


# Sino-nasal outcome Test-22 and Lund–Mackay CT score to select endoscopic sinus surgery in chronic rhinosinusitis

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## Abstract

**Objectives:** Chronic rhinosinusitis is one of the common diseases that cause morbidity and affects a person's quality of life. We tried to provide a more appropriate and effective approach to selecting patients for endoscopic sinus surgery.

**Methods:** The study population is chronic rhinosinusitis children referred to the ear, nose, and throat clinic of two general hospitals in Tehran, Iran, who have previously undergone sufficient drug treatment and have not recovered. The Lund–Mackay score is calculated by examining the computed tomography (CT) scan. The Sino-nasal Outcome Test-22 (SNOT-22) questionnaire was provided to the patients before the operation, after the operation, and 3 and 6 months later in the clinic.

**Results:** Before the operation, the most SNOT-22 score people were in the range of 40–59 points. The SNOT-22 score before the operation is significantly different from 3 and 6 months after the operation. The highest frequency of Lund–Mackay CT (LMCT) scan score was in the range of 18–23 points. The LMCT scan score did not show any significant relationship with the SNOT-22 score before surgery, 3 months, and 6 months after surgery. Sensitivity to aspirin had a significant relationship with SNOT-22 scores and the history of asthma and nasal polyps had a significant relationship with the preoperative LMCT scan score.

**Conclusions:** The LMCT scan scoring system cannot be a good measure of chronic rhinosinusitis severity or the prognosis of patients after surgery. The SNOT-22 questionnaire can be used as a predictive tool to help the doctor and the patient in deciding to operate and the possibility of obtaining a relative recovery.

## KEYWORDS

endoscopic surgical procedures, Lund–Mackay CT score, sinusitis, SNOT-22 questionnaire

## Key points

- The Lund–Mackay computed tomography scan scoring system cannot be a good measure of chronic rhinosinusitis severity or the prognosis of patients after surgery.

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- The Sino-nasal Outcome Test-22 questionnaire can be used as a predictive tool in deciding to operate and the possibility of obtaining a relative recovery.

## INTRODUCTION

Chronic rhinosinusitis (CRS) is one of the common diseases which impacts the quality of life of the person due to its complications. Therefore, choosing the appropriate and effective treatment for the different types of these patients is very important. Currently, CRS patients are treated with medical or surgical treatment or both methods. Due to the many problems in studies comparing surgery with medical treatment and complex pathogenesis and types of disease symptoms, there are still no precise and specific criteria for choosing the surgical method as an effective and useful method for each patient. It is very important for doctors to be aware of the consequences and specific results of endoscopic sinus surgery (ESS) in each patient in choosing this treatment method. One of the tools which have high credibility is the Sino-nasal Outcome Test-22 (SNOT-22) questionnaire.

In a study conducted by Rudmik et al.<sup>1</sup> in 2014 on 327 CRS patients, the SNOT-22 questionnaire was given to the patients before and after the operation. The results showed that the patients who had a SNOT-22 score of less than 20 before the operation got the lowest result in improving the quality of life after ESS and the patients who had a SNOT-22 score above 30 got the best result in improving the quality of life.

In a study by Brooks et al.,<sup>2</sup> in 2018 on 665 CRS patients resistant to drug therapy, a low Lund-Mackay CT (LMCT) score before surgery was associated with less improvement in SNOT-22 score after surgery. This study proved that the preoperative LMCT score is related to the severity of preoperative symptoms and can be used as an indicator to predict the results of the quality of life after the operation.

In a study conducted by Abdalla et al.<sup>3</sup> in 2012, using the SNOT-22 questionnaire, they examined the prevalence of symptoms in CRS patients with or without polyps who were undergoing ESS. The results showed that the three symptoms of nasal congestion, change in the sense of smell and taste, and the need to empty the nose have a high prevalence and severity. In the group with polyposis, the average score of SNOT-22 before surgery was 41.5, and in the group without polyposis, it was 44.4, which decreased to 18.3 and 14.1 three months after surgery, respectively. In fact, the overall SNOT-22 score and the score of each symptom improved after surgery.

In a study conducted by Hopkins et al.,<sup>4</sup> in 2007 on 1840 CRS patients who underwent ESS, the results showed that an absolute threshold for surgery cannot be defined based on LMCTs and there was no correlation between LMCT score and SNOT-22. But LMCT score was related to reducing complications and reducing the need for resurgery.

In a study conducted by Smith et al.,<sup>5</sup> in 2011 on CRS patients resistant to initial drug treatment, the patients were divided into two groups, one group that underwent continued drug treatment and one group of patients that underwent ESS. The results showed that patients who underwent ESS had higher levels of improvement in quality of life.

