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Original Research Article

Evaluation of pre-operative sino-nasal outcome test- 22 scores as a predictor of outcome in patients undergoing functional endoscopic sinus surgery for chronic rhinosinusitis

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ABSTRACT

Background: Numerous factors are to be considered when offering FESS as a treatment for patients with chronic rhinosinusitis (CRS) who have failed conservative medical treatment. The objective is to evaluate the sino-nasal outcome test (SNOT-22) and other patient demographic characteristics as predictors of postsurgical improvement in patients with CRS.
Methods: Consecutive adult subjects presenting to the Otolaryngology clinics in a tertiary hospital, with refractory CRS that required surgery were included. Subjects were excluded if they did not complete both pre and post-operative SNOT-22 Questionnaire. Demographic and baseline measures, including allergic rhinitis, asthma and addiction status, Lund Kennedy endoscopic scores and Lund-Mackay computed tomography (CT) scoring were also obtained for each subject. Regression analyses were performed.
Results: Fifty-one subjects met criteria and were included. These subjects showed a 55.4% overall improvement in postsurgical SNOT-22 evaluations. Multivariate regression analysis revealed that SNOT-22 items related to "runny nose," "waking up at night", "need to blow nose", and "sneezing" were independent predictors of postsurgical SNOT-22 improvement ($p<0.05$, for all).
Conclusions: ENT surgeons can utilize the SNOT-22 tool to predict the possibility of symptom improvement post FESS in patients with CRS.

Keywords: Chronic rhinosinusitis, Sino-nasal outcome test-22, Functional endoscopic sinus surgery, Predictive factors, Asthma, Allergy, Smoking, Depression

INTRODUCTION

Rhinosinusitis is a common disease worldwide, affecting the quality of life of the person. Chronic rhinosinusitis (CRS) is a common and debilitating condition with significant economic impact. Approximately 15% of the population in industrialized countries has nasal or paranasal problems, making it the second most prevalent condition among chronic diseases, with an annual socio-economical cost estimated in 6 billion USD in the USA.[1] CRS prevalence in the US is about 15% in the adult population, higher than arthritis and arterial hypertension.[2] The pathology and etiology have been well delineated so far, but the treatment modality is changing fast due to change in organisms causing it and emergence of resistance to antimicrobial agents, which makes the management challenging. The cutoff duration time for defining acute or CRS is 12 weeks, noting the

