Outcome reporting in functional nasal airway surgery: a scoping review to inform the development of a core outcome set

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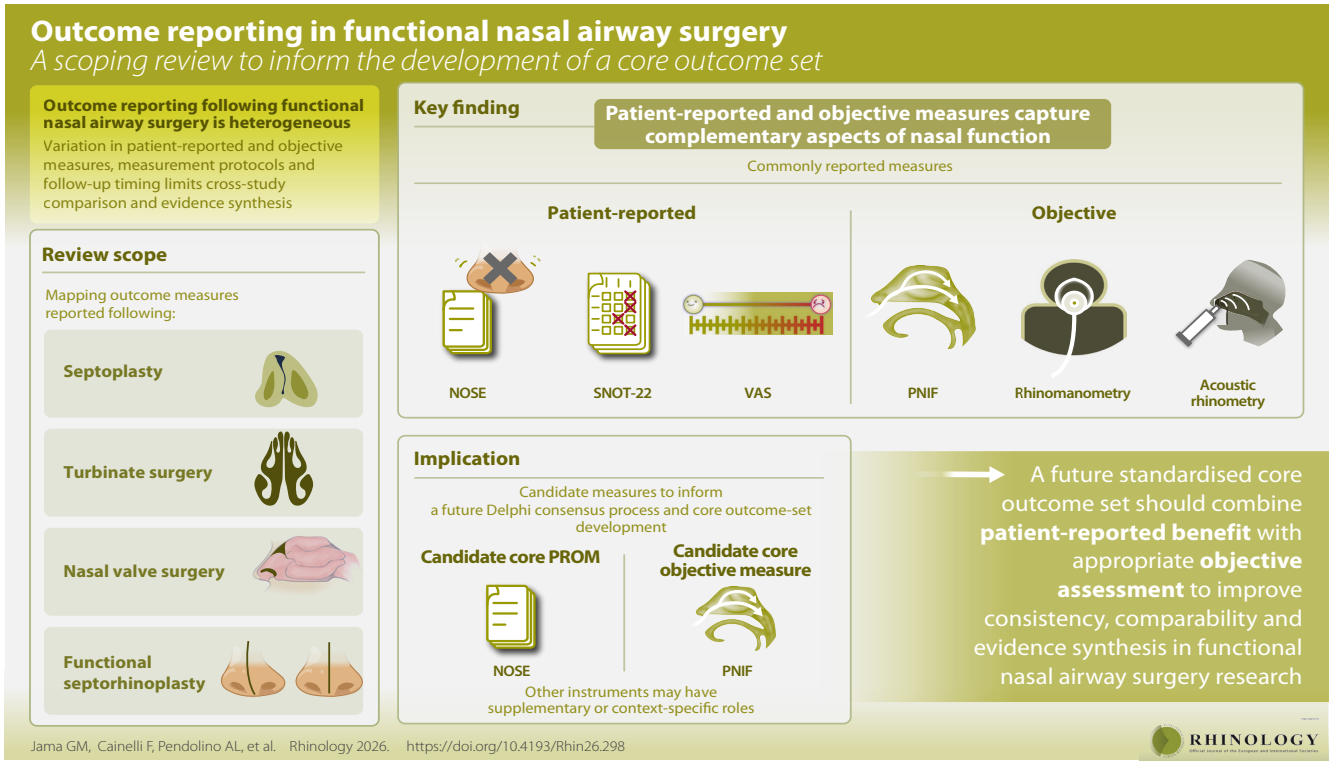

Abstract

Background: Functional nasal airway procedures are performed to relieve nasal airway obstruction; however, published studies use inconsistent outcome measures to quantify endpoints. This heterogeneity limits comparison between studies, weakens meta-analyses, and impedes the development of standardised research and audit frameworks. **Methodology**: A scoping review of the published literature was undertaken to map the current range of outcome measures utilised in clinical studies on functional nasal airway surgery and to identify outcome metrics that could populate a future Delphi exercise. **Results**: The contemporary literature comprises studies using a wide range of patient-reported and objective outcome measures, with substantial variation in the domains assessed, instruments selected and postoperative follow-up intervals. Only a minority of studies employ validated disease-specific outcome measures as primary endpoints. **Conclusions**: The present review establishes the current landscape of outcome reporting in functional nasal airway surgery. The findings provide the evidentiary groundwork required to inform a structured consensus process and the development of a standardised core outcome set.

Key words: nasal obstruction, nasal surgical procedures, outcome assessment, scoping review, core outcome sets

Introduction

Functional nasal airway procedures, such as septoplasty, turbinate reduction, nasal valve surgery, and functional septorhinoplasty, represent a cornerstone of rhinologic practice, offering patients symptomatic relief from nasal airway obstruction and demonstrable improvements in quality of life (QoL) [1,2]. Despite decades of refinement in surgical technique, the field continues to lack a unified standard for defining and measuring surgical

success [3]. This fragmentation has created a heterogeneous evidence base: published studies employ inconsistent measurement approaches, limiting direct comparison and meaningful synthesis of published outcome data [4].

Contemporary assessment generally draws on two broad paradigms: subjective and objective outcome measures [5]. Patient-reported outcome measures (PROMs), notably the Nasal Obstruction Symptom Evaluation (NOSE) scale and Sino-Nasal Outcome Test-22 (SNOT-22), have become well-established, reflecting the increasing recognition that patient experience is a valid and often superior indicator of functional benefit compared to objective testing alone [6,7]. Concurrently, objective physiological measures, including peak nasal inspiratory flow (PNIF), rhinomanometry, and acoustic rhinometry, quantify airflow dynamics and anatomical dimensions [8,9]. However, evidence consistently demonstrates poor correlation between subjective symptoms and objective findings, reflecting a fundamental mismatch between how patients perceive improvement and measurable physiological changes [10,11].

Beyond this discordance in measurement, broader methodological heterogeneity further undermines evidence quality. Inconsistencies in study design, patient populations, timing of assessments, and endpoint definitions systematically restrict cross-study comparability, obstruct meta-analytical synthesis, and ultimately impede guideline development [2,12]. This contrasts sharply with other rhinologic domains, such as chronic rhinosinusitis (CRS) and olfactory disorders, where explicit development of core outcome sets – that is, formally agreed, standardised collections of outcomes designed to unify reporting and enable collaborative research – has proven transformative in strengthening the evidence base and fostering international consensus on best practices [13,14]. The absence of an equivalent unified standard used to measure outcomes in functional nasal airway surgery represents a critical gap in the literature.

The aim of the present review was therefore to map the current landscape of outcome reporting in functional nasal airway surgery, to describe the principal instruments used, and to identify outcome measures that could be taken forward into a formal Delphi exercise and a Core Outcome Measures in Effectiveness Trials (COMET)-registered core outcome set development.

