Zagazig University Medical Journal
www.zumj.journals.ekb.eg

https://doi.org/10.21608/zumj.2024.318639.3565 Volume 30, Issue 9, December. 2024

**Manuscript ID:** ZUMJ-2409-3565
**Doi:** 10.21608/ZUMJ.2024.318639.3565

REVIEW ARTICLE

# An Outline about Endoscopic Sinus Surgery Outcome in Management of Chronic Rhinosinusitis

**Mohamed Abd-Alhamid Hassanain[1*], Amr Hassan El Sinbawy [2], Sherif Mohammad Askar [2], Mohammad Waheed El-Anwar [2]**

[1]Department of Otorhinolaryngology, Al Ahrar Teaching Hospital, Zagazig, Egypt
[2]Department of Otorhinolaryngology, Faculty of Medicine, Zagazig University, Zagazig, Egypt

***Corresponding author:**
Mohamed Abd-Alhamid Hassanain
**E-mail:**
M7md.ent.2017@gmail.com

**Submit Date: 05-09-2024**
**Accept Date: 19-09-2024**

## ABSTRACT

**Background**: Aside from the obvious negative effects on patients and society's financial well-being, chronic rhinosinusitis (CRS) can lead to absenteeism, decreased productivity, and impaired respiratory function, all of which have a major influence on patients and society's overall quality of life. Endoscopic sinus surgery is an option for patients who have not responded to other treatments, and there are several objective and subjective ways to evaluate the success of the procedure, even if there is little level 1 evidence. We summarize the available outcome metrics and provide a thorough evaluation of the published results up to this point. Also covered is research suggesting that endoscopic sinus surgery may improve asthma patients' respiratory performance.

**Conclusion:** There has been a shift in the last 20 years toward using patient-reported outcomes rather than objective data as the main result in sinus disease, especially CRS. The variety of instruments at our disposal enables us to assess the efficacy of surgery in relation to health-specific and general quality of life, burden of illness, healthcare utilization, and pulmonary function.

**Keywords:** Endoscopic sinus surgery, Outcome, Chronic rhinosinusitis

## INTRODUCTION

Chronic rhinosinusitis (CRS) affects about 11% of the UK population and can present with or without nasal polyps. Inflammation of the nasal passages and paranasal sinuses is the description given by the European Position Paper on Rhinosinusitis and Nasal Polyps. There needs to be a minimum of 12 weeks for there to be signs of polyps, mucopurulent discharge from the middle meatus, edema/mucosal blockage mainly in the middle meatus, mucosal alterations such as discharge, facial pain or pressure, or a loss in smell [1,2].

The impact of CRS on quality of life is significantly greater than that of other chronic illnesses, such as angina or chronic obstructive pulmonary disease (COPD) [3]. Both patients and society pay a heavy price for CRS; a recent analysis estimated that the US economy loses $22 billion per year due to CRS [4]. Each patient also has to pay an extra $1,547 to $2,700 in 2014 USD for medications before surgery, on top of the estimated $6.9 to $9.9 billion in direct healthcare expenditures and $13 billion in indirect costs.

Surgery is typically regarded as an option in cases where medical therapy does not alleviate symptoms or when problems are present or are expected to arise as a result of CRS. Open procedures are hardly contemplated for simple diseases, as endoscopic sinus surgery (ESS) has become the standard [4].

Over the past few years, there has been a surge in research focused on evaluating the results of sinus surgery. Numerous measures, both objective and subjective, have been devised to gauge the effectiveness of these procedures. This review attempts to summarize the current literature on endoscopic sinus surgery for chronic rhinosinusitis (CRS) and to identify potential outcome indicators for future research. We will also go over how ESS

for CRS has the potential to reduce the number of new asthma diagnoses and improve the disease pattern in asthma patients. Lastly, we think about how decisions made during the perioperative period can affect surgical results, specifically regarding patient selection, the time and scope of surgery, and the postoperative care plans chosen.

