Tonsillectomy Versus Watchful Waiting for Recurrent Throat Infection: A Systematic Review

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abstract

CONTEXT: The effectiveness of tonsillectomy or adenotonsillectomy ("tonsillectomy") for recurrent throat infection compared with watchful waiting is uncertain.

OBJECTIVE: To compare sleep, cognitive, behavioral, and health outcomes of tonsillectomy versus watchful waiting in children with recurrent throat infections.

DATA SOURCES: MEDLINE, Embase, and the Cochrane Library.

STUDY SELECTION: Two investigators independently screened studies against predetermined criteria.

DATA EXTRACTION: One investigator extracted data with review by a second. Investigators independently assessed risk of bias and strength of evidence (SOE) and confidence in the estimate of effects.

RESULTS: Seven studies including children with ≥3 infections in the previous 1 to 3 years addressed this question. In studies reporting baseline data, number of infections/sore throats decreased from baseline in both groups, with greater decreases in sore throat days, clinician contacts, diagnosed group A streptococcal infections, and school absences in tonsillectomized children in the short term (<12 months). Quality of life was not markedly different between groups at any time point.

LIMITATIONS: Few studies fully categorized infection/sore throat severity; attrition was high.

CONCLUSIONS: Throat infections, utilization, and school absences improved in the first postsurgical year in tonsillectomized children versus children not receiving surgery. Benefits did not persist over time; longer-term outcomes are limited. SOE is moderate for reduction in short-term throat infections and insufficient for longer-term reduction. SOE is low for no difference in longer-term streptococcal infection reduction. SOE is low for utilization and missed school reduction in the short term, low for no difference in longer-term missed school, and low for no differences in quality of life.

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Tonsillectomy in children has 2 primary indications: recurrent tonsillitis and obstructive sleep apnea. Recurrent or severe tonsillitis has been defined as ≥7 episodes of sore throat in the preceding year, or ≥5 episodes in the each of the preceding 2 years, or ≥3 episodes in each of the preceding 3 years.[1] No gold standard diagnostic test exists, however, to predictably attribute symptoms to tonsillitis. Often "tonsillitis" is used synonymously with sore throat or pharyngitis without diagnostic testing. However, the degree to which either of these terms reflects true tonsillitis is not known. Bacterial pharyngitis with group A streptococcus (GAS) can be diagnosed via rapid testing or culture. It is not possible, however, to determine whether the tonsil represents the infectious nidus or if the suspected pathogen represents normal bacterial flora for a particular child's pharynx (colonization without negative health impact). Sore throat or pharyngitis may or may not have a tonsillar origin, and it is possible that many cases have alternative explanations. Nonetheless, most diagnoses of "tonsillitis" are made without supportive documentation or bacterial testing.[2] In addition, frequency of infections as a metric of severity used to determine tonsillectomy eligibility[1,3,4] is fraught with complexity related to diagnostic variability and inconsistent medical documentation. Thus, heterogeneity in diagnostic accuracy, establishment of severity, and frequency of infections complicates treatment decisions regarding tonsillectomy and the performance of comparative effectiveness of its treatments.[1,3–5]

Previous systematic reviews of tonsillectomy for recurrent throat infections have combined studies of children and adults and reported moderate reductions in sore throats in the first postoperative year with greater benefit associated with more severe baseline infections.[6,7]

We conducted a new systematic review that included all currently available comparative studies to examine published evidence regarding the effectiveness of tonsillectomy compared with forms of watchful waiting (which could have included supportive treatment with medications such as antibiotics or nasal steroids) for children with recurrent throat infections. This review is a component of an Agency for Healthcare Research and Quality–commissioned comparative effectiveness review of tonsillectomy in children conducted by the Vanderbilt Evidence Based Practice Center. The full comparative effectiveness review and review protocol (PROSPERO registry number: CRD42015025600) are available at http://www.effectivehealthcare.ahrq.gov.

METHODS

Search Strategy and Study Selection

We searched the MEDLINE database via PubMed, Embase, and the Cochrane Library from January 1980 to June 2016 using a combination of controlled vocabulary and key terms related to tonsillectomy and throat infections (eg, "tonsillectomy," "adenotonsillectomy," "streptococcal"). We also hand-searched the reference lists of included articles and recent reviews addressing tonsillectomy in children to identify potentially relevant articles.