Materials and methods

A review of the published literature was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Figure 1) [15]. A comprehensive search of PubMed/MEDLINE, Embase and the Cochrane Library was performed in April 2026, combining MeSH/Emtree terms and free-text synonyms for nasal obstruction, functional nasal airway surgery and outcome assessment using Boolean operators. The full search strategy is provided in Appendix 1.

Studies were eligible if they: (i) included adults undergoing functional nasal airway surgery for nasal airway obstruction (septoplasty, functional septorhinoplasty, turbinate surgery, or nasal valve procedures); and (ii) reported at least one postoperative outcome measure (patient-reported or objective). Randomised trials, non-randomised comparative studies, cohort studies, case series, validation studies and relevant systematic reviews were eligible, as the aim was to identify outcome reporting rather than to estimate pooled treatment effects. Studies focusing exclusively on chronic rhinosinusitis without a clearly defined functional nasal airway procedure, studies on children, or non-surgical interventions were excluded. Disagreements at title/abstract and full-text screening stages were resolved by discussion between the two primary reviewers (FC, GMJ), with recourse to a third reviewer (ALP) where consensus was not reached.

Data were extracted using a standardised extraction form capturing procedure type, outcome domain, instrument name, whether the measure was used as a primary or secondary endpoint, follow-up interval, and whether a validated or non-validated measure was employed.

Results

Overview of reported outcome domains

Reported outcomes were categorised into the following broad domains: (i) nasal obstruction symptom severity; (ii) disease-specific sinonasal quality of life; (iii) generic health-related quality of life; (iv) objective airflow; (v) objective nasal resistance; (vi) nasal geometry and anatomy; and (vii) endoscopic or structural evaluation.

Patient-reported outcome measures

NOSE

The Nasal Obstruction Symptom Evaluation (NOSE) scale is the most widely used validated disease-specific PROM across all four procedure types [6]. The instrument comprises five items addressing nasal congestion, blockage, breathing difficulty, sleep disturbance, and exercise intolerance, each scored on a 0-4 ordinal scale and transformed to a 0-100 metric [6]. It demonstrates robust psychometric properties across multiple international validation studies: internal consistency (Cronbach's $\alpha = 0.785–0.971$), test-retest reliability (ICC = 0.702-0.942), and construct validity, with significant correlations with visual analogue scale (VAS) scores for nasal obstruction ($r = 0.548-0.574$) [6,16-22]. Postoperative improvements following septoplasty and functional septorhinoplasty consistently exceed 30-40 points, with high

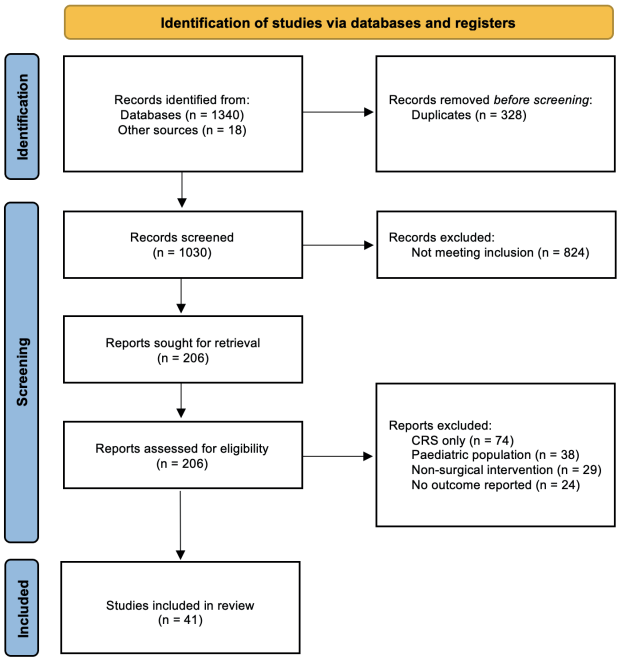

Figure 1. PRISMA flowchart outlining the study selection process.

sensitivity to surgical intervention [2,4-5]. The minimal clinically important difference (MCID) has been established using anchor-based methods at approximately 24 points, though distribution-based estimates range from 4-8 points, reflecting ongoing methodological variation across studies [4,23]. The NOSE scale has been validated in over 15 languages, including Swedish, Dutch, German, Spanish, Greek, Slovenian, Hebrew, and Thai versions [16-22,24]. It is freely available without restrictions and can be completed in under two minutes, facilitating implementation across care settings [6,25].

Despite its psychometric strengths, floor effects may limit responsiveness in patients with mild baseline obstruction [1,4,10]. Furthermore, the scale does not capture rhinorrhoea, olfactory dysfunction, or facial pain, which may coexist in patients with concurrent chronic rhinosinusitis (CRS) [10,26-27].

SNOT-22

The Sino-Nasal Outcome Test-22 (SNOT-22) is a 22-item, CRS-validated questionnaire covering five domains: nasal, facial/aural, sleep, function, and emotion [7]. It demonstrates robust psychometric performance in CRS, including high internal consistency (Cronbach's $\alpha > 0.80$) and good responsiveness [7,26]. SNOT-22 is widely used in functional nasal airway surgery studies, most often as a secondary outcome measure or in cohorts with coexistent sinonasal disease. The minimal clinically important difference (MCID) for the total SNOT-22 score has been estimated at 8.9 points in surgically managed CRS using anchor-based methods and 12 points in medically managed CRS in a multi-institutional cohort [28]. However, a validated MCID specific to patients with isolated nasal airway obstruction in the absence of CRS has not been established, representing an important evidence gap.

Only a subset of SNOT-22 items directly assesses nasal airway patency, and its broader sinonasal focus limits disease specificity for isolated obstruction. In CRS literature, analyses of SNOT-22 domain structure suggest that the nasal subdomain may, in selected contexts, better reflect rhinologic symptom burden than the total score [25,26,28]. This raises the possibility that, in patients with isolated nasal airway obstruction, the nasal subdomain may be more appropriate than the aggregate SNOT-22 score when the primary objective is to quantify obstruction-specific symptom change. Nevertheless, although SNOT-22 can be used to study outcomes in patients with septal deviation or inferior turbinate hypertrophy, its development and validation remain grounded predominantly in CRS, and the utility of the nasal subdomain as a standalone outcome measure in functional nasal airway surgery has not been formally established [7]. Typical completion time is in the order of 5-10 minutes [30,31].

