N(%) |
|---|---|
| Nasal obstruction | 78(92.9%) |
| Nasal discharge | 66(78.6%) |
| Post nasal drip | 62(73.8%) |
| Facial pain/pressure | 46(54.8%) |
| Headache | 45(53.6%) |
| Loss of smell/taste | 45(53.6%) |
| Sneezing | 40(47.6%) |

Based on the Lund–Mackay CT score, 45.2% patients had severe disease, 28.6% had moderate disease, 16.7% had very severe disease, and 9.5% had mild disease. The mean Lund–Mackay CT score was 13.69 ± 4.86 [Table 3].

**Table 3: Distribution of Lund–Mackay CT Score (n=84)**

| Lund–Mackay Score Category | N(%) |
|---|---|
| 0–6 (Mild) | 8(9.5%) |
| 7–12 (Moderate) | 24(28.6%) |
| 13–18 (Severe) | 38(45.2%) |
| 19–24 (Very severe) | 14(16.7%) |

The mean SNOT-22 score decreased from 57.82 ± 10.95 before surgery to 33.65 ± 10.20 at 1 month and 21.31 ± 10.65 at 3 months after FESS. The mean reduction was 24.17 points at 1 month ($t = 40.621$, $p < 0.001$) and 36.51 points at 3 months ($t = 42.762$, $p < 0.001$). The comparison between 1 month and 3 months also showed a mean difference of 12.35 points ($t = 37.515$, $p < 0.001$). The effect size for the preoperative versus 3-month comparison was Cohen's $d = 3.379$ [Table 4].

**Table 4: SNOT-22 Scores Before and After FESS, with Paired Comparisons and Effect Size (n=84)**

| Time Point | Mean ± SD | Mean Difference vs Pre-FESS | p-value |
|---|---|---|---|
| Pre-FESS | 57.82 ± 10.95 | — | — |
| 1-Month Post-FESS | 33.65 ± 10.20 | 24.17 | <0.001* |
| 3-Months Post-FESS | 21.31 ± 10.65 | 36.51 | <0.001* |

At 1 month after FESS, 83 (98.8%) patients achieved the minimal clinically important difference (MCID). At 3 months, all 84 (100%) patients achieved the MCID [Table 5].

**Table 5: Achievement of Minimal Clinically Important Difference (MCID ≥8.9 points) Following FESS (n=84)**

| Outcome | 1 month | 3 months |
|---|---|---|
| Mean improvement (%) | 41.8 | 63.15 |
| MCID achieved, n (%) | 83 (98.8) | 84 (100.0) |

The mean postoperative SNOT-22 improvement was 35.60 ± 7.57 in males and 38.44 ± 8.14 in females ($p = 0.1325$). Across age groups, the mean improvement was 34.86 ± 7.93 in patients aged 18–30 years, 37.29 ± 6.81 in those aged 31–40 years, 36.47 ± 8.85 in those aged 41–50 years, and 38.22 ± 7.91 in those aged 51–60 years ($p = 0.5164$) [Table 6].


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**Table 6: Postoperative SNOT-22 Improvement According to Gender and Age Group**

| Variable | Category | Mean ± SD Improvement | p-value |
|---|---|---|---|
| Gender | Male | 35.60 ± 7.57 | 0.1325 |
| | Female | 38.44 ± 8.14 | |
| Age group (years) | 18–30 | 34.86 ± 7.93 | 0.5164 |
| | 31–40 | 37.29 ± 6.81 | |
| | 41–50 | 36.47 ± 8.85 | |
| | 51–60 | 38.22 ± 7.91 | |

Gender comparison: independent samples t-test. Age group comparison: one-way ANOVA. p>0.05 indicates no statistically significant difference.

The correlation between the Lund–Mackay CT score and postoperative SNOT-22 improvement was r = 0.182 (p = 0.098). The mean improvement in SNOT-22 scores was 36.60 ± 7.28 in patients with diabetes mellitus compared with 36.49 ± 7.99 in those without (p = 0.960). Patients with allergic rhinitis had a mean improvement of 37.35 ± 7.47 compared with 36.14 ± 8.02 in those without (p = 0.506). Smokers had a mean improvement of 38.09 ± 5.68, whereas non-smokers had a mean improvement of 36.27 ± 8.10 (p = 0.367) [Table 7].