We developed inclusion criteria in consultation with an expert panel of clinicians and researchers (Table 1). We included comparative study designs (eg, randomized controlled trials [RCTs], prospective or retrospective cohort studies) and studies published in English. We did not include studies with high risk of bias as part of the evidence base.

Data Extraction and Analysis

One investigator extracted data regarding study design, descriptions of study populations and intervention and comparison groups, and baseline and outcome data using a standardized form. A second investigator independently verified the accuracy of the extraction and revised as needed. Principal outcomes of interest included the number and severity of recurrent throat infections, quality of life, and health care utilization (number of clinician visits or contacts, number of courses of antibiotics). Significant heterogeneity in outcomes reported precluded meta-analysis; thus, we synthesized studies qualitatively and report descriptive statistics in summary tables.

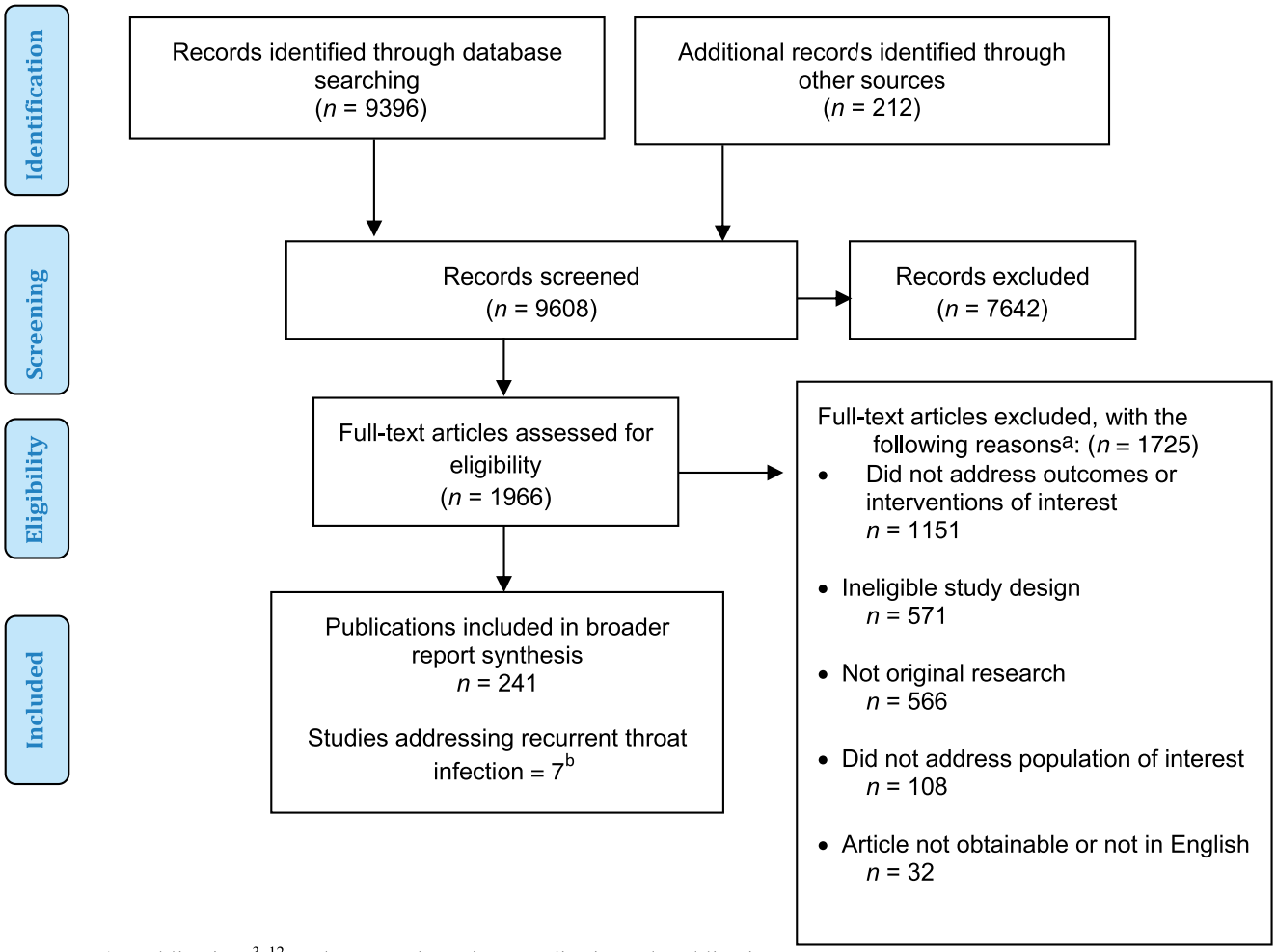
Assessment of Study Risk of Bias and Strength of Evidence