VAS and other measures

Visual analogue scales (VAS) for nasal obstruction are widely used in the literature, despite the absence of standardised scale construction, universally applicable MCID thresholds, or formal psychometric validation in functional nasal airway surgery [10,12,25]. Anchors vary across studies (0-10 and 0-100 scales are both used), with heterogeneous verbal descriptors that preclude meaningful cross study comparison [12]. In the absence of a universally applicable MCID for nasal obstruction VAS in functional nasal airway surgery, changes are typically interpreted using arbitrary absolute thresholds or percentage change criteria. In allied rhinologic domains, MCID thresholds for symptom VAS have been proposed at reductions of approximately 20-30 mm on a 100 mm scale [32]. However, these values have not been validated across all functional nasal airway surgery populations. The lack of a universal VAS MCID further reinforces the need for outcome measure standardisation, a central argument of the present review.

Generic health related quality of life instruments such as the EQ 5D and SF 36 are used in a minority of studies, predominantly for health economic analyses or broader functional assessment [33]. They demonstrate limited sensitivity to nasal symptom-specific change and therefore have restricted utility as primary outcome measures in functional nasal airway surgery [33].

Objective outcome measures

PNIF

Peak nasal inspiratory flow (PNIF) is the most commonly re-

ported objective measurement tool in functional nasal airway surgery studies. PNIF quantifies maximum nasal airflow (L/min) during forced inspiration through a tight fitting face mask, with the highest of three attempts recorded [8]. Validation studies demonstrate moderate convergent validity with rhinomanometry (r = 0.30-0.60) and excellent test-retest reliability (ICC > 0.85) [34,35]. Responsiveness to functional nasal airway surgery is well documented, with postoperative PNIF improvements of approximately 30-50% following functional septorhinoplasty [36-39]. Devices are relatively inexpensive, require no specialist infrastructure or extensive training, and permit assessment in under 2 minutes [8,40]. However, inconsistent measurement protocols represent a source of methodological heterogeneity: many studies do not specify whether PNIF was obtained with or without topical nasal decongestion, limiting comparability of reported values [41].

Standardisation of PNIF measurement protocols is important to improve cross study comparability. Pre and post decongestion measurements may provide different but complementary information, with post decongestion PNIF helping to distinguish fixed structural obstruction from reversible mucosal narrowing. Several authors have recommended that the decongestion protocol be explicitly reported and, wherever possible, standardised [8,9,34,35,41]. Normative PNIF values for children, adults, and older populations, including unilateral reference values, have been previously summarised, further supporting PNIF as a practical physiological adjunct when applied using consistent methodology [8,9]. Although postoperative PNIF improvements are frequently reported, and a 20 L/min MCID has been suggested in a septorhinoplasty cohort using anchor based and distribution based methods, a formally validated minimal clinically important difference specific to broader functional nasal airway surgery populations has not been established, and this remains an important evidence gap for outcome interpretation [36,39,42].

Rhinomanometry

Rhinomanometry quantifies nasal resistance by analysing pressure-flow relationships at standardised transnasal pressure differentials, typically 75 Pa or 150 Pa [43]. Active anterior rhinomanometry is the preferred technique, as it reflects physiological breathing conditions [44-46]. It provides detailed assessment of airflow resistance and is widely regarded as the reference physiological measure in mechanistic research [8,9]. Contemporary guidance has further refined both the performance and interpretation of rhinomanometry. The European Position Paper on Diagnostic Tools in Rhinology highlights rhinomanometry as a key objective tool for assessing nasal patency and recommends that measurement protocols be carefully standardised and interpreted alongside clinical findings and patient-reported symptoms [44,47]. Four-phase rhinomanometry has been proposed as an extension of conventional assessment because it characterises the full inspiratory and expiratory pressure-flow curve and may provide additional information on the dynamic behaviour and elasticity of the nasal valve region [46,47]. Guidance from the International Standardization Committee on Objective Assessment of the Nasal Airway similarly supports the incorporation of standardised four-phase analysis into contemporary practice, particularly in specialist and research settings [48]. However, use in the published literature is largely restricted to tertiary care and research environments, reflecting practical limitations related to equipment costs, dedicated space requirements, and the need for specialist operator training [8,9,43-46]. Testing typically requires 15-20 minutes, further limiting feasibility in routine clinical practice or multicentre audit. Active anterior rhinomanometry is also technically unreliable in the presence of a septal perforation, as the defect creates an alternative transnasal pressure pathway and leads to underestimation of true nasal resistance; in such cases, posterior rhinomanometry or alternative physiological measures should be considered [48-50].

Acoustic rhinometry

Acoustic rhinometry characterises nasal cavity cross-sectional area and volume through sound wave reflection [44,51]. It is used in a minority of studies, primarily to document structural and anatomical change following surgery [44,51]. Acoustic rhinometry does not directly measure airflow or resistance. Published systematic reviews consistently demonstrate poor correlation between acoustic rhinometry and subjective symptom measures (r < 0.30), limiting its utility as a primary functional outcome instrument [10,52].

Endoscopic and anatomical assessments

Endoscopic grading systems and computed tomography (CT) imaging are used in some studies to document structural outcomes including turbinate size, septal position, and patency of the internal and external nasal valves [53]. Although these measurements provide structural documentation, they correlate poorly with symptoms and nasal airflow dynamics and are not validated as primary functional outcome measures [53].

Trigeminal function assessment

Intranasal trigeminal function represents an emerging and currently underutilised domain of objective outcome assessment in functional nasal airway surgery. Four clinical methods for evaluating intranasal trigeminal sensitivity have been described in the literature: (i) a quick screening test based on ammonium vapour intensity rating; (ii) the lateralisation test, in which patients identify which nasal cavity is stimulated by eucalyptol or menthol and which assesses the functional integrity of the trigeminal chemosensory pathway; (iii) the trigeminal sticks test; and (iv) an automated CO_2 stimulation device that quantifies

Table 1. Candidate outcome domains and measurement instruments.