**Table 7: Association of Postoperative SNOT-22 Improvement with Lund–Mackay CT Score and Comorbidities**

| Variable | Present / r | Absent | p-value |
|---|---|---|---|
| Lund–Mackay score (correlation) | r = 0.182 | — | 0.098 |
| Diabetes mellitus | 36.60 ± 7.28 | 36.49 ± 7.99 | 0.960 |
| Allergic rhinitis | 37.35 ± 7.47 | 36.14 ± 8.02 | 0.506 |
| Smoking | 38.09 ± 5.68 | 36.27 ± 8.10 | 0.367 |

## DISCUSSION

The aim of the present study was to descriptively assess symptom improvement following functional endoscopic sinus surgery among patients diagnosed with chronic rhinosinusitis. The findings showed marked postoperative improvement, with mean SNOT-22 score decreasing from 57.82 ± 10.95 preoperatively to 33.65 ± 10.20 at 1 month and 21.31 ± 10.65 at 3 months. The mean improvement was 36.51 points, percentage improvement was 63.15%, MCID achievement was 100.0%, and Cohen's d was 3.379, indicating a very large clinical effect. Thus, the study is significant because it confirms that FESS produces statistically significant, clinically meaningful, and progressive symptomatic improvement in CRS patients and supports the routine use of SNOT-22 for outcome assessment and patient counselling.

The present study included 84 patients with chronic rhinosinusitis undergoing FESS, and the age-wise distribution showed that the largest proportion belonged to the 18–30 years age group, comprising 28 patients (33.3%), followed by 31–40 years in 21 patients (25.0%), 51–60 years in 18 patients (21.4%), and 41–50 years in 17 patients (20.2%). The mean age was 37.92 ± 12.10 years, indicating that CRS requiring surgical management was more common among young and middle-aged adults in this cohort. Similarly, Afolabi et al. documented a mean age of 34.95 ± 2.69 years among CRS patients undergoing FESS, supporting the predominance of young adults in surgical CRS cohorts.[13]

The present study showed a clear male predominance among CRS patients undergoing FESS, with 57 males (67.9%) and 27 females (32.1%), giving a male-to-female ratio of 2.1:1. However, gender did not significantly affect postoperative improvement in the present study. Male patients showed a mean SNOT-22 improvement of 35.60 ± 7.57, while female patients showed a mean improvement of 38.44 ± 8.14, and the difference was statistically non-significant (t = 1.531, p = 0.1325). In contrast, Afolabi et al. documented a more balanced gender distribution, with 19 males and 21 females, yet reported significant postoperative improvement in SNOT-22 score from 67.45 ± 15.10 to 31.73 ± 5.61, indicating that FESS benefit was not limited by gender distribution.[13]

The present study showed that most participants were from urban areas, with 58 patients (69.0%) belonging to urban residence and 26 patients (31.0%) belonging to rural residence. This urban predominance may reflect the tertiary care nature of the hospital located in Chennai, better access to ENT specialist services, greater awareness of chronic sinonasal symptoms, and easier availability of follow-up care after surgery. The finding is indirectly supported by Alvie et al., who emphasized the importance of region-specific data from South Asian populations and reported a highly significant postoperative SNOT-22 reduction after FESS in CRS patients from Rawalpindi, Pakistan.[14]

In the present study, occupation-wise distribution showed that the largest proportion of participants were employed, comprising 34 patients (40.5%), followed by 23 homemakers (27.4%), 14 unemployed individuals (16.7%), and 13 students (15.5%). DeConde et al. emphasized symptom-specific assessment beyond global quality-of-life measures and reported that ESS produced a 24.1-point reduction in SNOT-22 at six months, compared with only 8.0 points in patients continuing medical therapy, indicating that surgical management provides meaningful functional relief.[15]


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The present study showed that allergic rhinitis was the most common comorbidity, present in 26 patients (31.0%), followed by hypertension in 17 patients (20.2%), diabetes mellitus in 15 patients (17.9%), smoking in 11 patients (13.1%), and bronchial asthma in 10 patients (11.9%). Despite these comorbidities, the present study showed that diabetes mellitus, allergic rhinitis, and smoking did not significantly affect SNOT-22 improvement. Diabetic patients improved by 36.60 ± 7.28, compared with 36.49 ± 7.99 among non-diabetics ($p = 0.9599$). Patients with allergic rhinitis improved by 37.35 ± 7.47, compared with 36.14 ± 8.02 among those without allergic rhinitis ($p = 0.5059$). Smokers improved by 38.09 ± 5.68, compared with 36.27 ± 8.10 among non-smokers ($p = 0.3666$). In contrast, Samargandy et al. documented lower average improvement among CRS patients with immunoglobulin deficiency, around 12 points, compared with 25 points among immunocompetent controls, although the difference was not statistically significant.[16]

