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Effects of visual guidance and instrument choice on symptom recurrence following adenoidectomy: a systematic review of randomized controlled trials

Martin Mølhave ,[1] Therese Ovesen,[1,2] Adnan Madzak[1]

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[1]University Clinic for Flavour, Balance and Sleep, Department of Otorhinolaryngology, Head and Neck Surgery, Gødstrup Hospital, Herning, Denmark
[2]Department of Clinical Medicine, Aarhus University, Aarhus, Denmark

Correspondence to
Dr Martin Mølhave;
mmolhave@gmail.com

ABSTRACT

Objectives To assess the impact of visual guidance and instrument choice on obstructive sleep apnea (OSA) and otitis media with effusion (OME) symptom recurrence and reoperation rates following adenoidectomy in pediatric patients.

Design Systematic review of randomized controlled trials (RCTs).

Setting A comprehensive literature search was conducted in Embase, PubMed/Medline, the Cochrane Library, and Scopus, with the final search on September 23, 2024. Reference lists were also screened.

Participants Eligible studies included RCTs published from 2000 onwards, with ≥25 pediatric patients undergoing adenoidectomy for OSA or OME. Comparisons included visually guided versus blinded and cold versus hot adenoidectomy techniques. Studies involving concurrent procedures, craniofacial abnormalities, or non-primary adenoidectomy cases were excluded.

Main outcome measures The primary outcomes were OSA and OME symptom recurrence and reoperation rates following adenoidectomy. Risk of bias was assessed using Cochrane Risk of Bias tool, and evidence quality was evaluated using Grading of Recommendations Assessment, Development and Evaluation.

Results Of 2302 screened articles, 35 underwent full-text review, and 4r studies (373 participants) met inclusion criteria. All studies compared hot and cold techniques, with hot techniques being visually guided. Only one study directly compared both hot and cold techniques under visual guidance, reporting lower OSA recurrence rates with the hot technique, though with a high risk of bias. Other studies found no significant differences, and none reported reoperation rates. Study heterogeneity prevented meta-analysis. Overall risk of bias and evidence quality were moderate.

Conclusions There is insufficient evidence to determine whether visual guidance reduces symptom recurrence following adenoidectomy. Further high-quality RCTs are needed to provide more sound conclusions.

PROSPERO registration number CRD42024513408.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Adenoidectomy is a common pediatric surgical procedure, often performed using a blinded cold curettage technique. However, postoperative regrowth of residual adenoid tissue can lead to symptom recurrence for obstructive sleep apnea (OSA) and otitis media with effusion (OME).

⇒ Using hot instruments with visual guidance has demonstrated reduced residual adenoid tissue and fewer complications compared with conventional blinded cold curettage.

⇒ Despite these findings, it remains unclear whether the use of hot instruments leads to lower symptom recurrence rates. Moreover, the extent to which the reduction of residual adenoid tissue is attributable to instrument choice versus visual guidance is yet to be determined.

WHAT THIS STUDY ADDS

⇒ This systematic review of randomized controlled trials (RCTs) highlights a significant gap in research, with limited evidence comparing visually guided and blinded adenoidectomy techniques in terms of symptom recurrence rates for OSA and OME.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ There is a need for large-scale RCTs to evaluate the long-term effects of visual guidance and instrument choice on clinical outcomes, including symptom recurrence and reoperation rates.

INTRODUCTION

Adenoidectomy, the surgical removal of adenoids, is an extremely common procedure in pediatric patients, with incidence rates ranging from 176 to 1270 per 100 000 children. It is typically performed using a blinded curettage technique to address the conditions obstructive sleep apnea (OSA) and otitis media with effusion (OME). The procedure is often combined with tonsillotomy, tonsillectomy, or myringotomy and insertion of ventilation tubes.[1] However, postoperative regrowth of residual adenoid tissue is a

concern, as it can lead to a recurrence of symptoms originally necessitating the adenoidectomy.[1] The presence of any residual adenoid tissue after adenoidectomy has been reported in 15%[2] to as high as 68%[3] of cases following a blinded curettage approach. However, the rates of reoperation due to symptom recurrence are significantly lower, ranging from 1.5% to 9%,[1] since residual tissue alone is not considered an indication for reoperation. Symptom recurrence is required for reintervention to be warranted. Thus, it is essential to differentiate between the outcomes of residual adenoid tissue and symptom recurrence.