Instrument	Domain	Feasibility / cost	Advantages	Limitations	Likely role in framework
Subjective					
NOSE	Nasal obstruction	High / free	Specific to obstruction; high responsiveness; validated	Floor effects in mild cases	Candidate core measure
SNOT-22	Global sinonasal	High / free	Captures broader QoL (e.g., sleep, mood)	Low specificity for airflow; high burden (22 items)	Supplementary
VAS	Nasal obstruction	High / free	Extremely brief (<10s)	Unvalidated; poor standardisation	Clinical record only
Objective					
PNIF	Airflow (L/min)	High / <$50	Portable; simple; correlates with rhinomanometry	Effort-dependent; measures peak inspiratory flow rather than resistance.	Candidate core measure
Rhinomanometry	Pa·s/cm^3	Low / >$10k	Reference physiological measure; quantifies resistance	Expensive; time-consuming; requires expertise	Supplementary (research)
Acoustic rhinometry	Anatomy (area)	Low / >$10k	Maps geometry / MCA	Does not measure airflow; poor symptom correlation	Supplementary (research)

NOSE, Nasal Obstruction Symptom Evaluation; SNOT-22, Sino-Nasal Outcome Test-22; QoL, quality of life; VAS, Visual Analogue Scale; PNIF, peak nasal inspiratory flow; MCA, minimal cross-sectional area.

trigeminal pain thresholds through calibrated intranasal delivery of carbon dioxide [54]. Normative data for the lateralisation task have recently been published, providing a reference framework for clinical application [55]. These assessments are not yet incorporated as routine outcome instruments in functional nasal airway surgery studies; however, given the established role of trigeminal mucosal sensation in nasal patency perception and the persistent discordance between subjective and objective airflow measures, they represent a mechanistically distinct and potentially informative category of candidate outcome instrument for inclusion in a future core outcome set [56].

Subjective-objective discordance

A consistent and clinically important finding across the published literature is the weak-to-moderate correlation between patient-reported and objective outcome measures. Published meta-analyses and systematic reviews report correlation coefficients between NOSE scores and PNIF or rhinomanometry typically in the range of r = 0.20-0.45 across multiple study cohorts [10,11,52]. This discordance is reinforced by direct postoperative observations: patients frequently report substantial symptomatic improvement despite limited objective airflow change, while measurable objective improvement may not translate into subjective benefit [57-59]. These observations indicate that subjective and objective instruments assess overlapping but distinct constructs of nasal function. The underlying neurophysiological basis includes the decoupling of trigeminal mucosal sensation from actual airflow volume, modulation of nasal patency perception by airflow cooling, and the influence of psychological factors including expectation and emotional state on symptom reporting [60-66]. The nasal cycle introduces additional temporal variability in objective measures that may misalign with the patient's symptom burden at any single point in time [66].

Outcome timing and follow-up

Follow-up intervals vary widely across the literature. The most commonly reported primary postoperative assessment is at 3 months, though 6-month and 12-month follow-up intervals are also used, and a minority of studies report outcomes beyond 12 months [67]. This additional variability further limits the direct comparability of reported treatment effects across studies and makes it difficult to determine the temporal stability of postoperative improvement. Studies infrequently report whether observed improvements at short-term follow-up are maintained at 1 year or beyond.

Discussion

Principal findings

This scoping review demonstrates marked heterogeneity in outcome reporting following functional nasal airway surgery. Across septoplasty, functional septorhinoplasty, turbinate reduction, and nasal valve surgery, studies vary widely in the domains assessed, instruments selected, use of validated versus non-validated measures, and timing of postoperative follow-up. Validated disease-specific PROMs, most notably the NOSE scale, are underused as primary endpoints, whereas non-validated

symptom scores and visual analogue scales remain common. Correlation between subjective and objective outcome measures is generally weak to moderate, and follow-up intervals are highly variable, limiting direct comparison between studies and constraining meaningful evidence synthesis.

Outcome assessment in functional nasal airway surgery: strengths and gaps

The evolution of outcome assessment in functional nasal airway surgery mirrors the broader shift in rhinology from surgeon-centred to patient-centred metrics. Early work emphasised anatomical restoration and clinician-reported assessments of patency, whereas contemporary studies increasingly incorporate patient-reported outcome measures (PROMs) to capture the lived experience of nasal obstruction [6,12,68]. Within this landscape, the NOSE scale is the best-validated disease-specific PROM for nasal airway obstruction and is a particularly appropriate fit for routine clinical use and audit because it is brief, freely available, and easy to administer [6].

Despite these strengths, NOSE is not used consistently as a primary endpoint, and many studies continue to rely on non-validated subjective measures [2-4]. Broader instruments such as SNOT-22 are valuable in patients with concomitant chronic rhinosinusitis or wider sinonasal symptoms, but their lower specificity for isolated nasal obstruction and greater respondent burden limit their suitability as universal primary outcomes in functional nasal airway surgery [10]. Generic quality-of-life measures can inform health-economic and global impact analyses, yet they lack sensitivity to nasal symptom change and are best interpreted as supplementary rather than core outcomes in this context [33].

On the objective side, PNIF is a feasible physiological measure: it is inexpensive, quick to perform, and supported by evidence of reliability and responsiveness [8,9,34-40]. However, protocols vary considerably, particularly regarding the use of topical decongestants and the number and timing of measurements, reducing comparability between studies [41]. Rhinomanometry provides detailed information on nasal resistance and is regarded as a reference physiological tool in mechanistic studies, but its dependence on specialist equipment and training constrains routine use outside tertiary centres [43-47]. Acoustic rhinometry and imaging-based assessments contribute structural information but correlate poorly with symptoms and airflow metrics, underscoring their role as adjunctive rather than primary functional outcomes [10,44,48,51,52].

Collectively, these findings highlight clear strengths and important gaps: robust disease-specific PROMs exist but are underused as primary endpoints; feasible objective measures are available but lack standardised protocols and clinically grounded interpretation thresholds; and structural imaging, while useful for documentation, adds limited value to functional outcome evaluation. These limitations underpin the case for a core outcome set that specifies not only which instruments should be used, but also how they should be implemented and interpreted alongside patient-reported benefit.

Implications of subjective-objective discordance

A central finding of this review is the persistent discordance between subjective and objective measures of nasal obstruction. Correlation coefficients between PROMs such as NOSE and objective measures such as PNIF or rhinomanometry are generally weak to moderate, and postoperative series frequently show symptomatic improvement without commensurate objective change, or vice versa [10,11,52,57-59]. This disconnect reflects fundamental differences in the constructs being measured: PROMs capture an integrated perception of airflow, mucosal sensation, sleep, exercise tolerance, and emotional impact, whereas physiological tests quantify isolated parameters such as peak flow or resistance at a single time point.

The neurophysiological basis for this divergence is increasingly recognised. Trigeminal sensory mechanisms, the influence of airflow cooling on patency perception, the effects of the nasal cycle, and psychological factors such as expectation, anxiety, and mood all contribute to a perception of obstruction that is only partly explained by structural or flow parameters [60-66]. These insights support a dual paradigm approach to outcome assessment. Subjective and objective measures should not be viewed as competing, but rather as complementary tools that together provide a more complete picture of the patient and the success of surgical treatment. Importantly, the presence of discordance does not invalidate either domain; instead, it underlines the need to define clearly what each is intended to capture and how findings should be interpreted in clinical practice and research.