Nasal obstruction was the most common symptom, reported by 78 patients (92.9%), followed by nasal discharge in 66 patients (78.6%), postnasal drip in 62 patients (73.8%), facial pain/pressure in 46 patients (54.8%), headache in 45 patients (53.6%), loss of smell/taste in 45 patients (53.6%), and sneezing in 40 patients (47.6%). In contrast, Al Sharhan et al. documented the greatest improvements in nasal obstruction −2.1 ± 0.9, postnasal drip −1.8 ± 0.8, and facial pain −1.6 ± 0.7.[17]

The mean Lund-Mackay score was 13.69 ± 4.86, indicating a substantial radiological disease burden. The combined proportion of severe and very severe cases was 52 patients (61.9%), confirming that most patients had extensive sinonasal involvement before surgery. Similarly, Safoor et al. documented comparable baseline Lund-Mackay scores of 13.91 ± 4.11 in the ESS plus medical therapy group and 14.17 ± 4.23 in the conservative treatment group, closely resembling the present mean score.[18]

The mean preoperative SNOT-22 score was 57.82 ± 10.95, with a range of 36–88, indicating substantial baseline symptom burden and impaired quality of life. At 1 month post-FESS, the mean score decreased to 33.65 ± 10.20, with a range of 16–58, and at 3 months post-FESS, it further reduced to 21.31 ± 10.65, with a range of 8–42. The mean reduction from pre-FESS to 1 month was 24.17 points, with $t = 40.621$, $df = 83$, and $p < 0.001$. The reduction from pre-FESS to 3 months was even greater at 36.51 points, with $t = 42.762$, $df = 83$, and $p < 0.001$. The additional reduction from 1 month to 3 months post-FESS was 12.35 points, with $t = 37.515$, $df = 83$, and $p < 0.001$.

The mean improvement from pre-FESS to 1 month was 41.80%, with a range of 25.0%–58.5%. By 3 months post-FESS, the mean percentage improvement increased to 63.15%, with a range of 45.2%–80.6%. At 1 month post-FESS, 83 patients (98.8%) achieved MCID, defined as a SNOT-22 improvement of at least 8.9 points. At 3 months post-FESS, 84 patients (100.0%) achieved MCID, showing that all patients experienced clinically meaningful improvement by the end of follow-up.

The mean improvement was 34.86 ± 7.93 in the 18–30 years age group, 37.29 ± 6.81 in the 31–40 years group, 36.47 ± 8.85 in the 41–50 years group, and 38.22 ± 7.91 in the 51–60 years group. One-way ANOVA showed $F = 0.766$ and $p = 0.5164$, indicating that age did not significantly influence postoperative improvement. In contrast, Fatima et al. reported significant postoperative improvement in an older CRSwNP cohort with mean age 44.7 ± 12.5 years, where SNOT-22 improved from 62.4 ± 9.8 to 28.7 ± 7.6 at 12 months.[19]

A weak positive correlation was observed, with Pearson's $r = 0.182$, but this association was not statistically significant ($p = 0.0976$), suggesting that radiological severity alone was not a strong predictor of postoperative symptom relief. Cohen's d for the comparison between pre-FESS and 3-month post-FESS SNOT-22 scores was 3.379, which is interpreted as a very large effect. Philpott et al. also documented significantly lower SNOT-22 scores in the ESS group compared with clarithromycin by −18.13 points and placebo by −20.44 points, both with $p < 0.0001$, strengthening evidence for surgery in refractory CRS.[20] Therefore, the present study confirms that FESS is highly effective for medically refractory CRS and produces broad symptomatic improvement irrespective of age, gender, and selected comorbidities.

## CONCLUSION

The functional endoscopic sinus surgery produced substantial, statistically significant, and clinically meaningful improvement in symptoms among patients with chronic rhinosinusitis. All patients experienced clinically meaningful improvement by the final follow-up. Comorbidities such as diabetes mellitus, allergic rhinitis, and smoking did not significantly affect improvement. FESS is an effective intervention, producing improvement in patient-reported symptoms and quality of life, consistent across gender, age groups, and comorbidity profiles.

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