Defining the appropriate metrics to evaluate the success of sinus surgery is a crucial first step. The main outcome of early trials of endoscopic sinus surgery was frequently "objective" assessments of the surgery, such as changes in CT scans, ostial patency, or endoscopic appearances. However, the idea that patients' perspectives on their outcomes are the most essential has been gaining traction ever since validated disease-specific instruments for subjective outcome assessments emerged Patient Reported Outcome Measures – (PROMs). Eighty percent of patients and doctors in a recent survey on CRS outcome evaluation ranked symptomatic improvement as the most significant variable [5].

With the search phrases "Outcomes AND (Endoscopic sinus surgery OR ESS OR FESS OR sinus surgery)" entered into PubMed, a literature search was conducted. Only adult patients and searches conducted in English were considered. Exclusion criteria included that the studies did not include concomitant rhinoplasty. Studies that met the inclusion criteria were also evaluated for review after searching the Cochrane ENT online library (ent.cochrane.org). To find any other studies that weren't found in the first search, we thoroughly investigated the 2012 European Position Paper on Rhinosinusitis and Nasal Polyps [2]. Research with a higher quality of evidence, larger sample size, more precisely specified outcome measures, and studies whose main outcome measures were the ones we describe were given priority for inclusion in this review.

Visual analog scales are the simplest way to express the degree of symptoms as stated by patients. Regarding the question "How troublesome are your symptoms of rhinosinusitis?", patients are requested to mark their response at one point on a 10-centimeter line. It is also possible to use this method to rate the intensity of individual symptoms.

One example is the increasing number of disease-specific instruments that ask patients to rate the severity of various symptoms. Some examples of these instruments include the Chronic Sinusitis Survey (CSS), the Sino-Nasal Outcome Test (20-SNOT-20), and the Rhinosinusitis Disability Index (RSDI). They have the potential to create a valuable medical record, make it easy to track how a patient is responding to therapy, facilitate healthcare based on patient preferences, and reveal whether a patient is a good surgical candidate. The clinical context will determine which PROM is best, although a recent systematic evaluation of CRS PROMs found the SNOT-22 to be the gold standard [6]. Some of the symptoms listed on the instruments may be experienced by the general public; a typical SNOT-22 score is between 7 and 9 points [7]. A clinically meaningful change in symptoms is defined as a change of 8.9 points on the SNOT-22, which is the smallest observable change in symptoms, even though there may be a statistically significant change in symptom scores [8].

An updated 2009 Cochrane study from 2006 found no evidence that surgery improved symptoms more than continuing conventional treatment [9].

The evaluation only included three level 1 studies; one of them compared inferior meatal antrostomy to middle meatal antrostomy, while the other two reviewed antral wash-out to FESS for isolated maxillary sinus illness. The only research that compared medicinal and surgical treatments for CRS was Ragab et al. [10]. Either medical treatment alone or FESS with medical treatment were the two groups randomly assigned to 90 individuals who had CRS symptoms for 8 weeks. Results on patient-reported outcomes measures such as the Visual Analogue Scales, SNOT-20, and Short Form-36 (SF-36) QOL were not significantly different between the medical and surgical groups, despite improvements in both. Based on the limited duration of intranasal corticosteroids and alkaline nasal douche given to patients in this trial, the results do not accurately represent the current surgical practice of offering surgery as an option to patients who have not responded to conventional therapy.

A multi-center prospective cohort research including 298 UK Consultant Otorhinolaryngologists and 87 hospitals was the UK National Sinonasal audit, the biggest study of its type [11]. We included patients who were 16 years old or older and who received CRS surgery (main or revision) within six months, regardless of whether they had nasal polyposis or not. Before surgery, at3,12, and 36 months post-op, patients had their health-related quality of life evaluated with the SNOT-22. Of the 31,128 patients surveyed, 70% had nasal polyps; within this group, 52% had undergone prior sinonasal surgery, whereas 34% did not. Out of 2852 participants (or 91% of the total), 42.0 had an overall baseline SNOT-22 score, 41.0 had a CRSwNP score, and 44.2 had a Chronic