A further consideration is the non physiological context in which most objective measurements are obtained. PNIF involves forced maximal inspiration via a face mask, and rhinomanometry requires a mask seal and standardised transnasal pressure differentials, conditions that do not replicate normal tidal nasal breathing. While these measurements yield important physiological data points, they may not fully reflect the dynamic nasal function experienced by patients during everyday activities such as exercise, sleep, or quiet nasal breathing – contexts that most strongly influence patient reported outcome scores.

In addition, dysfunctional breathing patterns, particularly hyperventilation syndrome (HVS), represent an under recognised

confounding factor in the interpretation of surgical outcomes. Prospective evidence suggests that a substantial proportion of patients presenting with persistent nasal congestion after apparently adequate nasal surgery have features consistent with hyperventilation syndrome, with Nijmegen Questionnaire scores indicative of HVS reported in the majority of such patients in one series [69]. Patients with upper thoracic breathing, elevated respiratory rate, and reduced arterial pCO_2 may perceive ongoing nasal obstruction despite an anatomically and physiologically satisfactory surgical result [70]. Incorporating a breathing pattern assessment tool, such as the Nijmegen Questionnaire, into future outcome frameworks could help identify this clinically important subgroup and prevent misattribution of persistent symptoms to surgical failure.

Beyond the established dichotomy of patient reported and objective airflow measures, intranasal trigeminal function testing has emerged as a third, mechanistically distinct category of outcome instrument that may also be particularly useful in stratifying patients who report persistent nasal obstruction despite anatomically and physiologically adequate surgical results [56]. Trigeminal sensory pathways mediate the perception of airflow cooling, mucosal mechanoreception, and chemosensation within the nasal cavity, and their functional integrity is therefore a determinant of perceived nasal patency that is not captured by either PROMs or airflow/resistance measurements [54]. Clinical assessment methods, including the lateralisation test, trigeminal sticks, and automated CO_2 stimulation, may offer a means of quantifying this sensory dimension, and normative reference data for the lateralisation task are now available [55]. Incorporating trigeminal function assessment into future outcome frameworks would not only address an important mechanistic gap but could also provide a clinically meaningful explanation for the subset of patients in whom conventional subjective and objective measures diverge most markedly.

Lessons from other rhinologic core outcome set initiatives

In adjacent rhinologic domains, such as in chronic rhinosinusitis, the CHROME initiative and subsequent work have defined and implemented a consensus-based core outcome set that includes disease-specific PROMs and objective or endoscopic measures [14,71,72]. Similarly, for olfactory disorders, a COMET-aligned process has established standardised outcome recommendations that have already facilitated multicentre trials and more robust evidence synthesis [13]. These initiatives demonstrate that structured consensus processes can successfully harmonise outcome reporting in complex conditions.

The present review extends this logic to functional nasal airway surgery by systematically mapping existing outcome domains and instruments, thereby establishing the empirical groundwork necessary for a formal consensus process, including a Delphi survey with key stakeholders. The resulting long list of candidate domains and measures aligns with established methodological frameworks: it captures clinically and patient-relevant constructs already in use, highlights validated instruments where available, and identifies areas of redundancy and underrepresentation [73,74]. This structured approach enables refinement into a core outcome set comprising mandatory domains for all studies, alongside additional context-specific measures, for example, in cases involving concurrent chronic rhinosinusitis or revision surgery.

Why does outcome heterogeneity persist, and how can it be resolved?

Functional nasal airway surgery has evolved across multiple subspecialties, including otolaryngology, facial plastic surgery, and academic rhinology, without a single coordinating body. Early outcome reporting focused predominantly on surgeon reported assessments, and the formal adoption of patient reported outcome measures is relatively recent. The historic absence of a unified professional home for this area of clinical practice has impeded the kind of coordinated outcome standardisation seen in other rhinological domains, such as chronic rhinosinusitis, where dedicated networks have driven consensus processes and implementation of core outcome sets [72].

Methodologically, the evidence base in functional nasal airway surgery remains dominated by small, single centre studies. Multicentre collaborative designs, which inherently incentivise the adoption of shared outcome instruments and standardised protocols, are less common than in chronic rhinosinusitis, where initiatives such as CHROME have catalysed harmonisation of outcome reporting [72]. This fragmented research landscape has allowed a wide variety of instruments and measurement approaches to persist in parallel.

Looking forward, outcome heterogeneity can be addressed through coordinated initiatives at multiple levels. Registration of a functional nasal airway surgery core outcome set with COMET, followed by a formal Delphi consensus process involving rhinologists, patients, and allied specialists, would provide a structured mechanism for agreeing mandatory domains and preferred instruments [73,74]. Endorsement and author guidance from Rhinology and allied journals, requiring or strongly encouraging use of the agreed instruments, would support implementation at the publication level. Finally, adoption of the resulting core outcome set into audit and quality frameworks by professional societies, including the European Rhinologic Society, the European Academy of Allergy and Clinical Immunology, and the American Academy of Otolaryngology–Head and Neck Surgery, would embed standardised outcome reporting into routine

clinical practice and research.

Clinical and research implications

From a clinical perspective, greater standardisation of outcome reporting has clear potential to improve patient care. Routine use of validated PROMs alongside simple objective measures in outpatient settings would enable meaningful local audit, support shared decision making, and facilitate benchmarking across centres.

For objective measures such as PNIF and rhinomanometry, formal MCID thresholds have not yet been established for functional nasal airway surgery as a group of procedures. Although postoperative PNIF improvements of approximately 30-50% following functional septorhinoplasty have been described, and a PNIF MCID in the order of 20 L/min has been proposed in a septorhinoplasty cohort, this cohort-specific estimate has not been validated or adopted as a universal standard across other functional nasal procedures [36,37,42]. This contrasts with the more developed, though still incomplete, MCID evidence base for PROMs and represents an important methodological gap [4,29]. A future core outcome set process should explicitly address MCID derivation for objective measures in parallel with validated PROMs, so that both subjective and physiological endpoints can be interpreted in a clinically meaningful way.

For researchers, adoption of a core outcome set would reduce selective and inconsistent outcome reporting, allow direct comparison between trials and observational studies, and substantially strengthen the evidence base underpinning guidelines and health policy decisions.

Strengths and limitations of this review

The current review has several strengths. It uses a scoping methodology to capture a broad range of study designs and outcome measures across the spectrum of functional nasal airway surgery, follows recognised reporting guidance, and explicitly maps outcomes to clearly defined domains. By drawing on existing systematic reviews and validation studies, it synthesises both clinical and psychometric evidence for key instruments.