following distinctions: acute rhinosinusitis (ARS) may be associated with upper and lower airway complications; CRS, with or without nasal polyposis (NP; CRSwNP and CRSsNP respectively) is often linked to asthma, cystic fibrosis, primary ciliary dyskinesia, or aspirin sensitivity[3]. Although rhinosinusitis is not a life-threatening condition, it impairs daily functioning and quality of life (QoL).[4] First line therapy for treatment of CRS is aimed at reducing underlying inflammation and facilitating clearance of the paranasal sinuses. Antibiotics, topical steroids, systemic steroids, and nasal saline irrigation are mainstays of treatment.[5] Unfortunately, many patients are refractory to this treatment and ultimately require functional endoscopic sinus surgery (FESS) to achieve improved symptom control and better Quality of Life (QoL). The advent of endoscopy has revolutionized the way in which otolaryngologists manage sinus disease chronic sinusitis. Endoscopy permits accurate diagnosis of the nasal manifestations of sinus disease by revealing findings easily missed with anterior rhinoscopy, as well as permitting directed cultures of the middle meatus and other areas of the nasal cavity.[6,7] The purpose of endoscopic surgery for CRS is to restore physiologic mucociliary flow.[6,8,9] Given the relevance and societal impact of this disease process, careful selection of patients for surgery is necessary to optimize outcomes and reduce unnecessary risk. To that end, prior studies have attempted to define patient characteristics predictive of surgical outcomes.[10,11] Unfortunately, there is conflicting information regarding which of these characteristics are important. Although there are general questionnaires, such as SF-36 was demonstrated to be useful in assessment of CRS patient's QoL, disease-specific questionnaire found to be more suitable to evaluate many aspects of the disease. SNOT-22 (Sino-Nasal Outcome test) is one of the widely used disease-specific questionnaires for CRS. The questionnaire had been tested and showed high reliability and validity, and significantly correlated with general QOL measured by the SF-36.[12-14] In addition, the SNOT-22 has been translated to other languages. The Sinonasal Outcome Test-22 (SNOT-22) is often utilized to assess this disease- specific quality of life. Patients undergoing FESS within 1 year of onset of symptoms that fail to respond to maximum medical therapy (MMT), attain significantly better measured outcomes in terms on improvements in SNOT-22 than those undergoing FESS at a later stage.[15,16] Health care utilization is significantly lower in first 2 years following surgery in patients undergoing surgical intervention compared with those having surgery at a later stage.[17] Specific disease questionnaires identify easily the important symptoms, focus the medical visit and to define treatment objectives. They are sensitive to small changes after interventions than the general questionnaires; hence, specific questionnaires like SNOT 22 are preferable. The SNOT-22 (sinonasal outcome test) questionnaire has the advantage of combining issues which are specific of sinonasal disease with general health issues, which may be assessed alone or together, both in the pre and postoperative period.[18] Functional endoscopic sinus surgery (FESS) is the treatment of choice for CRS patients not responding to drug therapy. SNOT is an ideal tool to predict the quality of life among CRS patients. Hence this study aimed to bring out the association between FESS and QoL and evaluate pre-operative score as a predictor of outcome for surgery among CRS patients using a disease-specific questionnaire (SNOT 22).

METHODS

This prospective observational study was conducted to analyze the outcomes of Functional Endoscopic Sinus Surgery in CRS patients using pre and post-operative symptom-based outcome measure tool, sino nasal outcome test-22 (SNOT-22). This study was conducted in the Department of Ear, Nose and Throat (ENT) in a tertiary care teaching hospital located in Pondicherry. All consecutive cases of CRS (CRS) undergoing functional endoscopic sinus surgery (FESS) in the department of ENT during the study period between November 2016 and October 2017 were included in the study. As of October 2017, there were 51 patients who received FESS. Inclusion criteria includes adults (age >18 years old), diagnosis of CRS based on European position paper on rhinosinusitis and nasal polyps 2012 (EPOS 2012), which requires that in addition to positive objective endoscopic or CT findings that the patient notes at least two of the following four symptoms: nasal congestion, nasal drainage, facial pain/ pressure, and/or diminished smell. Prior to and post-surgical intervention, these patients were asked to maintain maximal medical therapy with medications directed towards the specific presumed underlying triggers, such as the presence of bacterial biofilms, allergies and eosinophilic inflammations as part of standard care. At a minimum, pre-operative therapy included a 1–2-week course of oral corticosteroids, topically administered nasal steroids, isotonic saline nasal irrigations and culture-directed antibiotic if purulent or thickened mucous was noted on exam. Patients presenting with a history of prior surgery were also prescribed topical steroid sprays. Exclusion criteria included patients without a minimum of 3 months' follow-up after FESS, patients who elected to continue with medical therapy as opposed to receiving sinus surgery, systemic granulomatous disease, recurrent acute rhinosinusitis, cystic fibrosis, and ciliary dyskinesia. Due to preoperative survey floor effects, patients with a preoperative SNOT-22 score between 0 and 9 were also excluded since they were unable to achieve a MCID of 9 points. Standard protocol for all patients presenting for evaluation also included completion of the SNOT-22 prior to and following surgical intervention. Each subject completed the SNOT-22 during a clinic visit by answering all questions based on a 0-5 scale, where 0 defines no problem with the given symptom and 5 defines maximal problem. This is a validated patient reported measure of outcome established to delineate the presence and severity of Sino-nasal disorder. Patients