Several surgical techniques are available for adenoidectomy. The conventional 'cold' curettage technique involves blinded removal of adenoids with a curette, followed by digital or laryngeal mirror examination to assess for any remaining tissue. Newer techniques using 'hot' instruments such as microdebriders, coblation, and electrocautery provide a visually guided approach.[1 4 5] Systematic reviews and meta-analyses suggest that these visually guided hot techniques are superior to conventional blinded curettage, showing reduced blood loss and fewer complications, such as bleeding or Eustachian tubal orifice injury.[4 5] Additionally, the use of hot instruments is associated with a lower risk of residual adenoid tissue, which is expected to decrease the risk of symptom recurrence due to regrowth.[4 6 7] However, previous cohort studies indicate that visually guided cold adenoidectomy also can achieve more complete adenoid removal.[8 9] This suggests that the benefits of visual guidance in achieving complete removal may have been mistakenly attributed to the use of hot instruments.

To clarify this issue, we conducted a systematic review of randomized controlled trials (RCTs) comparing visually guided versus blinded adenoidectomy, as well as hot versus cold techniques. The primary objectives of this review were to assess the rates of OSA and OME symptom recurrence, as well as surgical complications. We assume that visually guided adenoidectomy is associated with lower rates of OSA and OME symptom recurrence and comparable complication rates compared with blinded adenoidectomy, regardless of the instruments used.

METHODS

This systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) (registration number CRD42024513408) and conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The PRISMA checklist was followed and filled out (online supplemental tables 1 and 2).[10]

Eligibility

The review employed the Population, Intervention, Comparator, Outcome, Study design, Timing framework to define eligibility criteria: Patients: cohorts of at least 25 pediatric patients (age under 18 years); Intervention: adenoidectomy performed under general anesthesia for OSA and OME; Comparator: visually guided versus blinded adenoidectomy techniques, or visually guided cold vs hot adenoidectomy techniques; Outcome: rates of OSA and OME symptom recurrence after adenoidectomy, and reoperation rates due to symptom recurrence; Study design: RCTs; Timing: publication year 2000 and onwards.

Eligible studies were limited to those published in English, Danish, Swedish, and Norwegian for Embase and Medline searches, with the Scopus search restricted to English and the Cochrane Library search not restricted by language. Our PROSPERO registration initially specified English and Danish as the included languages.

Exclusion criteria were as follows: studies involving patients with craniofacial abnormalities (eg, cleft lip and palate, choanal atresia, Down's syndrome, Treacher-Collin's syndrome, non-primary cases adenoidectomy, tumor surgery, or when adenoidectomy was combined with other procedures potentially affecting OSA and OME outcomes (eg, tonsillectomy, tonsillotomy, myringotomy and insertion of ventilation tubes, and procedures in the nasal cavity). Non-RCT studies, non-peer-reviewed publications, abstract-only papers, and conference presentations were also excluded.

Risk of bias and quality assessment

The risk of bias in included studies was evaluated using the Cochrane Risk of Bias tool (RoB 2) and its signaling questions were used.[11] This tool assesses five domains of bias: randomization, adherence to intervention, missing outcome data, measurement of outcomes, and selective outcome reporting. Each study was categorized as having a 'low risk of bias,' 'some concerns,' or a 'high risk of bias' for each domain.

The overall quality of evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework, which considers seven domains: study design, risk of bias (based on RoB 2), imprecision, inconsistency, indirectness, effect size (classified as 'serious' or 'not serious'), quality of evidence ('high,' 'moderate,' 'low,' or 'very low'), and clinical importance ('important' or 'critical').[12 13]

Electronic database searches were conducted on March 11, 2024, using Embase, PubMed/Medline, the Cochrane Library, and Scopus. A subsequent and final search was performed on September 23, 2024, to identify any newly eligible studies (see online supplemental table 3). Additionally, reference lists of included studies were manually screened to capture any relevant articles missed during the electronic searches.