Nonetheless, certain limitations must be acknowledged. As a scoping review, it focuses on mapping and description rather than formal risk-of-bias assessment or meta-analysis of treatment effects. Some relevant studies may have been missed despite comprehensive searching, particularly those published in languages other than English or older reports using now-obsolete instruments. Finally, the findings reflect the current published literature and may not fully capture evolving practices in centres that have adopted more standardised outcome protocols but have not yet reported them.

Conclusion

Outcome reporting in functional nasal airway surgery is highly heterogeneous, with wide variation in the domains assessed, instruments used, timing of follow-up, and protocols applied to objective measurement. Validated disease-specific PROMs and feasible objective measures are underused as primary endpoints, and persistent subjective-objective discordance underscores the importance of a dual-paradigm assessment approach. This scoping review delineates the current landscape of commonly utilised outcome measures and generates a long-list of candidate domains and instruments that can now be taken forward into a formal Delphi exercise and COMET-registered core outcome set development.

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None.

Author contributions

GMJ conceived and designed the review, performed the literature search and drafted the manuscript. FC performed the literature search and data extraction, and drafted the manuscript. ALP contributed to study selection, data charting and manuscript revision. GO, PJA, CMP and HS supervised the study, contributed to design and interpretation, and critically revised the manuscript. All authors approved the final manuscript.

Conflict of interest

None.

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References

1. Carrie S, O'Hara J, Fouweather T, et al. Clinical effectiveness of septoplasty versus medical management for nasal airways obstruction: multicentre, open label, randomised controlled trial. BMJ 2023; 383: e075445.
2. Floyd EM, Ho S, Patel P, Rosenfeld RM, Gordin E. Systematic review and meta-analysis of studies evaluating functional rhinoplasty outcomes with the NOSE Score. Otolaryngol Head Neck Surg 2017; 156: 809-815.
3. Hassan Y, Leveille CF, Gallo L, et al. Reporting outcomes and outcome measures in open rhinoplasty: a systematic review. Aesthet Surg J 2020; 40: 135-146.
4. van Zijl FVWJ, Mokkink LB, Haagsma JA, Datema FR. Evaluation of measurement properties of patient-reported outcome measures after rhinoplasty: a systematic review. JAMA Facial Plast Surg 2019; 21: 152-162.
5. Spataro E, Most SP. Measuring nasal obstruction outcomes. Otolaryngol Clin North Am 2018; 51: 883-895.
6. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hannley MT. Development and validation of the Nasal Obstruction Symptom Evaluation (NOSE) scale.