were excluded if they had not completed both pre- and post-operative evaluations. Perioperative demographic and medical histories were obtained from the patient. This includes presence of prior diagnosis of allergic rhinitis, asthma. Post medical therapy computed tomography (CT) scans performed preoperatively were evaluated using the Lund-Mackay CT scoring system. The post-operative SNOT-22 was completed between three and six months after the surgery. Written informed consent was obtained from the study participant prior to the interview. Only the observations from the patients who have been completely responded to pre-operative and post-operative SNOT 22 questionnaire were taken up for statistical analysis. The data was entered in excel sheet and analyzed using SPSS (Version 16). Descriptive statistics with mean, standard deviation and proportions (%) were calculated for quantitative variables. Univariate analyses and multivariate analyses were done to determine which questions of SNOT-22 independently predict the preoperative to post-operative change in the SNOT-22 total score.

RESULTS

The data for a total of 51 subjects that met the defined criteria were included. The baseline characteristics for the subjects are summarized in Table 1. Among the 51 participants 34 (66.7%) patients were males and 17 (33.3%) patients were females. The male subjects showed 44.28% overall improvement while the female subjects showed 45.6% overall improvement. Among the 51 patients who underwent FESS 7 (13.7%) were below 25 years, 9 (17.6%) between 25 and 29 years, 3 (5.9%) between 30 and 34 years, 10 (19.6%) between 35 and 39 years, 8 (15.7%) between 40 and 44 years, 5 (9.8%) between 45 and 49 years, 5 (9.8%) between 50 and 55 years and 4 (7.8%) above 55 years of age. Their overall improvement was 44.3%, 39.94%, 48.36%, 49.39%, 40.67%, 50.08%, 45.52% and 41.93% respectively (Table 2). There were 45 participants who never underwent FESS and 2 and 4 patients underwent FESS once and more than once respectively. Overall improvement among them was found to be 45.3%, 48.68% and 57.02% respectively (Table 3). The demographic features were tabulated and their effect on outcome of FESS tabulated. It showed, Hypertension group (n=9, 17.6%) showed 41.11% improvement against non-hypertension group (n=42, 82.35%) which showed 45.47% improvement, Diabetes Mellitus group (n=12, 23.5%) showed 48.17% improvement against non-diabetic group (n=39, 76.5%) which showed 43.03% improvement, Bronchial asthma group (n=6, 11.8%) showed 39.71% improvement against non-bronchial asthma group (n=45, 88.23%) which showed 45.34% improvement, COPD group (n=1, 2%) which showed 39.71% against non-COPD group (n=50, 98%) which showed 44.80% improvement, Allergic rhinitis group (n=23, 45%) which showed 43.9% improvement against non-allergic rhinitis group (n=28, 55%) which showed 45.36% improvement, migraine group (n=12, 23.5%) showed 42.94% improvement against non-migraine group (n=39, 76.5%) which showed 45.24% improvement. Patient reported addictions were analysed, smoking group (n=18, 35.3%) showed 42.38% improvement against non-smoking group (n=33, 64.7%) showed 45.96%, tobacco chewing group (n=5, 10%) showed 43.73% improvement against non-tobacco chewing group (n=46, 90%) which showed 44.8% improvement, betel nut chewing group (n=3, 6%) showed 54.58% improvement against non-betel nut chewing group (n=48, 94%) which showed 44.08% improvement, tobacco inhalation group (n=1, 2%) showed 39.71%, against non-tobacco inhaling group (n=50, 98%) which showed 44.8%), alcohol consuming group (n=18, 35.3%) showed 43.57% improvement against non-alcohol consuming group (n=33, 64.7%) which showed 45.32% improvement. In this study 57% patients were diagnosed to have CRS with sinonasal polyposis (CRSwSNP) while 43% of cases had only CRS, without polyps (CRSsSNP). They had 43.43% and 46.37% improvement respectively. Because many of the questions in the SNOT-22 cluster together, we conducted hypothesis tests related to determine which clusters of questions provided uniquely/independently predictive information about post-operative improvement. For these analyses, we grouped questions into 4 main categories: Nasal related ("need to blow nose", "sneezing", "runny nose", "nasal obstruction", "loss of smell/taste", and "post-nasal drip" (PND), Ear and Facial Related ("ear fullness", "dizziness", "ear pain", "facial pain and pressure"), Quality of Life related ("difficulty falling asleep", "wake up at night", "wake up tired", "fatigue", "reduced productivity", "reduced concentration"), and Psychologically related ("frustrated/ restless/ irritable", "sad", "embarrassed"). Those clusters that related to nasal and to ear and facial symptoms were significantly associated with post-operative improvement ($p<0.000$, and $p=0.0284$, respectively). Total percentage of improvement in this study was found to be 55.4% and maximum improvement was noted in the symptom running nose and lease improvement in wake up at night times whereas need to blow nose and sneezing were found to be statistically significant (Table 7).