Data extraction

The primary outcome of interest was the recurrence of OSA-related and OME-related symptoms following adenoidectomy in relation to the type of surgical instruments used and whether the procedure was visually guided or blinded. Secondary outcomes included blood loss, operation time, and perioperative and postoperative

complications. After identifying studies through the database search, all articles were uploaded to Covidence, a systematic review management tool, for screening and data extraction.[14]

Following removal of duplicates, the titles and abstracts were screened independently by the first (MM) and last authors (AM), who were blinded to each other's decisions. Discrepancies were resolved by a third reviewer (TO). The extracted data included study characteristics (eg, primary author, PubMed ID, year of publication, study location), methods (eg, inclusion period, hot and cold surgical techniques, blinding), patient characteristics (eg, sex, age, sample size, allocation, adenoidectomy indications), and adenoidectomy outcomes (eg, operation time, blood loss, complications, follow-up duration, loss to follow-up, reoperation rates). Information on RoB 2 bias domains (randomization, adherence to intervention, missing outcome data, measurement of primary outcome, and selection of reported results) and domains of GRADE quality assessment (eg, study design, risk of bias, imprecision, inconsistency, indirectness, effect) was also collected. Final data extraction was performed independently by MM and AM, with disagreements resolved by TO.

Statistical analysis and data synthesis

Data from eligible studies were entered into an Excel spreadsheet. For all studies with available data, results were pooled for demographic and perioperative outcomes.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

A total of 2302 articles were identified. After removing 1331 duplicates, 971 unique titles and abstracts were screened, leading to 35 studies being assessed for eligibility. Most studies were excluded because their primary outcome did not relate to OSA and OME. Ultimately, four studies (Capaccio *et al*,[15] Na'ara *et al*,[16] Öztürk and Polat,[17] and Rajan *et al*[18]) out of the 35 studies met the inclusion criteria and were included in the review (figure 1). The most common reason for exclusion among the 31 studies included in full-text screening was due to other outcomes than OSA- and OME-symptom relapse (online supplemental table 4). No additional studies were identified through screening reference lists of the included studies.

Overall, all included studies compared a hot adenoidectomy technique with a cold one, and all hot adenoidectomy techniques used were visually guided. The primary outcome measures between baseline and postoperative follow-ups significantly improved in both intervention groups across all included studies. Some insignificant trends favored hot techniques, but the primary outcome measures varied considerably across studies. As a result, the available data were unsuitable for meta-analysis.

Study characteristics

The four studies, conducted in Italy, Israel, Turkey, and India, included a total of 373 patients, with a balanced distribution of males and females (overall 48.5% females). For the studies that reported mean ages, they ranged from 5.3 to 6 years, while studies reporting median ages ranged from 4.9 to 10 years (table 1).

Three studies used a microdebrider as the hot adenoidectomy technique, one in combination with bipolar diathermy, paired with either 0° or 70° endoscopes. The corresponding cold techniques relied on adenotomes or curettes,[15 17 18] with one study performing a perioperative endoscopic examination of the nasopharynx postadenoidectomy.[17] One study employed suction coagulators for the hot technique and curettes for the cold, both using a laryngeal mirror for visual guidance during the procedure.[16]

Adenoidectomy indications varied but consistently included symptoms of nasopharyngeal obstruction causing OSA and OME.

Surgical outcomes

Operation times and blood loss were reported inconsistently across studies. Na'ara *et al* found that the visually guided hot technique using a suction coagulator had a longer operation time (9.4±2.2 min) compared with the cold technique (6.6±4 min). They also reported lower blood loss for the hot technique (5.4±2 mL) compared with the cold (8±3.6 mL).[16] Öztürk and Polat found that the visually guided hot technique using a microdebrider was associated with shorter operation times, with a median of 12 min for the hot technique compared with 16 min for the cold.[17] Complication rates were generally low and similar in both studies, with Na'ara *et al* reporting 0% complications, and Öztürk and Polat reporting one complication in the hot group and two in the cold group.[16 17] Operation times, blood losses, and complication rates were not reported in Capaccio *et al* and Rajan *et al*.[15 18] Reoperation rates were not reported in any studies. Loss to follow-up was minimal and balanced across studies, except in Na'ara *et al*, where eight patients in the visually guided cold group were lost to follow-up compared with five in the visually guided hot group.[16]

Follow-up time and primary outcomes varied across studies, focusing on different measures of ear and nasal function. Capaccio *et al* and Rajan *et al*[15 18] evaluated middle ear outcomes, including tympanometry, mild conductive hearing loss (Capaccio *et al*), and middle ear pressure (Rajan *et al*). Na'ara *et al*[16] assessed Pediatric Sleep Questionnaire (PSQ) scores, while Öztürk and Polat[17] analyzed self-reported nasal obstruction using a Visual Analog Scale (VAS).