In a study conducted by Smith et al.,<sup>6</sup> in 2014 on resistant CRS patients to investigate and compare the quality of life of two groups after surgical treatment and after continued drug treatment, the results showed that ESS had a greater effect on improving quality of life than to continue drug treatment in this group of patients.

In a study conducted by Soler et al.,<sup>7</sup> in 2013 on resistant CRS patients to investigate the effective factors for choosing the type of treatment (continuation of drug treatment or surgery), the results showed that demographic and clinical factors and the social and individual support in the patient's decision to the choice of ESS were not effective. The only factor that led the patient to surgery was a worse score in the quality of life based on the SNOT-22 questionnaire. Therefore, the SNOT-22 score had a predictive value for choosing a treatment method, and it was recommended that this test be performed routinely in the clinic before choosing treatment for patients.

In a study conducted by Bradley and Kountakis,<sup>8</sup> in 2005, the results showed that the severity of rhinosinusitis based on a CT scan before surgery was not related to the severity of symptoms based on the SNOT-22 questionnaire after ESS surgery. Also, a CT scan could not predict the improvement of symptoms after ESS.

In summary, it could be said that the results of previous studies showed that the results of using the SNOT-22 questionnaire were somewhat predictive of the results after ESS, but in the case of the LMCT test, the results were contradictory.

Due to the different results and the insufficiency of studies in this field especially in Iran, in the present study, by using the SNOT-22 questionnaire and the LMCT scan score before the operation, we wanted to provide a suitable and more effective approach to selecting patients for ESS. We could improve the usefulness of this treatment method for patients and reduce additional costs in the health care system. Glossary is described below.

## CRS

CRS is the inflammation of the nasal mucosa and sinuses for more than 12 weeks, with two or more symptoms of nasal congestion, nasal anterior/posterior discharge, facial pain/pressure, reduction, or loss of smell. It is determined based on endoscopic findings. It can be with or without nasal polyps.<sup>9</sup>

## SNOT-22

SNOT-22 is a validated 22-item self-administered instrument for CRS-specific quality of life outcome measuring and the health status of the nose and sinuses after ESS. It is scored using a Likert scale where 0 = "No problem," 1 = "Very mild problem," 2 = "Mild or slight problem," 3 = "Moderate problem," 4 = "Severe problem," and 5 = "Problem as bad as it can be."<sup>1,10</sup> According to recent review studies based on reliability, verifiability, response rate, and ease of use, the SNOT-22 questionnaire is the most appropriate tool, and its validity and reliability have been proven in other countries and in Iran.<sup>1,11-14</sup>

## LMCT score

The LMCT staging involves scoring six bilateral areas of sinus opacification on CT imaging from 0 to 2, and the total range of scores are between 0 and 24.<sup>2</sup> Complete opacity is 2 points, incomplete opacity is 1 point, and natural ventilation is 0 points. The ostiomeatal unit scores 2 or 0 depending on whether it is blocked or open. The maximum score for each side is 12.<sup>15</sup>

## Minimal clinically important difference (MCID)

A decrease in the score of the SNOT-22 test is a measure of patients' improvement. The MCID value refers to the smallest change that is clinically significant. MCID is directly evaluated by the SNOT-22 questionnaire.<sup>16</sup> The operational definition of MCID is a reduction of at least 9 points from the SNOT-22 test after surgery compared to before surgery. The percentage of relative improvement is calculated and the percentage closer to 100, the greater the relative recovery.

## ESS

It is a surgical procedure in drug-resistant CRS disease. The procedure is performed under endoscopic vision to remove the polyp, open the blocked sinuses, and clear secretions, reducing the overall inflammatory disease and enhancing the effect of post-operative drug treatment.<sup>17</sup>

## Resistance to drug treatment

If the patient's sino-nasal symptoms do not improve after taking at least 3 months of topical corticosteroids and 2 weeks of systemic antibiotics and 1 week of systemic corticosteroids, the patient is considered resistant to drug treatment.<sup>18</sup>

## METHODS

The type of study was a prospective observational study. The study population was CRS patients referred to the ENT clinic of two general hospitals in Tehran, Iran who had previously undergone effective and sufficient drug treatment and had not recovered.

### Inclusion criteria

CRS, resistance to drug treatment, age between 15 and 70 years.

### Exclusion criteria

Systemic granulomatous disease, cystic fibrosis, acute recurrent rhinosinusitis, ciliary dyskinesia, preoperative SNOT-22 score less than 10, age less than 15 years, and patients who had not taken sufficient and effective medical drugs.

### Sample size and its calculation method

The sampling was carried out by census and a minimum sample size of 70 people was included.