Two investigators independently evaluated the methodologic quality of studies using prespecified questions appropriate to each study design to assess risk of bias of RCTs and observational studies.[16] Senior reviewers resolved discrepancies in risk of bias assessment, and we used an approach described in the full review[17] to determine low, moderate, or high risk of bias ratings. Assessment of the strength of the evidence (SOE) reflects the confidence that we have in the stability of treatment effects in the face of future research.[18] The degree of confidence that the observed effect of an intervention is unlikely to change in additional research, the SOE, is presented as insufficient, low, moderate, or high. Assessments are based on consideration of 5 domains: study limitations, consistency in direction of the effect, directness in measuring intended outcomes, precision of effect, and reporting bias. We determined the strength of evidence separately for major intervention-outcome pairs using a

TABLE 1 Study Characteristics

Author, Year, Study Design, ROB	Definition of Throat Infection	Comparison Groups (*N*)	Outcomes
Lock 2010,[8–10] RCT, moderate ROB	• ≥4 episodes of sore throat within each of the preceding 2 y • ≥6 episodes of sore throat within the past year	G1: tonsillectomy (119) G2: watchful waiting (undefined) (112)	Primary: number of episodes of sore throat in the 2 y after entry into the study Secondary: reported number of sore throats, number of sore throat–related GP consultations; reported number of symptom-free days; reported severity of sore throats
Lock 2010,[8–10] Nonrandomized trial, moderate ROB	• ≥4 episodes of sore throat within each of the preceding 2 y • ≥6 episodes of sore throat within the past year	G1: tonsillectomy (349) G2: watchful waiting (undefined) (67)	Primary: number of episodes of sore throat in the 2 y after entry into the study Secondary: reported number of sore throats, number of sore throat–related GP consultations; reported number of symptom-free days; reported severity of sore throats
Orvidas 2006,[11] retrospective cohort, moderate ROB	Three or more diagnoses of group A β-hemolytic streptococcal pharyngitis or tonsillitis at least 1 mo apart in 12 mo at any time before tonsillectomy	G1: tonsillectomy (145) G2: watchful waiting (undefined) (145)	Primary: number of throat infections after end of study period Secondary: harms
Van Staaij 2004,[12–14] RCT, moderate ROB	Mild symptoms of throat infections	G1: tonsillectomy (133) G2: watchful waiting (undefined)124)	Primary: number of episodes of fever, throat infections, and upper respiratory tract infections Secondary: health-related quality of life
Paradise 2002a,[3] RCT, moderate ROB	Varied by age; overall, at least 1 instance of throat infection characterized by 1 of the following: oral temperature of at least 38.3°C, cervical lymphadenopathy, OR tender cervical lymph nodes, tonsillar or pharyngeal exudate or positive strep culture treated with antibiotics or diagnoses of throat infection documented in clinical record or study team	G1: tonsillectomy (58 randomized, 52 received intervention) G2: tonsillectomy (59 randomized, 50 received intervention) G3: watchful waiting (undefined) (60 randomized, 60 received intervention)	Primary: occurrence of episodes of throat infection during the 3 y of follow-up Secondary: number of sore-throat days; sore throat associated school absence
Paradise 2002b,[3] RCT, moderate ROB	Varied by age; overall, at least 1 instance of throat infection characterized by 1 of following: oral temperature of at least 38.3°C, cervical lymphadenopathy, or tender cervical lymph nodes, tonsillar or pharyngeal exudate or positive strep culture treated with antibiotics OR diagnoses of throat infection documented in clinical record or study team	G1: tonsillectomy (73 randomized, 63 received intervention) G2: watchful waiting (undefined) (78 randomized, 78 received intervention)	Primary: occurrence of episodes of throat infection during the 3 y of follow-up Secondary: number of sore-throat days; sore throat–associated school absence
Koshy 2015,[15] retrospective cohort, moderate ROB	Read codes for sore throat and upper respiratory infection	G1: tonsillectomy and ≤3 acute throat infection consultations (450) G2: watchful waiting (undefined) (13 442)	Primary: mean differences in ATI consultation rates over the first 3 y and subsequent 3 y follow-up compared with baseline Secondary: NA

ATI, acute throat infection; G, group; GP, general practitioner; NA, not available; ROB, risk of bias.