Results were mixed. Capaccio *et al*[15] found no significant differences in postoperative audiometry or tympanometry between surgical techniques. Na'ara *et al*[16]

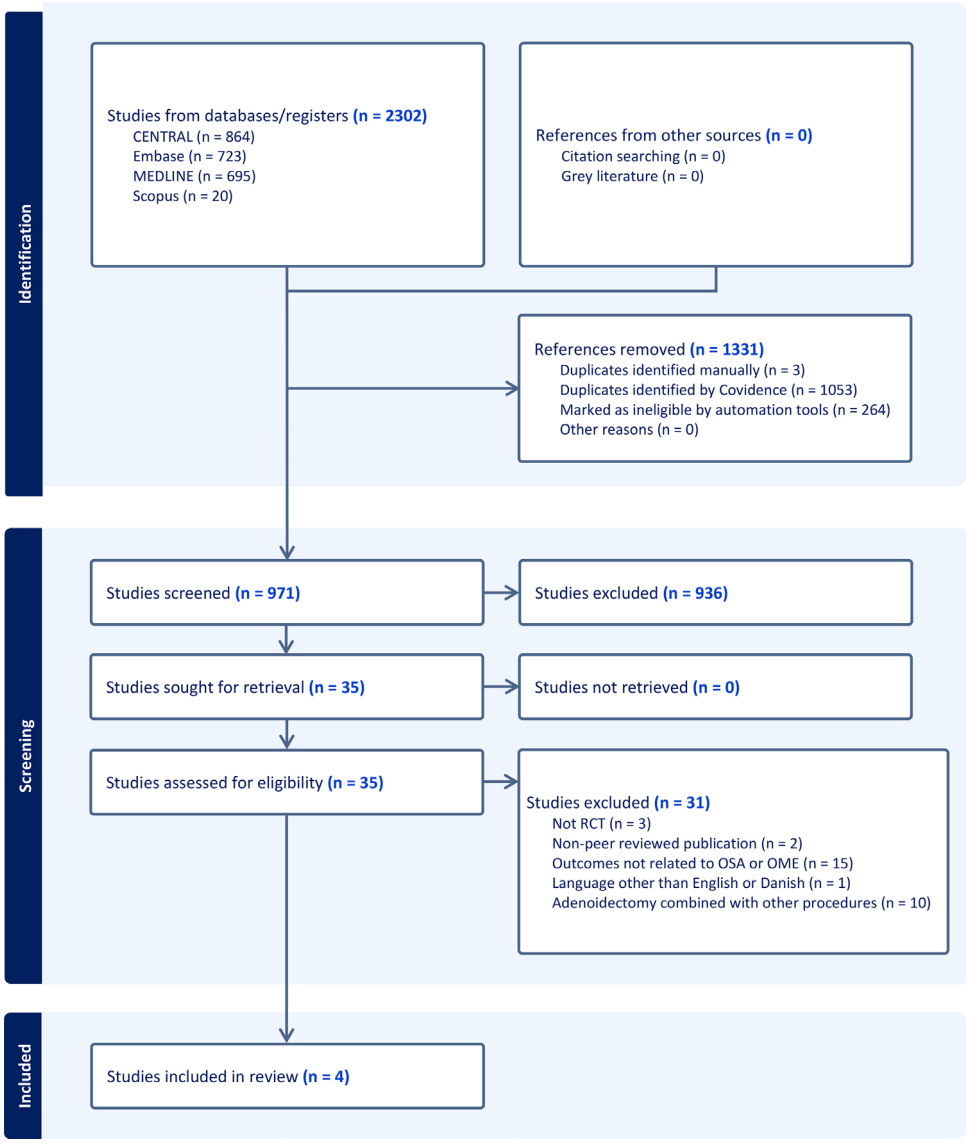

Figure 1 PRISMA flow chart of study selection. OME, otitis media with effusio; OSA, obstructive sleep apnea; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, randomized controlled trial.

reported significant improvements in sleep outcomes for the visually guided hot technique group compared with the visually guided cold group, with postoperative PSQ scores of 0.12 for the hot group and 0.24 for the cold group, compared with comparable baseline scores of 0.43 and 0.46, respectively. Öztürk and Polat found no significant differences in VAS scores for nasal obstruction between groups,[17] and Rajan *et al*[18] found no significant differences in middle ear compliance, pressure, or tympanometry types between groups (table 2).