### Project implementation method

If the conditions and criteria of entry and exit of the study were met, the patients who were candidates for ESS were identified and the LMCT score was calculated by examining the CT scan. Also, the SNOT-22 questionnaire and the demographic questionnaire included the patient's name, age, gender, duration of illness, history of smoking, aspirin sensitivity, and asthma, which were provided to the patients before the operation. After the operation, they were again provided with the SNOT-22 questionnaire 3 and 6 months later in the clinic. In some cases, due to the patient's disability, the questionnaire was filled in by the researcher.

### Data analysis

All data were anonymously entered into the statistical software. The findings were analyzed by using IBM SPSS V22.0 software. The statistical tests of  $\chi^2$ , paired  $t$  test, binary logistic regression analysis, or their nonparametric equivalent tests were used to analyze the data. A  $P$  value less than 0.05 were considered significant.

## RESULTS

In this study, out of a total of 70 people, 46 people (65.7%) were men and 24 people (34.3%) were women. The average age of the patients was 41.9 years ( $\pm$ SD = 11.29). About 68% of people were in the age range of 30–52 years. In different age decades, the more age frequency was in the age decade of 40–49 years (22 people, 31.4%). The lowest age frequency was related to the age decade of 10–19 years (2 people, 2.9%).

In terms of the duration of the disease, 18 people had symptoms for less than 12 months and 52 people (74.3%) mentioned more than 12 months.

In terms of frequency of history of diseases, 18 people (25.7%) had asthma. Six people (8.6%) mentioned a history of smoking. Seven people (10%) mentioned a history of aspirin allergy, and 43 people (61.4%) had nasal polyps.

### The SNOT-22 test results

The average SNOT-22 score was shown in Table 1.

Before the operation, the most SNOT-22 score people were in the range of 40–59 points. The highest average age was observed in the score group of 80–99. The group of 60–79 had the highest percentage of women. The 80–99 group had the highest percentage of asthma disease and aspirin sensitivity. Asthma had a significant relationship with a higher score on the SNOT-22 questionnaire. The 20–39 group had the highest percentage of smokers.

We investigated the relationship between the factors of age, gender, duration of infection, history of smoking, history of aspirin sensitivity, and history of asthma and nasal polyps with SNOT-22 scores before and after surgery (3 and 6 months) with binary logistic regression analysis. In terms of examining the relationship between each factor and SNOT-22 scores before surgery, only sensitivity to aspirin was significant ( $P < 0.05$ ). But none of the factors had a significant relationship with SNOT-22 scores 3 and 6 months after surgery. The mean SNOT-22 score before the operation was significantly different from 3 and 6 months after the operation ( $P < 0.05$ ).

### The LMCT score results

The highest frequency of LMCT scores was in the range of 18–23 points. In patients with asthma, sensitivity to aspirin, and the average

LMCT score, a significant difference was observed between the SNOT score groups before the operation ( $P < 0.05$ ).

The average score of LMCT in 70 participants was 18.25 ( $\pm$ SD = 3.87, Variance = 15.03, Minimum = 9, Maximum = 24). The distribution of the LMCT index did not follow the normal distribution. However, the highest frequency was in the range of 18–23 points.

Three months after the operation, the highest recovery percentage (54.87%) in MCID value was obtained in the 40–59 group, and the lowest recovery percentage (53.05%) was calculated in the 60–79 group. In other groups, more than a 50% probability of relative improvement has been seen. In patients with polyps, the highest percentage of recovery (57.10%) was in the 60–79 group and the lowest percentage of recovery (51.85%) was in the 20–39 group. On the contrary, the highest percentage of recovery (57.89%) in patients without polyps was obtained in the group of 20–39, and the lowest percentage of recovery (47.27%) was calculated in the group of 60–79.

By performing binary logistic regression analysis to determine the relationship between the factors of age, sex, duration of infection, history of smoking, history of aspirin sensitivity, history of asthma, and nasal polyps with the score of preoperative LMCT score, results showed the  $P < 0.05$ . By testing each of the factors separately, only the history of asthma and nasal polyps had a significant relationship with the preoperative LMCT score ( $P < 0.05$ ).

### The MCID value changing

Six months after the operation, in terms of MCID, the highest percentage of recovery (66.97%) was obtained in the group of 20–39, and the lowest percentage of recovery (58.68%) was calculated in the group of 60–79. In patients with polyps, the highest percentage of recovery (68.62%) was obtained in the group of 40–59 and the lowest percentage of recovery (57.52%) was calculated in the group of 60–79. In patients without polyps, the highest percentage of recovery (78.96%) was obtained in patients without polyps in the group of 20–39, and the lowest percentage of recovery (60.15%) was calculated in the group of 40–59.

### Analysis between tests

The LMCT score did not show any significant relationship with the SNOT-22 score before surgery, 3 months, and 6 months after surgery ( $P < 0.05$ ).