Table 1: Gender distribution.

Sex	N	% improvement
Male	34	44.28
Female	17	45.6

Table 2: Age distribution.

Age distribution (in years)	Frequency	% improvement
<25	7	44.3
25-29	9	39.94
30-34	3	48.36
35-39	10	49.39
40-44	8	40.67
45-49	5	50.08
50-54	5	45.52
>55	4	41.93

Table 3: Distribution based on prior FESS status.

Prior FESS	N	% improvement
Never	45	45.3
Once	2	48.68
More than once	4	37.02

Table 4: Effect of demographic factors on the outcome of FESS.

Characteristics	N	%	Mean improvement (%)	P value
Hypertension	9	17.6	41.11	0.897
Diabetes mellitus	12	23.5	48.17	0.912
Bronchial asthma	6	11.8	39.86	0.26
COPD	1	2.0	39.71	0.749
Allergic rhinitis	23	45.1	43.9	<0.01
Migraine	12	23.5	42.94	0.886
Smoking	18	35.3	42.38	0.317
Tobacco chewing	5	9.8	43.73	0.399
Betel nut chewing	3	5.9	54.58	0.002
Tobacco inhalation	1	2.0	39.71	0.749
Alcohol consumption	18	35.3	43.57	0.889

Table 5: Distribution based on diagnosis.

Diagnosis	Frequency	% improvement
CRSwSNP	29	43.43
CRSsSNP	22	46.37

Table 6: Improvement plotted against pre-op SNOT 22 scores.

Pre op score Groups	overall% Change	% change in nasal group	% change in ear-facial group	% change in QoL group	% change in psychological related group
31-40	12.5	53.3	66.67	50.00	30.00
41-50	2.5	36.03	37.5	37.77	27.61
51-60	39.1	50.68	53.37	41.33	35.09
61-70	46.3	52.38	62.23	36.75	34.21
71-80	54.12	53.88	46.62	36.57	27.96
81-90	46.99	46.15	100.00	33.33	-25.00
91-100	67.35	45.83	33.33	54.55	12.50

Table 7: Improvement on each item in SNOT 22.

Questions	% of improvement	Lower limit of 95% CI	Upper limit of 95% CI	P value
Total	55.4	41.4	67.7	> 0.05
Runny nose	74.1	61.1	84.5	> 0.05
Embarrassed	64.7	51.1	76.4	> 0.05
Facial pain	63.8	50.5	75.4	> 0.05
Nasal obstruction	62.1	49.0	74.7	> 0.05
Lack of sleep	59.2	47.1	73.1	> 0.05
Frustration	58.3	45.2	71.2	> 0.05
Ear pain	55.9	43.3	67.4	> 0.05
Need to blow nose	54.5	42.1	66.5	< 0.05
Sad	54.0	41.5	66.0	> 0.05
Thick ND	53.5	39.8	65.9	> 0.05
Reduced concentration	52.9	39.1	65.3	> 0.05
Reduced productivity	52.8	39.0	65.8	> 0.05
Loss of smell	52.3	38.5	65.0	> 0.05

Continued.