Capaccio *et al*, Rajan *et al* and Öztürk and Polat also reported rates of residual adenoid tissue, but none examined associations between residual tissue and recurrence of OSA-related and OME-related symptoms.[15 17 18]

The risk of bias ranged from low (Rajan *et al*)[18] to high (Na'ara *et al* and Öztürk and Polat).[16 17] Consequently, the quality of evidence ranged from low to high (online supplemental tables 5 and 6). Only Capaccio *et al* reported performing a power calculation prior to patient enrollment.[15]

DISCUSSION

We identified only four studies that matched our inclusion criteria, which is surprising given the frequency of adenoidectomy and the importance of visual guidance during surgical procedures. All included studies reported significant improvements in primary outcomes between baseline and postoperative follow-ups for both intervention groups.

Three studies comparing visually guided hot adenoidectomy with blinded cold adenoidectomy did not find significant differences in recurrence rates of OSA-related and OME-related symptoms.[15 17 18] Na'ara *et al*'s study[16] was the only study in the present review that specifically compared visually guided hot versus visually guided cold

Table 1 Overall characteristics of included studies

Reference	Country	Inclusion period	Hot surgical technique (H)	Cold surgical technique (C)	Blinding	Females (%)	Age in years	Adenoidectomy indications
Capaccio *et al*[15]	Italy	January 2012–January 2015	Microdebrider, bipolar diathermy, 70° endoscope	La Force adenotome blinded	Double	(H) 46.7% (C) 43.3%	Median±SD: (H) 4.9±1.1 (C) 5.3±0.9	Chronic adenoiditis (hypertrophy with ongoing inflammation/infection) and OME with mild conductive HL (<40dB)
Na'ara *et al*[16]	Israel	2014–2017	Suction coagulator, laryngeal mirror	Adenoid curettes, laryngeal mirror	Single	(H) 37% (C) 47%	Mean: (H) 6.0 (C) 5.7	Breathing sleep disturbances and adenoid hypertrophy
Öztürk and Polat[17]	Turkey	January 2004–December 2010	Microdebrider, 70° endoscope	Adenoid curette blinded, followed by endoscopic examination	N/A	(H) 50% (C) 44%	Mean: (H) 5.7 (C) 5.3	Obstructive adenoid size, nasal obstruction with sleep disordered breathing, OME, recurrent acute otitis media, chronic or recurrent rhinosinusitis
Rajan *et al*[18]	India	August 2015–February 2017	Microdebrider, 0° or 70° endoscope	St Clair Thompson curette, blinded	Single	(H) 59% (C) 54%	Median, IQR: (H) 10, 4 (C) 9, 5	Adenoid hypertrophy with nasal obstruction, snoring, mouth-breathing

N/A, not available; OME, otitis media with effusion.

techniques and assessed the impact on recurrence rates for OSA-related and OME-related symptoms. This study used laryngeal mirrors for visual guidance and found a significantly greater improvement in PSQ scores at 1 for the hot technique group. However, due to an uneven loss to follow-up, particularly a higher dropout rate in the cold technique group, the study had a high risk of attrition bias, which may have skewed results. This loss to follow-up suggests that healthier subjects in the cold technique group might have been less motivated to continue in the study, potentially leading to a poorer PSQ score for this group.

A recent comprehensive systematic review and network meta-analysis by Malas *et al* reported a significantly lower likelihood (97%) of residual adenoid tissue after adenoidectomy with any other technique than conventional curettage.[4] Similarly, Yang *et al* found that hot, visually guided techniques were associated with reduced blood loss and fewer postoperative complications.[5]

However, these reviews did not address symptom recurrence or reoperation rates, which are critical for understanding long-term clinical outcomes. Other than the study by Na'ara *et al*,[16] no other studies included in the reviews specifically compared visually guided cold adenoidectomy with visually guided hot techniques, leaving the relationship between visual guidance, instrument choice, and symptom recurrence unexamined.