Rhinosinusitis without Nasal Polyps (CRSsNP) score. A significant improvement in health-related quality of life was seen three months after surgery, when the mean total score dropped to 25.5, a decrease of 16.5. At every follow-up period, patients with polyps had better scores than those without polyps. The mean SNOT-22 score at 36 months was 27.7. The average SNOT-22 score was 28.2 out of 2797 participants (1459/2797, or 52%) who were able to undergo additional follow-up at 60 months [12]. The possibility for a long-term impact on health-related quality of life is demonstrated by these long-term findings.

Patients who had not responded to medical treatment after three weeks were enrolled in a prospective cohort trial by Smith et al. [13]. Participants could choose between continuing medical therapy (n = 33) or ESS (n = 65). At 12-month follow-up, the surgical group showed a considerably larger improvement when the RSDI and CSS were used as end measures. Similarly, Smith et al. [14] compared the efficacy of endoscopic sinus surgery versus that of continuing medical treatment for CRS by including 31 patients on the surgical waiting list after three months of ineffective medical treatment. Those on the waiting list chose to keep getting medical care because they wanted to. At baseline, two weeks before surgery, and six and twelve months following the procedure, SNOT-22 scores were recorded. The mean SNOT-22 scores of patients increased significantly from 57.6 at baseline to 66.1 at surgery, with an average of 7.1 months of continued medical care preceding surgery. Before surgery, the average SNOT-22 score was 16.0, representing a decline of 50.1 points.

Standardized measures of health-related QOL symptoms

Examples of general scores that do not focus on a specific disease condition include the Short Form 36 (SF-36) [15] and the EQ-5D [16]. A wide range of generalized physical and mental symptoms are assessed by these scores. In terms of Quality-Adjusted Life Years (QALYs), they provide comparisons across diseases and cost-effectiveness. Because of their low sensitivity, they are unable to detect changes in CRS symptoms and have limited use in clinical records.

A team from Oregon, USA, used the Short-Form 6D for five years to measure patients' self-reported quality of life following main or revision ESS for CRS. Included in the study were 232 adults [3]. Health state utility values (HUVs) were then calculated from the data, which are estimates of the public's perception of a certain health status. On a scale from 0 (death) to 1.0 (perfect health), results can be compared across different diseases and therapies. With a utility value difference of 0.03 [17], we get the minimal clinically relevant difference (MCID). They had a lower average pre-operative health utility value (0.65) than the US population as a whole (0.81). Among the 168/232 (72%) patients who completed the post-operative SF-6D at an average follow-up of 1.5 years after surgery, the authors found an increase of 0.087 (0.06-0.12) for patients who underwent primary surgery and 0.062 (0.04-0.09) for patients who underwent revision. This improvement was compared to that observed after coronary angioplasty. Compared to pre-operative scores, the mean utility value at 5 years was 0.80 in the 83 patients (or 49% of the total) who did the survey. This was in line with the US population mean and demonstrated a significant improvement [18].

The health utility values of 212 patients who chose either continued medical therapy or ESS for CRS were evaluated using the SF-6D in a recent North American prospective cohort study. After three weeks of ineffective medical treatment, patients who chose ESS had statistically and clinically significant improvements in health utility compared to those who chose medical therapy, whose health utility was higher at baseline but stayed the same at 6 and 12 months of follow-up [19].

In addition, a team from Boston conducted a prospective study involving 242 patients with chronic rhinosinusitis who underwent primary and revision endoscopic sinus surgery. The Euroqol 5-Dimension evaluation (EQ-5D) was used to assess their health status at baseline, 3, 12, and 24 months after the surgery [20]. The EQ-5D normal population in the United States has a baseline HUV of 0.85, however, their patients' HUV was a much lower 0.81. Nevertheless, following surgery, their HUV reached 0.89 at 3 months and stayed consistent at 24 months. Chronic recurring stress disorder (CRS) is known to cause absenteeism, which is defined as the inability to appear for work as a result of health concerns. One measure of presenteeism is the degree to which CRS causes workers to lose focus on their jobs, as measured by self-reported questionnaires [21]. Using the national average daily income, we may calculate the societal economic impact of presenteeism and absenteeism, which is the total of lost productive time.