Questions	% of improvement	Lower limit of 95% CI	Upper limit of 95% CI	P value
Wake up tired	51.4	38.1	64.6	> 0.05
PND	50.1	37.7	64.1	> 0.05
Sneezing	48.9	35.9	62.3	< 0.05
Ear fullness	48.2	35.4	61.7	> 0.05
Dizziness	47.5	34.0	60.5	> 0.05
Fatigue	44.2	31.9	58.1	> 0.05
Difficulty in falling asleep	43.3	30.5	56.7	> 0.05
Wake up at night	38.2	28.1	52.9	> 0.05

DISCUSSION

This study was done to predict the outcome of functional endoscopic surgery (FESS) for CRS by pre-operative Sino nasal outcome test (SNOT-22). Mean age of study participant in this study was found to be 35.4±14.2 years. Marambia et al[19] study mean age was 40.7±13.5 years. The value of the overall SNOT-22 score was apparent with patients with the highest symptom scores experiencing the greatest degree of symptom improvement. This corresponds with previous studies, which have cited the relatively greater improvement among more severely affected patients.[20,21] It is important to note that even the patients with the lowest pre-operative symptoms scores did experience improvement, although the magnitude of the change was limited by the associated flooring effect. Our study confirmed the ability of FESS to improve the overall symptom score in patients who identify "sneezing" as a significant symptom. However, multiple regression analysis revealed that these scores correlated with *less* improvement in overall score after surgery. Given this finding in the greater context of the literature, it is advisable to address these considerations with patients having persistent sneezing. Also based on the literature some studies have reported depression (sadness) as a significant factor among all these 22 variables. There is significant association with known cases of allergic rhinitis and cases who has habit of using beetle nut chewing were found to have significant association with poor improvement in post-operative scores compared to other factors. Patients with a SNOT-22 score less than 40, had the lowest chance of achieving an MCID (37.5%) and received a relative mean worsening of their QoL after FESS (+18.8%). Patients with a SNOT-22 score greater than 40 obtained a greater than 75% chance of achieving an MCID and there was a relative improvement of 45% in QoL after ESS. Outcomes from the CRS with polyp status subgroup analysis were like the findings from the overall cohort. Outcomes from this study suggest that patients with a preoperative SNOT-22 score higher than 40 points receive a greater than 75% chance of achieving an MCID and on average obtain a 45% relative improvement in their QoL after FESS. Joushva et al in their study reported that low-SNOT scores were identified in 6% of subjects with CRS. After adjustment, low-SNOT CRS and control groups without CRS report similar baseline average SNOT-22 total scores (p=0.879). Unexpectedly, compared to controls, low-SNOT CRS patients had significantly better average psychological (2.1 [2.3] vs. 5.8 [6.0]; p=0.030) and sleep dysfunction (2.7 [3.4] vs. 6.0 [5.2]; p=0.016) scores. 14/38 (37%) low-SNOT patients elected to undergo endoscopic sinus surgery (ESS) with a significantly lower likelihood of reporting a minimal clinically important difference (MCID) when compared to high-SNOT patients (43% vs. 82%; p<0.001) after a mean follow-up of ~15 months.[22] Levy et al reported that low SNOT scores were identified in 6% of subjects with CRS. After adjustment, low-SNOT CRS and control groups without CRS reported similar baseline average SNOT-22 total scores (p=5.879). Unexpectedly, compared to controls, low-SNOT CRS patients had significantly better average psychological and sleep dysfunction scores. Fourteen of 38 (37%) low-SNOT patients elected to undergo endoscopic sinus surgery (ESS), with a significantly lower likelihood of reporting a minimal clinically important difference (MCID) when compared to high-SNOT patients (43% vs. 82%; p<0.001) after a mean follow-up of 15 months.[22] Erskine et al stated that patients with CRSwNPs report higher symptom scores in the nasal domain of SNOT-22 than those with CRSsNPs with women in both subgroups reporting higher total scores than men.[23] In another study conducted by Marambaia et al QOL score was 42.1 (±16.4) in the group with an indication for surgery and 40.6 (±23.4) in the group without this indication, p=0.84. All the patients were assessed by a single doctor with blinding in relation to the initial score. No differences were detected between the groups. Also, Marambaia et al in their another study reported that CRS reduces the quality of life of patients, according to the SNOT-22 questionnaire.[19] They stated that the impact of the CRS was reduced even among the patients with the indication for surgery. Both groups scored over 40. They concluded that their study can help predict the impact of the CRS over time and better adjust expectations with non-surgical treatment.[24] Ersline et al in their study stated that differences in SNOT-22 scores were identified between those with different types of CRS with those with CRSwNPs /AFRS having significantly higher scores in the nasal domain compared to those without polyps.[23]