†2 publications[3, 12] each reported 2 unique studies in each publication.
*Numbers do not tally as studies could be excluded for multiple reasons.
Abbreviations: n = Number.

FIGURE 1
Disposition of studies identified for this review. [a] Numbers do not tally because studies could be excluded for multiple reasons. [b] Two publications[3,8] each reported 2 unique studies in each publication.

prespecified approach described in detail in the full review.[17]

RESULTS

Our searches (conducted for the broader systematic review[17]) identified 9608 citations, of which 7 (reported in multiple publications) had low or moderate risk of bias and met inclusion criteria (Fig 1).[3,8–15,19] Two unique RCTs were reported in 1 publication,[3] and 1 set of investigators reported RCT and nonrandomized trial results together in multiple publications.[8–10] Another RCT was reported in multiple publications.[12–14] Table 1 outlines study characteristics and risk of bias assessments.

Number and Severity of Throat Infections and Utilization

All of the included studies evaluated children with a history of mild to moderate throat infection (classified by number of infections reported, Table 1). Four RCTs[3,8–10,12–14] and 1 retrospective cohort study[11] included children with at least 3 throat infections in the 1 to 3 years before surgery and reported on frequency of recurrent throat infections and clinician visits after surgery versus no surgery. In all studies reporting baseline data, number of infections decreased from baseline in both groups, with significantly greater decreases in sore throat days and diagnosed GAS infections in children who received tonsillectomy versus no surgery/watchful waiting with supportive care in the short term (<12 months).

Reduction in Sore Throat Episodes

One RCT and 1 nonrandomized trial[8–10] reported that children who underwent tonsillectomy had fewer recorded days of sore throat in a symptom diary than children

who had medical management with tonsillectomized children experiencing 0.50 ± 0.43 sore throat episodes per year after surgery compared with nonsurgical group who had 0.64 ± 0.49 episodes over the same time frame (95% confidence interval [CI]: 0.16 to 0.80). In the RCTs' intention-to-treat analysis, number of sore throat episodes decreased by 3.5 (95% CI: 1.8 to 5.2) over the full 2-year study period for tonsillectomized children, but sore throats per month did not decrease significantly (Table 2). These studies are limited by a strong preference for surgery among parents of children with more severe symptoms, thus affecting the generalizability of the patients who were randomized. Children who were randomized were only moderately affected by their symptoms. The study also had significant attrition in return of the symptom diaries over time and difficulty obtaining provider records for review.

In 2 additional RCTs, children in the surgical groups had fewer visits for sore throat after tonsillectomy, but the number of visits for sore throat in the watchful waiting groups was also low.[20] In the first postsurgical year, the tonsillectomy group had 1.74 (95% CI: 1.54 to 2.00) episodes of sore throat or throat infection compared with 2.93 episodes (95% CI: 2.69 to 3.22) in the control group. Although statistically significant, it is unclear whether this difference is clinically meaningful.

In another RCT including both children with mild symptoms of throat infection or tonsillar hypertrophy (≥7 throat infections in the previous year or ≥5 in the previous 2 years or ≥3 in the previous 3 years and Brouillette obstructive sleep apnea score of <3.5—ie, in no apnea or possible apnea range), children who received tonsillectomy had fewer throat infections (defined as throat pain and fever) compared with those

TABLE 2 Key Infection Outcomes in Studies Comparing Tonsillectomy and No Surgery in Children With Recurrent Throat Infections