Our systematic review highlighted a significant gap in research regarding the rates of recurrence for OSA-related and OME-related symptoms that require reoperation. Only one study by Na'ara *et al*,[16] with a sample size of 71 patients, reported significantly better PSQ outcomes for visually guided hot vs cold adenoidectomy. However, an uneven loss to follow-up in the cold group may have introduced bias and potentially underestimated the effectiveness of cold techniques. This issue might have been mitigated by conducting a power calculation prior to patient enrollment. For context, Capaccio *et al* determined that a sample size of 60 patients per group (120 total) would be sufficient for detecting a minimal detectable effect,[15] underscoring that the sample size in Na'ara *et al*[16] was likely inadequate.

Additionally, the studies by Capaccio *et al*,[15] Öztürk and Polat,[17] and Rajan *et al*[18] investigated the use of blinded cold versus visually guided hot techniques without identifying significant differences in the recurrence of OSA-related and OME-related symptoms. This supports the notion that the proposed benefits of using hot instruments for more complete tissue removal may lack clinical relevance, as the primary concern for patients is the recurrence of symptoms and the need for reoperation. Although these studies also assessed residual adenoid tissue, none investigated the association between residual tissue and symptom recurrence.

Strengths and limitations

One strength of this review is the focus on a highly specific question: whether visual guidance and instrument choice

Table 2 Surgical outcomes of included studies

Reference	Sample size	Allocation	Loss to follow-up (n (%))	Primary outcome	Results				Overall risk of bias	Quality of evidence	Importance
Capaccio *et al*[15]	120	(H) 60	0	Changes in audiometry and tympanometry		Baseline	3 months	9 months	Some concerns	Moderate	Important
		(C) 60			Type B tympanogram						
					Cold group	100%	32%	38%			
					Hot group	100%	15%	18%			
					Mild conductive hearing loss						
					Cold group	100%	23%	28%			
					Hot group	100%	3%	8%			
Na'ara *et al*[16]	71	(H) 35	(H) 5 (14)	Changes in Pediatric Sleep Questionnaire.		Baseline	12 months		High risk	Low	Critical
		(C) 36	(C) 8 (22)		Hot group	0.43	0.12*				
					Cold group	0.46	0.24*				
Öztürk and Polat[17]	56	(H) 28	(H) 2 (7)	Self-reported VAS score for nasal obstruction.		Baseline	6 months		High risk	Low	Important
		(C) 28	(C) 1 (4)		Hot group	8.69±0.85	2.08±1.05				
					Cold group	8.63±0.88	2.22±1.01				
Rajan *et al*[18]	126	(H) 63	(H) 6 (10)	Improvements in middle ear function and hearing threshold		Baseline	12 weeks		Low risk	High	Critical
		(C) 63	(C) 7 (11)		Middle ear pressure						
					Hot group	−106.2 dPa	−21.6 daPa				
					Cold group	−105.9 dPa	−13.8 daPa				
					Middle ear compliance						
					Hot group	1.10 mL	1.36 mL				
					Cold group	1.16 mL	1.36 mL				
					Type A; B; C tympanogram						
					Hot group	37; 13; 62	102; 0; 10				
					Cold group	37; 18; 59	112; 0; 2				

*Statistically significant results between intervention groups. If not displayed, results were not statistically significant.
VAS, Visual Analog Scale.

affect the risk of symptom recurrence following adenoidectomy. This allows for a concentrated analysis of the available literature. However, the limited number of existing studies meeting the inclusion criteria is a limitation, restricting our ability to draw robust conclusions on the most suitable adenoidectomy technique. Additionally, many of the included studies had a high risk of bias, particularly due to inadequate sample sizes, uneven loss to follow-up, and the lack of long-term outcome measures. This raises concerns about the generalizability and reliability of the findings.

CONCLUSIONS

Despite the high volume of adenoidectomies performed worldwide, there is still limited evidence on whether visual guidance or specific instrument types provide superior outcomes in terms of recurrence of symptoms originally necessitating the adenoidectomy. Consequently, we are unable to determine the best method for adenoidectomy. Further large-scale RCTs are needed to determine whether visual guidance or instrument selection significantly influences postoperative recurrence of OSA-related and OME-related symptoms requiring reoperation, using objective measures such as cardiorespiratory monitoring, polysomnography, or tympanometry. Additionally, such studies could evaluate the potential economic and environmental impact of single-use hot instruments, including their use and disposal.

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ORCID iD

Martin Mølhave http://orcid.org/0000-0001-5303-9185

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