CONCLUSION

Current evidence suggests that patients with CRS who are candidates for FESS may make decisions based on the

degree of their preoperative Quality of life (QoL) impairment. The purpose of this study was to improve patient understanding of their surgical outcomes while they make preference sensitive decisions regarding electing FESS. Outcomes from this study suggest that patient with a preoperative SNOT-22 score higher than 40 points receive a greater than 75% chance of achieving MCID (Gross pre- to post- op change score > 9) and on average obtained 40% relative improvement in their QoL after FESS. Patients with SNOT-22 score less than 40 typically fail to achieve significant QoL improvement after FESS. Information from this study can be used to improve patient understanding of the potential outcomes after FESS and may improve preference-sensitive café for CRS.

In conclusion, our study showed that, with optimal surgical intervention (and post-operative medical management), FESS is an extremely effective treatment of CRS. Also, patient-based outcome measures, such as the SNOT-22, are helpful tools for quantifying changes in symptoms and, can be used to predict extent of post-operative improvement. While all the components of the SNOT-22 significantly improved after surgery, only "sneezing" (associated with lesser improvement), as well as "Nasal clearing by blowing nose" (associated with greater improvement) were independent predictors of post-surgical SNOT-22 improvement. Also factors like allergic rhinitis was found to have significant influence (associated with lesser improvement) on the outcome.