There has been a dearth of research attempting to quantify the societal and patient-level indirect costs of absenteeism and lost productivity [21, 22]. One

study examined the impact of ESS on productivity expenses; however, only that study included 27 patients willing to undergo the operation and had refractory CRS [23]. On average, households lost 75 days of output per year due to absenteeism, presenteeism, and time spent caring for CRS symptoms; this cost $9,190 per person per annum. Costs associated with productivity decreased to $3,373 and time lost to productivity decreased to 28 days during an average of 15 months of follow-up.

**Endoscopic grades**

There are several grading methods available for evaluating illness in CRS through endoscopic evaluation. There are different opinions regarding which grading system is considered superior, but Lund and Kennedy's is frequently utilized because of its comprehensive approach that takes into account various factors such as polyps, edema, discharge, crusting, and scarring [24]. It has proven to be highly beneficial in research on polypoid disease. Psaltis et al. [25] showed a significant connection with the SNOT-22 and strong inter-rater and test-retest reliability using a modified Lund-Kennedy score that only accounts for polyps, edema, and discharge. They noted that 40% of this system is devoted to assessing scarring and crusting, which are post-operative observations.

In their presentation, Djukic et al. [26] included data from 85 patients who had ESS for CRSwNP. Lund-Kennedy endoscopic scores showed significant improvement from 8.4 at baseline to 2.8 at 6-month and 3.7 at 12-month follow-up, respectively.

While waiting for surgery, 31 Canadian patients who had tried maximal medical therapy for three months without success continued their medication. The Lund-Kennedy endoscopic scores went from 6.9 to 7.7 during the course of 7 months on average, whereas they went from 2.4 to 2.7 after the operation [14].

**Recurrence rates**

A stated end-point is necessary for measuring recurrence. One easy and objective approach to accomplish this is to look at data on revision surgery. However, it is debatable whether the disease had returned before the revision surgery; pinpointing exactly when this happened is more difficult and is contingent, in part, on the frequency of the patient's evaluations following the procedure. The UK National Sinonasal Audit [11] collected data from 3,128 individuals who had CRS surgery between 2000 and 2001; around 4% required a revision procedure within one year, and 11% within three years. Of the 1459 patients who participated in the study and gave their consent, 19% (or 52.2% of the total) underwent previous revision surgery [12]. In the study, 51.2% of patients had previous sinonasal surgery, compared to 34.4% without polyposis and 46.0% overall.

In a subsequent countrywide, multi-center trial in the UK, 553 patients with CRSsNP and 651 with CRSwNP were included from ENT clinics. Data regarding the amount and timing of prior surgery was collected by self-reported patient questionnaires. Although 43% of individuals with polyps had previously had sinonasal surgery, 55% of those without polyps had done the same. On average, a ten-year interval separated sinonasal procedures [27].

**Complications**

Weighing the potential advantages of an intervention against its potential risks is essential. Serious complications can include leakage of cerebrospinal fluid, issues with the orbit (such as ecchymosis, diplopia, or impaired visual acuity), and significant intra- or immediate post-operative hemorrhage; it can also lead to infections, mild bleeding, post-operative pain, and adhesions [28].

The National Sinonasal Audit found that little blood loss accounted for the vast majority of the 6.6% total adverse event rate. Out of 31,28 patients, eleven (0.4%) experienced major complications, with seven (0.2%) impacting the orbit. There were five individuals affected by peri-orbital bleeding and two patients impacted by peri-orbital emphysema. Nobody had any trouble seeing or moving their eyes in any way. During the procedure, two patients (0.06%) had CSF fluid leaks that were repaired, and two more had to be readmitted because of substantial postoperative hemorrhage. There was a statistically significant association between the degree of polyposis, SNOT-22, and Lund-Mackay CT scores, and the likelihood of postoperative complications, according to multivariate analysis [28]. This suggests that these important subjective and objective outcome measures can be used to predict the postoperative outcome when calculating complication rates. Major complication rates of 0.4% in the UK are lower than those of 1.1% in a meta-analysis of 4691 US patients who had ESS performed 10 years ago [29].