Otolaryngol Head Neck Surg 2004; 130: 157-63.
7. Hopkins C, Gillett S, Slack R, Lund VJ, Browne JP. Psychometric validity of the 22-item Sinonasal Outcome Test. Clin Otolaryngol 2009; 34: 447-454.
8. Ottaviano G, Fokkens WJ. Measurements of nasal airflow and patency: a critical review with emphasis on the use of peak nasal inspiratory flow in daily practice. Allergy 2016; 71: 162-174.
9. Ottaviano G, Scadding GK, Scarpa B, Accordi D, Staffieri A, Lund VJ. Unilateral peak nasal inspiratory flow, normal values in adult population. Rhinology 2012; 50: 386-392.
10. Ta NH, Gao J, Philpott C. A systematic review to examine the relationship between objective and patient-reported outcome measures in sinonasal disorders: recommendations for use in research and clinical practice. Int Forum Allergy Rhinol 2021; 11: 910-923.
11. Yepes-Nuñez JJ, Bartra J, Muñoz-Cano R, et al. Assessment of nasal obstruction: correlation between subjective and objective techniques. Allergol Immunopathol (Madr) 2013; 41: 397-401.
12. Rhee JS. Measuring outcomes in nasal surgery: realities and possibilities. Arch Facial Plast Surg 2009; 11: 416-419.
13. Philpott C, Kumaresan K, Fjaeldstad AW, et al. Developing a core outcome set for clinical trials in olfactory disorders: a COMET initiative. Rhinology 2023; 61: 312-319.
14. Hopkins C, Hettige R, Soni-Jaiswal A, et al. CHronic Rhinosinusitis Outcome MEasures (CHROME), developing a core outcome set for trials of interventions in chronic rhinosinusitis. Rhinology 2018; 56: 22-32.
15. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169:467-473.
16. Lachanas VA, Tsiouvaka S, Tsea M, Hajiioannou JK, Skoulakis CE. Validation of the nasal obstruction symptom evaluation (NOSE) scale for Greek patients. Otolaryngol Head Neck Surg 2014; 151: 819-823.
17. Larrosa F, Roura J, Dura MJ, et al. Adaptation and validation of the Spanish version of the Nasal Obstruction Symptom Evaluation (NOSE) scale. Rhinology 2015; 53: 176-180.
18. Urbančič J, Soklič Košak T, Jenko K, et al. Cross-cultural adaptation and validation of nasal obstruction symptom evaluation questionnaire in Slovenian language. Zdr Varst 2016; 56: 18-23.
19. van Zijl FVWJ, Timman R, Datema FR. Adaptation and validation of the Dutch version of the nasal obstruction symptom evaluation (NOSE) scale. Eur Arch Otorhinolaryngol 2017; 274: 2469-2476.
20. Spiekermann C, Savvas E, Rudack C, Stenner M. Adaption and validation of the nasal obstruction symptom evaluation scale in German language (D-NOSE). Health Qual Life Outcomes 2018; 16: 172.
21. Daoud A, Eisenbach N, Ronen O, et al. Cross-cultural adaptation of the Hebrew Nasal Obstruction Symptom Evaluation (NOSE) scale. Laryngoscope Investig Otolaryngol 2022; 8: 34-39.
22. Sunnergren O, Pakpour AH, Bergquist H, Sahlstrand-Johnson P, Stjärne P, Broström A. Validation and psychometric evaluation of the Swedish version of the Nasal Obstruction Symptom Evaluation scale. Laryngoscope Investig Otolaryngol 2023; 8: 357-366.
23. Kandathil CK, Saltychev M, Abdelwahab M, Spataro EA, Moubayed SP, Most SP. Minimal clinically important difference of the Standardized Cosmesis and Health Nasal Outcomes Survey. Aesthet Surg J 2019; 39: 837-840.
24. Prasertwit K, Tanjararak K, Tangbumrungtham N, Emasithi A, Roongpuvapaht B. Translation and validation of the Thai version of the Nasal Obstruction Symptom Evaluation (NOSE) scale. OTO Open 2023; 7: e29.
25. Shukla RH, Nemade SV, Shinde KJ. Comparison of visual analogue scale (VAS) and the Nasal Obstruction Symptom Evaluation (NOSE) score in evaluation of post septoplasty patients. World J Otorhinolaryngol Head Neck Surg 2020; 6: 53-58.
26. Khan AH, Reaney M, Guillemin I, et al. Development of Sinonasal Outcome Test (SNOT-22) domains in chronic rhinosinusitis with nasal polyps. Laryngoscope 2022; 132: 933-941.
27. DeConde AS, Mace JC, Bodner T, et al. SNOT-22 quality of life domains differentially predict treatment modality selection in chronic rhinosinusitis. Int Forum Allergy Rhinol 2014; 4: 972-979.
28. Phillips KM, Houssein FA, Boeckermann LM, Singerman KW, Liu DT, Sedaghat AR. Multi-institutional minimal clinically important difference of the 22-item Sinonasal Outcome Test in medically managed chronic rhinosinusitis. Rhinology 2021; 59: 552-559.
29. Feng AL, Wesely NC, Hoehle LP, et al. A validated model for the 22-item Sino-Nasal Outcome Test subdomain structure in chronic rhinosinusitis. Int Forum Allergy Rhinol 2017; 7: 1140-1148.
30. Thamboo A, Santos RC, Naidoo L, Rahmanian R, Chilvers MA, Chadha NK. Use of the SNOT-22 and UPSIT to appropriately select pediatric patients with cystic fibrosis who should be referred to an otolaryngologist: cross-sectional study. JAMA Otolaryngol Head Neck Surg 2014; 140: 934-939.
31. Al Sharhan SS, Al Bar MH, Al Saied AS, Al Somali MI, Abdel Wahab MM. Development and validation of the Sinonasal Outcome Test-12. J Prim Care Community Health 2023; 14: 21501319231189060.
32. Ciprandi G, Tosca MA, Signori A, Cirillo I. Visual analogue scale assessment of nasal obstruction might define patients candidates to spirometry. Rhinology 2011; 49: 292-296.
33. Medeiros N, Aguiar C, Pina P, Lima NB, Larangeiro J, Condé A. Disease-specific vs non-specific questionnaires on septoplasty outcomes. Iran J Otorhinolaryngol 2022; 34: 163-170.
34. Starling-Schwanz R, Peake HL, Salome CM, et al. Repeatability of peak nasal inspiratory flow measurements and utility for assessing the severity of rhinitis. Allergy 2005; 60: 795-800.
35. Pendolino AL, Nardello E, Lund VJ, et al. Comparison between unilateral PNIF and rhinomanometry in the evaluation of nasal cycle. Rhinology 2018; 56: 122-126.
36. Andrews PJ, Choudhury N, Takhar A, Poirrier AL, Jacques T, Randhawa PS. The need for an objective measure in septorhinoplasty surgery: are we any closer to finding an answer? Clin Otolaryngol 2015; 40: 698-703.
37. Fuller JC, Bernstein CH, Levesque PA, Lindsay RW. Peak nasal inspiratory flow as an objective measure of nasal obstruction and functional septorhinoplasty outcomes. JAMA Facial Plast Surg 2018; 20: 175-176.
38. Fuller JC, Gadkaree SK, Levesque PA, Lindsay RW. Peak nasal inspiratory flow is a useful measure of nasal airflow in functional septorhinoplasty. Laryngoscope 2019; 129: 594-601.
39. Pendolino AL, Scarpa B, Andrews PJ. The effectiveness of functional septorhinoplasty in improving COVID-19-related olfactory dysfunction. Facial Plast Surg 2025 Feb 24. doi: 10.1055/a-2535-0153. Epub ahead of print.
40. Xavier R. Peak nasal inspiratory flow (PNIF) for nasal breathing evaluation. Facial Plast Surg 2024; 40: 310-313.
41. Nathan RA, Eccles R, Howarth PH, Steinsvåg SK, Togias A. Objective monitoring of nasal patency and nasal physiology in rhinitis. J Allergy Clin Immunol 2005; 115 (3 Suppl 1): S442-459.
42. Timperley D, Srubisky A, Stow N, Marcells GN, Harvey RJ. Minimal clinically important differences in nasal peak inspiratory flow. Rhinology 2011; 49: 37-40.
43. Wong EH, Eccles R. Comparison of classic and 4-phase rhinomanometry methods, is there any difference? Rhinology 2014; 52: 360-365.
44. Clement PA, Gordts F. Consensus report on acoustic rhinometry and rhinomanometry. Rhinology 2005; 43: 169-179.
45. Roithmann R, Cole P, Chapnik J, Barreto SM, Szalai JP, Zamel N. Acoustic rhinometry, rhinomanometry, and the sensation of nasal patency: a correlative study. J Otolaryngol 1994; 23: 454-458.
46. Ottaviano G, Pendolino AL, Scarpa B, et al. Correlations between peak nasal inspiratory flow, acoustic rhinometry, 4-phase rhinomanometry and reported nasal symptoms. J Pers Med 2022; 12: 1513.
47. Rimmer J, Hellings P, Lund VJ, et al. European position paper on diagnostic tools in rhinology. Rhinology 2019; 57 (Suppl S28): 1-41.
48. Vogt K, Zhang L. Airway assessment by