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REFERENCES

1. Lehrer-Coriat E, Mariño-Sánchez F, Alobid I, Mullol J. Quality of life measures in patients on rhinosinusitis trials. Clin Investigation. 2013;3(3):251-63.
2. Blackwell DL, Collins JG, Coles, R. Summary health statistics for U.S. adults: National Health Interview Survey. 1997. Vital Health Stat. 2002;(205):1-109.
3. Settipane GA. Epidemiology of nasal polyps. Allergy Asthma Proc. 1996;17(5):231–6.
4. Meltzer EO, Hamilos DL, Hadley JA, Lanza DC, Marple BF, Nicklas RA, et al. Rhinosinusitis: Establishing definitions for clinical research and patient care. Otolaryngol Head Neck Surg. 2004;131(6):1-62.
5. Kennedy JL, Hubbard MA, Huyett P, Patrie JT, Borish L, Payne SC. Sino-nasal outcome test (SNOT-22): a predictor of postsurgical improvement in patients with chronic sinusitis. Ann Allergy Asthma Immunol. 2013;111(4):246-51.
6. Messerklinger W. Endoscopy of the Nose. Baltimore: Urban and Schwarzenberg, 1978.
7. Wigand D. Endoscopic S11.1gery of the Paranasal Sinuses and Anterior Skull Base. New York: Thieme; 1991.
8. Zinreich SJ, Kennedy DW, Rosenbaum AE, Gayler BW, Kumar AJ, Stammberger H, et al. Paranasal sinuses: CT imaging requirements for endoscopic surgery. Radiology. 1987;163:769–75.
9. Messerklinger W. On the drainage of the normal frontal sinus of man. Acta Otolaryngol (Stockh) 1967;63:176–81.
10. Mackay IS, Lund VJ. Surgical management of sinusitis. In:Scott- Brown's Otolaryngology. Oxford: Butterworth-Heinemann;1997.
11. Earwaker J. Anatomic variants in sinonasal CT. Radiographics 1993;13:381–415.
12. Brandsted R, Sindwani R. Impact of depression on disease-specific symptoms and quality of life in patients with chronic rhinosinusitis. American J Rhinol. 2007;21:50–54.
13. Smith TL, Mendolia-Loffredo S, Loehrl TA, Sparapani R, Laud PW, Nattinger AB. Predictive factors and outcomes in endoscopic sinus surgery for chronic rhinosinusitis. Laryngoscope. 2005;115:2199–205.
14. Anderson ER, Murphy MP, Weymuller EA Jr. Clinimetric evaluation of the Sinonasal Outcome Test-16. Student Research Award 1998. Otolaryngol Head Neck Surg. 1999;121(6):702–7.
15. Hopkins C, Gillett S, Slack R, Lund VJ, Browne JP. Psychometric validity of the 22-item Sinonasal Outcome Test. Clin Otolaryngol. 2009;34(5):447–54.
16. Canonica GW, Bousquet J, Mullol J, Scadding GK, Virchow JC. A survey of the burden of allergic rhinitis in Europe. Allergy. 2007;62(85):17–25.
17. Lü W, Qi F, Gao ZQ, Feng GD, Yuan XD, Jin XF. Quality of life survey on patients with chronic rhinosinusitis by using Chinese version of the 22-item sinonasal outcome test (SNOT-22). Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi. 2008;43(1):18–21.
18. Kosugi EM, Chen VG, Fonseca VM, Cursino MM, Mendes Neto JA, Gregório LC. Translation, cross-cultural adaptation and validation of SinoNasal outcome test (SNOT):22 to Brazilian Portuguese. Braz J Otorhinolaryngol. 2011;77(5):663–9.
19. Marambaia PP, Lima MG, Santos KP, Gomes AD, Sousa MM, Marques ME. Evaluation of the quality of life of patients with chronic rhinosinusitis by means of the SNOT-22 questionnaire. Brazilian J Otorhinolaryngol. 2013;79(1):54-8.
20. Poetker DM, Smith TL. Adult chronic rhinosinusitis:surgical outcomes and the role of endoscopic sinus surgery. Current opinion in Otolaryngol Head Neck Surg. 2007;15:6–9.
21. Smith TL, Litvack JR, Hwang PH, Loehrl TA, Mace JC, Fong KJ, et al. Determinants of outcomes of sinus surgery:a multi-institutional prospective cohort study. J Am Acad Otolaryngol-Head Neck Surg. 2010;142:5.

22. Levy JM, Mace JC, Rudmik L, Soler ZM, Smith TL. Low 22-item sinonasal outcome test scores in chronic rhinosinusitis: Why do patients seek treatment? Laryngoscope. 2017;127(1):22-8.
23. Erskine S, Hopkins C, Kumar N, Wilson J, Clark A, Robertson A, Kara N, Sunkaraneni V, Anari S, Philpott C. A cross sectional analysis of a case-control study about quality of life in CRS in the UK;a comparison between CRS subtypes. Rhinology. 2016;54(4):311-5.
24. Marambaia PP, Lima MG, Macario H, de Machado Gomes A, Gomes LM, Marambaia MP, et al. Use of the long-term quality of life assessment in the decision to indicate surgery in patients with chronic rhinosinusitis. Brazilian J Otorhinolaryngol. 2018.

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