Medical treatment for CRS carries an unknown risk of consequences, according to available data. There is mounting evidence that clarithromycin poses a risk of cardiac mortality in individuals with cardiac abnormalities, and there is a minor but significant risk of serious problems like stomach ulcers, osteoporosis, and immunological suppression when

systemic steroids are used. Future trials must ensure that the surgical and medical therapy groups' risk of adverse events is addressed.

**Olfactory tests**

The recognition of well-known odors is a component of several olfactory function tests, such as the UPSIT [30] developed by the University of Pennsylvania. Odor discrimination and olfactory threshold tests are also possible using Sniffin' Sticks [31]. It is important that tests can distinguish between individuals with normal olfactory function and those with different levels of olfactory impairment. Their application is more prevalent in academic investigations than in everyday medical treatment.

Minwengen [32] divided patients into groups with mild or severe sinus disease, as assessed by a Lund-Mackay score of ≤7 or ≥8, in a prospective research that examined the impact of primary ESS for CRS on olfactory function as measured by Sniffin' Sticks testing. Of the original 76 patients, 38 (about 50%) underwent olfactory evaluation after surgery. Patients with severe disease showed substantial improvement, whereas those with mild disease showed little change; nonetheless, the mild group's pre-operative olfactory scores were almost normal.

Using the UPSIT at baseline, 6 and 12 months after ESS, Litvack et al. [33] examined olfactory function in 111 individuals in a prospective cohort study spanning multiple centers. Significant improvement in olfactory function was noted in anosmic individuals (UPSIT scores 6-18/40), with a mean score increase from 9.7 to 21.3 at 6 months and continued at 12 months of follow-up. Hyposmic patients did not show any statistically significant improvement, normosmic patients were steady, and anosmic patients experienced a 26% rise in UPSIT scores of 4 or above. In particular, for the anosmic individuals, the presence of nasal polyps was a robust predictor of recovery.

After initial medical management failed, 280 patients were compared who chose to continue medical therapy or undergo ESS. The results of the Brief Smell Identification Test (B-SIT) demonstrated that both groups improved equally [34]. The data from this trial cannot be applied to patients in Europe since, according to existing standards, the decision to continue treatment was taken after only three weeks at the very latest.

**Measures of Outcome Heterogeneity**

Being well-versed in data interpretation and comparing outcomes from multiple studies for meta-analysis becomes increasingly difficult due to the breadth of outcome measures. No treatment, whether cutting-edge or standard, can have its effectiveness evaluated using just one outcome measure. As part of the COMET group (Core Outcome Measures in Effectiveness Trials), a group of international rhinologists is presently working to resolve the challenges that arise with this heterogeneity [35]. As a starting point for assessing both novel treatments and standard care, they hope to establish a "core outcome set" of outcome metrics.

**The effect of ESS on asthma rates**

For this study, researchers looked for medical records of 2833 American patients with CRS who had primary ESS and also had asthma, as well as any related doctor visits [36]. Patients with asthma were more common among those who waited at least five years after their diagnosis to undergo surgery (45.4% of the total), in contrast to those who underwent surgery within one year (20.3% of the total). It is still unclear from these results whether treating medically refractory CRS improves respiratory function or if the increased prevalence of asthma is a sign of a systemic illness.

This group also aimed to determine the relationship between the time it took to go from a first CRS diagnosis to primary ESS and the frequency of additional asthma diagnoses. An examination of 1204 patients' medical records revealed an almost linear increase in the incidence of asthma diagnoses. For example, in the first 1-2 years following diagnosis, 9.4% of patients received primary ESS; in the fourth to fifth years after diagnosis, 22.4% of patients underwent surgery. All of these patients did not have a history of asthma before the study. Patients who underwent surgery within one to two years after surgery had a much lower rate of new asthma diagnoses compared to those who waited four to five years after surgery [37].