**TABLE 1** The frequency of SNOT-22 scores before surgery, 3 and 6 months after surgery in subjects participating in the study.

SNOT-22 score calculation time	The most value range	Minimum–Maximum score	Mean score $\pm$ SD	Variance score
Before surgery	40–59	23–96	57.37 $\pm$ 15.56	242.20
3 months after surgery	10–29	0–63	26.97 $\pm$ 13.41	179.88
6 months after surgery	10–29	0–56	21.3 $\pm$ 12.52	156.96

Abbreviation: SNOT-22, Sino-nasal Outcome Test-22.

There was no significant correlation between the MCID score 3 and 6 months after the operation with the LMCT score before the operation ( $P > 0.05$ ).

## DISCUSSION

In the CRS treatment process, patients must decide between continuing drug treatment and performing more invasive procedures. Various factors such as quality of life, efficiency, financial costs, and negative events affect this decision.<sup>1,6,19,20</sup>

In this study, by using two tools SNOT-22 and LMCT scoring system, we quantitatively evaluated the outcome of ESS in CRS patients. Before the operation, the most SNOT-22 score people were in the range of 40–59 points. The SNOT-22 score before the operation is significantly different from 3 and 6 months after the operation. The highest frequency of LMCT scores was in the range of 18–23 points. The LMCT score did not show any significant relationship with the SNOT-22 score before surgery, 3, and 6 months after surgery. Sensitivity to aspirin had a significant relationship with SNOT-22 scores and the history of asthma and nasal polyps had a significant relationship with the preoperative LMCT score.

A study by Bradley and Kountakis<sup>8</sup> in 2005 did not show a relationship between the CT scan score and the severity of the disease and CRS symptoms. Based on the results of Bhattacharyya et al.<sup>21</sup> and Stewart et al.,<sup>22</sup> it can be said that the LMCT scoring system cannot be a suitable measure for the severity of CRS and predicting the outcome of ESS and the prognosis of patients or helping the doctor and the patient in making surgical decisions. Rudmik et al.<sup>1</sup> reported in a study that in patients with polyps and without polyps who had a SNOT-22 score of less than 30, fewer than 55% reached the MCID. Patients with SNOT-22 more than 30 reached MCID in more than 80% and their questionnaire score increase was more than 50%. In our study, the groups of 20%–39% and 40%–59%, were above 65% for relative improvement and reached MCID. He also stated that patients with SNOT-22 less than 20 benefited the least from ESS. But in our study, the group between 20 and 39 reported the most benefit from this surgery. Considering that in Rudmik's study, a higher number of samples were evaluated, the result of this study was preferable to ours.

Our study was a confirmation of the study of Bradley and Kountakis,<sup>8</sup> Bhattacharyya et al.,<sup>21</sup> and Stewart et al.<sup>22</sup> In all these studies it was shown that the LMCT scoring system could not be a good test for the severity of CRS or the prognosis of patients after surgery. Also similar to the research of Rudmik et al.,<sup>1</sup> we concluded that the SNOT-22 questionnaire could be used as a predictive tool to help the doctor and the patient in deciding to operate and the possibility of obtaining a relative recovery.

In our study, the relative improvement percentages obtained in this study can be used to explain to patients and educate them. Considering that all patients reached MCID 6 months after surgery, it can be concluded that the obtained average is the average of SNOT

in the healthy population. According to these results, it can be said that although all patients did not reach the MCID 3 months after the operation, they reached the average score on this test in the healthy community.

By doing this research, we concluded that the SNOT-22 questionnaire can help the doctor and the patient as a predictive tool in making decisions about the operation.

Due to the time limit, it was not possible to attract more patients to this plan; therefore, compared to similar studies, it had a smaller sample size. For further studies, it is suggested that a review study be designed and implemented for a comprehensive review and conclusion in this matter.

## AUTHOR CONTRIBUTIONS

Dr. Abolfazl Taheri is the main manager. He created the main conception and design of the research. Dr. Mohsen Saberi Esfeadvajani is statistical consultant. Dr. Masoumeh Saedi and Dr. Sajad Hasani cooperated in finding and referring patients to participate in the research. Dr. Reyhaneh Abolghasemi is a major contributor to writing the manuscript. All authors read and approved the final manuscript. The authors have no funding to report.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

## ETHICS STATEMENT

All the information of the patients was kept confidential. Written consent was obtained from the patients to participate in the study. After the analysis, the information was published in the form of text, tables, and graphs without mentioning the patients' characteristics. The project was approved by the Ethics Committee of the Ministry of Health, Medical Education and Treatment of Iran (Ethical code: IR.BMSU.REC.1398.286).

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