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Correlation between Nasal Patency and Chronic Rhinosinusitis based on Peak Nasal Inspiratory Flow and Sino-Nasal Outcome Test-22

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ABSTRACT

Introduction
Chronic Rhinosinusitis (CRS) is a chronic inflammatory condition of the sinuses and nasal mucosa that affects quality of life. This study aims to analyze the correlation between Peak Nasal Inspiratory Flow (PNIF) and Sino-Nasal Outcome Test-22 (SNOT-22) in assessing nasal patency in CRS patients.

Methods
This study used a cross-sectional design with CRS patient subjects who underwent PNIF examination and were interviewed using SNOT-22. Statistical analysis involved normality test, log transformation, and Mann Whitney test for non-normally distributed data.

Results
Results showed that there was a significant correlation between increased PNIF scores and decreased SNOT-22 scores (p=0.021), indicating improved nasal patency and decreased CRS symptoms. The data showed a significant difference between the groups with normal and low PNIF in terms of SNOT-22 scores. In normal PNIF there were 6 people with Mild SNOT-22 and 1 person with M-S SNOT-22. In low PNIF there were 2 people with Mild SNOT-22 and 44 people with M-S SNOT-22.

Conclusion
PNIF and SNOT-22 are effective as measurement tools to assess nasal patency in CRS patients. The correlation between these two tools shows that increased nasal patency is associated with decreased CRS symptoms.

Keywords: Chronic Rhinosinusitis, Nasal patency, Peak Nasal Inspiratory Flow, Sino-Nasal Outcome Test-22.

1. Introduction

Chronic Rhinosinusitis (CRS) is a common condition characterized by persistent inflammation of the nasal and paranasal sinus mucosa. The condition significantly impacts patients' quality of life through symptoms such as nasal obstruction, facial pain, reduced sense of smell, and nasal discharge. The symptom complexity of CRS requires effective diagnostic and monitoring tools to evaluate therapy outcomes and guide clinical management.[1,2]

PNIF is an objective measure of nasal patency, which measures the maximum flow rate of air that can be inhaled through the nostrils. It is a simple, non-invasive and cost-effective diagnostic tool that provides immediate results regarding airway obstruction. PNIF measurement is particularly useful in the clinical setting as it requires minimal patient cooperation and can be used repeatedly to monitor the development or improvement of nasal patency over time. Studies have shown mixed results regarding the correlation between PNIF measurements and subjective symptoms of nasal obstruction, indicating the need for further research in diverse patient populations.[3–6]

SNOT-22 is a validated patient-reported outcome measure that assesses the health burden of sinonasal conditions. The tool includes 22 items covering physical problems, functional

limitations, emotional consequences, and social interactions. It is widely used to evaluate quality of life in patients with CRS and other sinonasal disorders. It helps in diagnosing CRS and in monitoring the effectiveness of medical or surgical treatments. The SNOT-22 has been adapted and validated in multiple languages and cultural contexts, increasing its applicability to diverse patient populations.[7–10]
The relationship between objective measures of nasal patency (such as PNIF) and subjective symptom scores (such as those derived from the SNOT-22) is critical in understanding the overall impact of CRS on patients and the effectiveness of treatment. While some studies have shown a correlation between improved PNIF scores and decreased symptom severity on the SNOT-22 following treatment intervention, other studies have found no significant association, highlighting the complex interplay between objective airflow measurements and subjective symptom perception.[3,4,11]
This study aims to analyze the relationship of PNIF and SNOT-22 with nasal patency in CRS patients.

1.1 Method

Research Design

This study used a cross-sectional study design. In this study, all patients with *Chronic Rhinosinusitis* (CRS) underwent *Peak Nasal Inspiratory Flow* (PNIF) examination, and their quality of life was assessed through interviews using the *Sino-Nasal Outcome Test-22* (SNOT-22). The aim of this study was to analyze the relationship between PNIF and SNOT-22 with nasal patency in patients with CRS.

Research Variables

The main variables studied were PNIF as an objective measure of nasal patency and SNOT-22 as a subjective measure of quality of life related to CRS symptoms. Patients were divided into two groups based on PNIF results: a group with normal range (female: >90 L/min & male: 100-130 L/min) and a group below normal range (obstructed group).

Operational Definition

PNIF is a measurement tool used to assess the maximal inspiratory flow rate through the nose, which indicates the level of nasal obstruction. SNOT is a questionnaire used to assess the impact of CRS on the patient's quality of life, including physical, functional, emotional, and social aspects.