At least one asthma outcome was identified in 22 studies that underwent sinus surgery, according to a comprehensive review and meta-analysis [38]. Overall, 76% of patients reported an improvement in their asthma symptoms, and the number of asthma episodes, hospitalizations, and trips to the emergency room all decreased. The use of oral corticosteroids fell 72% and inhaled corticosteroids fell 28% in frequency. Unfortunately, there was no evidence that FEV1 or PEF improved in the studies that were found. The included trials did not control for people without surgery; this thorough evaluation did not determine if the observed improvement in asthma outcomes is sustainable, given the severity of the condition and the amount of surgery differed.

For 47 Canadians with severe asthma who had previously tried and failed medical treatment for ESS, the number of asthma clinic visits decreased by 50% (6 to 3) in the year preceding FESS [39].

There is currently no cure for chronic rhinosinusitis, and evidence from the UK indicates that 43-56% of individuals need revision surgery [11, 27]. Results data on revision compared to primary surgery are diverse due to the variability of illness severity, surgical extent and time, and study design. Nonetheless, there does seem to be consensus among the results that revision surgery can alleviate symptoms in some patients.

Among 302 patients enrolled in a prospective cohort analysis, 61% were revision cases; the odds of success for the RSDI were 2.1 times greater than those for the CSS in original surgery, while the odds for the CSS were 1.8 times higher [40].

## CONCLUSION

In the last 20 years, there has been a marked shift in the emphasis from objective measurements to patient-reported outcomes as the principal determinant of success in the management of sinus disease, specifically chronic rhinosinusitis (CRS). We can assess the efficacy of surgery in terms of disease burden, healthcare utilization, pulmonary function, health-specific and generic quality of life, and a variety of other metrics thanks to the array of technologies at our disposal. Despite the lack of level 1 proof, these results show that surgical procedures can help medically resistant individuals in a big way. Optimal surgical indications and duration should be defined in subsequent research, and a randomized controlled study comparing surgical vs. medical treatment for patients who have failed medical treatment at first attempt should be the primary emphasis.