four-phase rhinomanometry in septal surgery. Curr Opin Otolaryngol Head Neck Surg 2012; 20: 33-9.
49. Guyette TW, Smith BE. Effect of septal perforations on measures of nasal resistance. Cleft Palate Craniofac J 1997; 34: 129-134.
50. Cannon DE, Frank DO, Kimbell JS, Poetker DM, Rhee JS. Modeling nasal physiology changes due to septal perforations. Otolaryngol Head Neck Surg 2013; 148: 513-518.
51. Fisher EW, Lund VJ, Scadding GK. Acoustic rhinometry in rhinological practice: discussion paper. J R Soc Med 1994; 87: 411-413.
52. André RF, Vuyk HD, Ahmed A, Graamans K, Nolst Trenité GJ. Correlation between subjective and objective evaluation of the nasal airway. A systematic review of the highest level of evidence. Clin Otolaryngol 2009; 34: 518-525.
53. Kimbell JS, Garcia GJ, Frank DO, Cannon DE, Pawar SS, Rhee JS. Computed nasal resistance compared with patient-reported symptoms in surgically treated nasal airway passages: a preliminary report. Am J Rhinol Allergy 2012; 26: e94-98.
54. Garefis K, Markou D, Chatziavramidis A, Nikolaidis V, Markou K, Konstantinidis I. Assessment of intranasal function of the trigeminal nerve in daily clinical practice. ORL J Otorhinolaryngol Relat Spec 2024; 86: 55-64.
55. Mai Y, Hernandez AK, Konstantinidis I, Haehner A, Hummel T. Normative data for the lateralization task in the assessment of intranasal trigeminal function. Rhinology 2025; 63: 92-102.
56. Hernandez AK, Garefis K, Konstantinidis I, Hummel T. Implications of intranasal trigeminal nerve function on the surgical management of nasal obstruction. ORL J Otorhinolaryngol Relat Spec 2025; 87: 85-97.
57. Murrell GL. Correlation between subjective and objective results in nasal surgery. Aesthet Surg J 2014; 34: 249-257.
58. Umihanic S, Brkic F, Osmic M, et al. The discrepancy between subjective and objective findings after septoplasty. Med Arch 2016; 70: 336-338.
59. Xavier R, Azeredo-Lopes S, Menger DJ, de Carvalho HC, Spratley J. Objective measurement and patient-reported evaluation of the nasal airway: Is correlation dependent on symptoms or on nasal airflow? Clin Otolaryngol 2021; 46: 744-751.
60. Sozansky J, Houser SM. The physiological mechanism for sensing nasal airflow: a literature review. Int Forum Allergy Rhinol 2014; 4: 834-838.
61. Zhao K, Blacker K, Luo Y, Bryant B, Jiang J. Perceiving nasal patency through mucosal cooling rather than air temperature or nasal resistance. PLoS One 2011; 6: e24618.
62. Yao F, Ye Y, Zhou W. Nasal airflow engages central olfactory processing and shapes olfactory percepts. Proc Biol Sci 2020; 287: 20201772.
63. Akkoca Ö, Oğuz H, Ünlü CE, Aydın E, Ozdel K, Kavuzlu A. Association between nasal obstruction symptoms and anxiety. Ear Nose Throat J 2020; 99: 448-452.
64. Ephrat M, Jacobowitz O, Driver M. Quality-of-life impact after in-office treatment of nasal valve obstruction with a radiofrequency device: 2-year results from a multicenter, prospective clinical trial. Int Forum Allergy Rhinol 2021; 11: 755-765.
65. Harju T, Numminen J, Kivekäs I, Rautiainen M. A prospective, randomized, placebo-controlled study of inferior turbinate surgery. Laryngoscope 2018; 128: 1997-2003.
66. Tahamiler R, Yener M, Canakcioglu S. Detection of the nasal cycle in daily activity by remote evaluation of nasal sound. Arch Otolaryngol Head Neck Surg 2009; 135: 137-142.
67. Tsang CLN, Nguyen T, Sivesind T, Cervin A. Long-term patient-related outcome measures of septoplasty: a systematic review. Eur Arch Otorhinolaryngol 2018; 275: 1039-1048.
68. Alsarraf R. Outcomes research in facial plastic surgery: a review and new directions. Aesthetic Plast Surg 2000; 24: 192-197.
69. Hanna BC, Woodman P, Adair R. Assessing the role of chronic hyperventilation in patients with nasal congestion: our experience in 118 patients. Clin Otolaryngol 2012; 37: 155-158.
70. Bartley J. Nasal congestion and hyperventilation syndrome. Am J Rhinol 2005; 19: 607-611.
71. Sedaghat AR, Campbell RG, Douglas RG, et al. Outcome measures for chronic rhinosinusitis with nasal polyps. Rhinology 2024; 62: 1-37.
72. Soni-Jaiswal A, Lakhani R, Hopkins C. Developing a core outcome set for chronic rhinosinusitis: a systematic review of outcomes utilised in the current literature. Trials 2017; 18: 320.
73. Prinsen CA, Vohra S, Rose MR, et al. How to select outcome measurement instruments for outcomes included in a "Core Outcome Set" - a practical guideline. Trials 2016; 17: 449.
74. Williamson PR, Altman DG, Blazeby JM, et al. Developing core outcome sets for clinical trials: issues to consider. Trials 2012; 13: 132.

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SUPPLEMENTARY MATERIAL

Appendix 1. Search strategies.

The full line-by-line search strategies for each database are reported below, exactly as run.

PubMed/MEDLINE (searched April 2026):

("nasal obstruction" [MeSH Terms] OR "nasal airway obstruction" OR "nasal blockage")

AND

("septoplasty" [MeSH Terms] OR "turbinate surgery" OR "nasal valve surgery" OR "functional septorhinoplasty")

AND

("outcome measure" OR "patient-reported outcome*" OR "NOSE scale" OR "SNOT-22" OR "peak nasal inspiratory flow" OR "rhinomanometry" OR "acoustic rhinometry")

Embase (Elsevier) via Ovid (searched April 2026):

1. 'nasal obstruction'/exp OR 'nasal airway obstruction' OR 'nasal blockage' OR
('nose'/exp AND (obstruction OR blockage))

2. 'septoplasty'/exp OR septoplasty:ti,ab OR
('nasal septum surgery'/exp) OR
('functional septorhinoplasty' OR 'septorhinoplasty'):ti,ab

3. 'turbinate surgery' OR 'inferior turbinate hypertrophy'/exp OR
('inferior turbinate' OR 'nasal turbinate*'):ti,ab AND (surgery OR reduction OR resection)

4. 'nasal valve'/exp OR 'nasal valve surgery' OR
('internal nasal valve' OR 'external nasal valve'):ti,ab

5. 2 OR 3 OR 4

6. 'outcome assessment'/exp OR 'treatment outcome'/exp OR 'treatment effectiveness'/exp OR
'patient reported outcome'/exp OR 'patient-reported outcome*':ti,ab OR
'NOSE scale':ti,ab OR 'Nasal Obstruction Symptom Evaluation':ti,ab OR
'SNOT-22':ti,ab OR 'Sinonasal Outcome Test-22':ti,ab OR
'peak nasal inspiratory flow':ti,ab OR PNIF:ti,ab OR
'rhinomanometry':ti,ab OR 'acoustic rhinometry':ti,ab

7. 1 AND 5 AND 6

8. humans/lim AND adult/lim

9. 7 AND 8

10. Remove duplicates

Cochrane Library (CENTRAL and Cochrane Reviews) (searched April 2026):

#1 "nasal obstruction" OR "nasal airway obstruction" OR "nasal blockage"

#2 septoplasty OR "functional septorhinoplasty" OR septorhinoplasty
OR "turbinate surgery" OR "inferior turbinate" OR "nasal valve surgery"

#3 "outcome measure*" OR "patient-reported outcome*" OR "patient reported outcome*"
OR "NOSE scale" OR "Nasal Obstruction Symptom Evaluation"
OR "SNOT-22" OR "Sinonasal Outcome Test-22"
OR "peak nasal inspiratory flow" OR PNIF
OR rhinomanometry OR "acoustic rhinometry"

#4 #1 AND #2 AND #3

Limits: Trials and observational studies involving humans, adults
Search fields: Title, Abstract, Keywords