Research Flow

Patients with CRS were recruited and underwent a PNIF examination. Afterwards, they were interviewed to complete the SNOT-22 questionnaire. Based on the PNIF results, patients were then grouped into two categories: normal and below normal. The data obtained from these two measurements were then analyzed to determine the relationship between PNIF and SNOT-22 with nasal patency.

Statistical Analysis

Nominal scale variables were described as frequencies and percentages while continuous scale variables were tested for normality first. The normality test used is Kolmogorov-Smirnov because the number of samples is more than 50 samples.
Once the data is not normally distributed, log transformation is performed and normality is re-done. Non-normally distributed data were displayed as median (minimum-maximum). The difference between two variables in ratio data uses the Independent Sample T Test on normally distributed data, and the Mann Whitney test on non-normally distributed data. For nominal data with Chi square test on normally distributed data and fisher exact test on non-normally distributed data. Data were processed using a computer program with a significance level of $p<0.05$ with a 95% confidence interval (CI).
This study was approved by the RSDM Research Ethics Committee with Number: 1.029/VII/HREC/2022 and a statement of willingness as a research subject by briefly explaining the objectives, benefits of the study, and blood sampling techniques, then the patient signed a statement of willingness to become a research subject. Decree of the

Director of RSDM concerning the Appointment of the RSDM Funded Internal Research Research Team with Number: 188.4/8826/2022.

2. Research Results and Discussion

2.1 Research Results

Table 1. PNIF and SNOT-22 characteristics of the study population.

	PNIF		P-value
	Normal (N = 7)	Low (N = 46)	
Mild SNOT-22	6	2	0,021
M-S SNOT-22	1	44	

Table 1. shows the frequency distribution of Mild SNOT-22 and M-S SNOT-22 based on PNIF score which is classified into normal PNIF (7 people) and low PNIF (46 people). In normal PNIF there were 6 people with Mild SNOT-22 and 1 person with M-S SNOT-22. In low PNIF there were 2 people with Mild SNOT-22 and 44 people with M-S SNOT-22. The table shows the Chi-square test p value of 0.021 (significant if <0.05).

2.2 Discussion

The relationship between *Peak Nasal Inspiratory Flow* (PNIF) and nasal patency in patients with *Chronic Rhinosinusitis* (CRS) is significant as PNIF serves as a direct and objective measure of nasal airflow and thus, nasal patency. PNIF measures the maximum level of air that can be inhaled through the nostrils, which is directly affected by the level of nasal obstruction or patency.

A study evaluating the effects of Dupilumab in severe Chronic Rhinosinusitis with Nasal Polyps (CRSwNP) patients showed that all parameters, including PNIF, improved during treatment. At first, no correlation was found between PNIF and nasal symptoms at the start of treatment. However, significant correlations between changes in PNIF and nasal symptoms as well as nasal polyp score (NPS) were observed during follow-up evaluations. This suggests that as nasal patency improves (evidenced by an increase in PNIF), nasal obstruction symptoms decrease.[4]

In general, PNIF is used to assess the degree of nasal blockage or obstruction in CRS patients. Higher PNIF values usually indicate better nasal patency, which means less obstruction and better airflow through the nasal passages. Conversely, lower PNIF values indicate greater nasal obstruction.[3,4,11]

Another study explored the effects of nasal irrigation (both heated and room temperature saline) on mucociliary clearance in CRS patients. Although this study mainly focused on mucociliary function, nasal patency was assessed using PNIF among other measures. An increase in saccharin transit time, which indirectly reflects nasal patency, was observed after nasal irrigation, suggesting that the treatment may improve airflow and nasal patency.[12]

The relationship between PNIF and nasal patency in CRS patients is well established, with PNIF serving as an important objective measure to evaluate the effectiveness of various treatments aimed at improving nasal airflow and reducing nasal obstruction. As nasal patency improves, usually reflected by higher PNIF scores, patients experience a decrease in nasal obstruction symptoms. This relationship is critical for monitoring treatment outcomes and adjusting therapeutic approaches in managing CRS.

3. Research Conclusion

There is a significant relationship between SNOT-22 and nasal patency. PNIF and SNOT-22 are feasible measurement tools to measure nasal patency. Both measuring instruments are considered cheap, simple, and easy to apply.

4. Research Suggestions

Further research needs to be done with a prospective cohort or retrospective cohort approach and using other parameters that are considered to affect nasal patency in *Chronic Rhinosinusitis* (CRS) cases.

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