**Conflict of Interest:** No

**Financial disclosure:** No

## REFERENCES

1. Hastan D, Fokkens WJ, Bachert C, Newson RB, Bislimovska J, Bockelbrink A, et al. Chronic rhinosinusitis in Europe--an underestimated disease. A GA2LEN study. Allergy. 2011;66(9):1216–23.
2. Fokkens WJ, Lund VJ, Mullol J, Bachert C, Alobid I, Baroody F, et al. EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. A summary for otorhinolaryngologists. Rhinology. 2012;50(1):1–12.
3. Soler ZM, Wittenberg E, Schlosser RJ, Mace JC, Smith TL. Health state utility values in patients undergoing endoscopic sinus surgery. Laryngoscope. 2011;121(12):2672–8.
4. Smith KA, Orlandi RR, Rudmik L. Cost of adult chronic rhinosinusitis: A systematic review. Laryngoscope. 2015;125(7):1547–56.
5. Hopkins C, Philpott C, Crowe S, Regan S, Degun A, Papachristou I, Schilder AG. Identifying the most important outcomes for systematic reviews of interventions for rhinosinusitis in adults: working with Patients. Public and Practitioners. Rhinology. 2016;54(1):20–6.
6. Rudmik L, Hopkins C, Peters A, Smith TL, Schlosser RJ, Soler ZM. Patient-reported outcome measures for adult chronic rhinosinusitis: A systematic review and quality assessment. J Allergy Clin Immunol. 2015;136(6):1532–40.
7. Gillett S, Hopkins C, Slack R, Browne JP. A pilot study of the SNOT 22 score in adults with no sinonasal disease. Clin Otolaryngol. 2009;34(5):467–9.
8. 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.
9. Khalil HS, Nunez DA. Functional endoscopic sinus surgery for chronic rhinosinusitis. Cochrane Database Syst Rev. 2006;(3): CD004458.
10. Ragab SM, Lund VJ, Scadding G. Evaluation of the medical and surgical treatment of chronic rhinosinusitis: a prospective, randomized, controlled trial. Laryngoscope. 2004;114(5):923–30.
11. Hopkins C, Browne JP, Slack R, Lund V, Topham J, Reeves B, et al. The national comparative audit of surgery for nasal polyposis and chronic rhinosinusitis. Clin Otolaryngol. 2006;31(5):390–8.
12. Hopkins C, Slack R, Lund V, Brown P, Copley L, Browne J. Long-term outcomes from the English national comparative audit of surgery for nasal polyposis and chronic rhinosinusitis. Laryngoscope. 2009;119(12):2459–65.
13. Smith TL, Kern R, Palmer JN, Schlosser R, Chandra RK, Chiu AG, et al. Medical therapy vs surgery for chronic rhinosinusitis: a prospective, multi-institutional study with 1-year follow-up. Int Forum Allergy Rhinol. 2013;3(1):4–9.
14. Smith KA, Smith TL, Mace JC, Rudmik L. Endoscopic sinus surgery compared to continued medical therapy for patients with refractory chronic rhinosinusitis. Int Forum Allergy Rhinol. 2014;4(10):823–7.
15. RAND Health. Medical Outcomes Study: 36-Item Short Form Survey Instrument [Internet]. [cited 2016 Jan 5]. Available from:

http://www.rand.org/health/surveys_tools/mos/mos_core_36item_survey.html
16. EuroQol. EQ-5D questionnaire [Internet]. [cited 2016 Jan 5]. Available from: http://www.euroqol.org
17. Walters SJ, Brazier JE. What is the relationship between the minimally important difference and health state utility values? The case of the SF-6D. Health Qual Life Outcomes. 2003;1:4.
18. Rudmik L, Mace J, Soler ZM, Smith TL. Long-term utility outcomes in patients undergoing endoscopic sinus surgery. Laryngoscope. 2014;124(1):19–23.
19. Luk LJ, Steele TO, Mace JC, Soler ZM, Rudmik L, Smith TL. Health utility outcomes in patients undergoing medical management for chronic rhinosinusitis: a prospective multiinstitutional study. Int Forum Allergy Rhinol. 2015;5(11):1018-27.
20. Remenschneider AK, Scangas G, Meier JC, Gray ST, Holbrook EH, Gliklich RE, et al. EQ-5D-derived health utility values in patients undergoing surgery for chronic rhinosinusitis. Laryngoscope. 2015;125(5):1056–61.
21. Rudmik L, Smith TL, Schlosser RJ, Hwang PH, Mace JC, Soler ZM. Productivity costs in patients with refractory chronic rhinosinusitis. Laryngoscope. 2014;124(9):2007–12.
22. Sahlstrand-Johnson P, Ohlsson B, Von Buchwald C, Jannert M, Ahlner-Elmqvist M. A multi-center study on quality of life and absenteeism in patients with CRS referred for endoscopic surgery. Rhinology. 2011;49(4):420–8.
23. Rudmik L, Smith TL, Mace JC, Schlosser RJ, Hwang PH, Soler ZM. Productivity costs decrease after endoscopic sinus surgery for refractory chronic rhinosinusitis. Laryngoscope. 2016;126(3):570-4.
24. Lund VJ, Kennedy DW. Staging for rhinosinusitis. Otolaryngol Head Neck Surg. 1997;117(3 Pt 2):S35–40.
25. Psaltis AJ, Li G, Vaezeafshar R, Cho K-S, Hwang PH. Modification of the Lund-Kennedy endoscopic scoring system improves its reliability and correlation with patient-reported outcome measures. Laryngoscope. 2014;124(10):2216–23.
26. Djukic V, Dudvarski Z, Arsovic N, Dimitrijevic M, Janosevic L. Clinical outcomes and quality of life in patients with nasal polyposis after functional endoscopic sinus surgery. Eur Arch Otorhinolaryngol. 2015;272(1):83–9.
27. Philpott C, Hopkins C, Erskine S, Kumar N, Robertson A, Farboud A, et al. The burden of revision sinonasal surgery in the UK-data from the Chronic Rhinosinusitis Epidemiology Study (CRES): a cross-sectional study. BMJ Open. 2015;5(4). e006680.
28. Hopkins C, Browne JP, Slack R, Lund VJ, Topham J, Reeves BC, et al. Complications of surgery for nasal polyposis and chronic rhinosinusitis: the results of a national audit in England and Wales. Laryngoscope. 2006;116(8):1494–9.
29. May M, Levine HL, Mester SJ, Schaitkin B. Complications of endoscopic sinus surgery: analysis of 2108 patients--incidence and prevention. Laryngoscope. 1994;104(9):1080–3.
30. Doty RL, Shaman P, Kimmelman CP, Dann MS. University of Pennsylvania Smell Identification Test: a rapid quantitative olfactory function test for the clinic. Laryngoscope. 1984;94(2):176–8.
31. Hummel T, Sekinger B, Wolf SR, Pauli E, Kobal G. "Sniffin" sticks': olfactory performance assessed by the combined testing of odor identification, odor discrimination and olfactory threshold. Chem Senses. 1997;22(1):39–52.
32. Minwegen F, Thomas JP, Bernal-Sprekelsen M, Dazert S, Minovi A. Predictive value of disease severity on self-reported rating and quantitative measures of olfactory function outcomes after primary endoscopic sinus surgery. A prospective study. Rhinology. 2014;52(4):437–43.
33. Litvack JR, Mace J, Smith TL. Does olfactory function improve after endoscopic sinus surgery? Otolaryngol Head Neck Surg. 2009;140(3):312–9.
34. DeConde AS, Mace JC, Alt JA, Schlosser RJ, Smith TL, Soler ZM. Comparative effectiveness of medical and surgical therapy on olfaction in chronic rhinosinusitis: a prospective, multi-institutional study. Int Forum Allergy Rhinol. 2014;4(9):725–33.
35. COMET Initiative. Chronic Rhinosinusitis Outcome MEasures – developing a core outcome set for trials of interventions in chronic rhinosinusitis [Internet]. [cited 2016 Jan 5]. Available from: http://www.comet-initiative.org/studies/details/748?result=true [PubMed]
36. Benninger MS, Sindwani R, Holy CE, Hopkins C. Early versus delayed endoscopic sinus surgery in patients with chronic rhinosinusitis: impact on health care utilization. Otolaryngol Head Neck Surg. 2015;152(3):546–52.
37. Benninger MS, Sindwani R, Holy CE, Hopkins C. Impact of medically recalcitrant chronic rhinosinusitis on incidence of asthma. Int Forum Allergy Rhinol. 2016;6(2):124–9.
38. Vashishta R, Soler ZM, Nguyen SA, Schlosser RJ. A systematic review and meta-analysis of asthma outcomes following endoscopic sinus surgery for chronic rhinosinusitis. Int Forum Allergy Rhinol. 2013;3(10):788–94.

39. Al Badaai Y, Valdés CJ, Samaha M. Outcomes and cost benefits of functional endoscopic sinus surgery in severely asthmatic patients with chronic rhinosinusitis. J Laryngol Otol. 2014;128(6):512–7.

40. 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. Otolaryngol Head Neck Surg. 2010;142(1):55–63.

## Citation

**Hassanain, M., El Sinbawy, A., Askar, S., El-Anwar, M. An Outline about Endoscopic Sinus Surgery outcome in Management of Chronic Rhinosinusitis. *Zagazig University Medical Journal*, 2024; (4629-4636): -. doi: 10.21608/zumj.2024.318639.3565**