Author, Year Study Type Risk of Bias	Outcome Measure Baseline (mean)	Outcome Measure Follow-up (mean)
Lock 2010[8–10] RCT G1: Tonsillectomy (119) G2: Medical management (112) Moderate ROB	Throat infections *N* sore throats, 3 mo before study entry, mean ± SD G1: 3.09 ± 2.08 G2: 3.34 ± 2.63 Utilization No. GP consultations in 2 y before study entry, mean ± SD G1 + G2: 10.3 ± 6.3 No. consultations for sore throat in 2 y before study entry, mean ± SD G1 + G2: 6.0 ± 3.7 Quality of life *N* respondents G1: 111 G2: 108 PedsQL 4.0 Physical Health G1: 76.26 ± 19.50 G2: 78.75 ± 18.01 *N* respondents G1: 111 G2: 110 PedsQL 4.0 Psychosocial Health G1: 70.95 ± 14.18 G2: 72.33 ± 14.86	Throat infections Sore throats/month, mean ± SD Year 1 G1: 0.50 ± 0.43 (*n* = 119) G2: 0.64 ± 0.49 (*n* = 112) RR = 0.70 (95% CI: 0.61 to 0.80), *P* <.001 Year 2 G1: 0.13 ± 0.21 (*n* = 83) G2: 0.33 ± 0.43 (*n* = 74) RR = 0.54 (95% CI: 0.42 to 0.70), *P* < .001 Utilization Year 1 No. clinician consultations, mean ± SD G1: 3.99 ± 3.74 G2: 4.38 ± 3.48 RR: 0.91 (95% CI: 0.71 to 1.17) No. sore throat consultations, mean ± SD G1: 1.90 ± 2.84 G2: 2.35 ± 2.35 Year 2 No. clinician consultations, mean ± SD G1: 2.84 ± 2.90 G2: 3.40 ± 3.20 RR: 0.83 (95% CI: 0.63 to 1.10) No. sore throat consultations, mean ± SD G1: 0.89 ± 1.44 G2: 1.33 ± 1.56 RR: 0.67 (95% CI: 0.46 to 0.97) Quality of life 12 mo, *N* respondents G1: 71 G2: 52 PedsQL 4.0 Physical Health G1: 89.95 ± 16.37 (adjusted effect size: 3.08; 95% CI: 3.11 to 9.27) G2: 85.34 ± 17.86 PedsQL 4.0 Psychosocial Health G1: 83.81 ± 15.31 (adjusted effect size: 2.43; 95% CI: −3.08 to 7.03) G2: 79.97 ± 17.49 24 mo, *N* respondents G1: 63 G2: 53 PedsQL 4.0 Physical Health G1: 88.79 ± 17.66 (adjusted effect size: 0.31; 95% CI: −5.74 to 6.37) G2: 88.05 ± 12.76

TABLE 2 Continued

Author, Year Study Type Risk of Bias	Outcome Measure Baseline (mean)	Outcome Measure Follow-up (mean)
		PedsQL 4.0 Psychosocial Health G1: 84.30 ± 15.02 (adjusted effect size: 0.39; 95% CI: −4.52 to 5.29) G2: 83.897 ± 12.95
Lock 2010[8–10] Nonrandomized trial G1: Tonsillectomy (349) G2: Medical management (67) Moderate ROB	Throat infections No. sore throat lasting <2 wk in 3 mo before study entry, mean ± SD G1: 3.6 ± 2.5 G1: 3.6 ± 2.5 Utilization No. GP consultations in 2 y before study entry, mean ± SD G1: 8.6 ± 5.8 G2: 10.3 ± 6.9 No. consultations for sore throat in 2 y before study entry, mean ± SD G1: 5.4 ± 3.4 G2: 6.2 ± 4.2 Quality of life N respondents G1: 338 G2: 65 PedsQL 4.0 Physical Health G1: 76.26 ± 19.50 G2: 78.75 ± 18.01 *N* respondents G1: 334 G2: 66 PedsQL 4.0 Psychosocial Health G1: 70.95 ± 14.18 G2: 72.33 ± 14.86	Throat infections Sore throats/month, mean ± SD Year 1 G1: 0.71 ± 0.50 G2: 0.59 ± 0.44 Year 2 G1: 0.19 ± 0.36 G2: 0.38 ± 0.34 Utilization Year 1 No. clinician consultations, mean ± SD G1: 3.69 ± 3.33 G2: 3.16 ± 3.14 No. sore throat consultations, mean ± SD G1: 1.86 ± 2.23 G2: 1.63 ± 1.98 Year 2 No. clinician consultations, mean ± SD G1: 2.71 ± 3.51 G2: 3.12 ± 3.10 No. sore throat consultations, mean ± SD G1: 0.78 ± 1.31 G2: 1.45 ± 2.07 Quality of life 12 mo *N* respondents G1: 117 G2: 27 PedsQL 4.0 Physical Health G1: 87.15 ± 15.00 G2: 84.66 ± 16.00 *N* respondents G1: 118 G2: 27 PedsQL 4.0 Psychosocial Health G1: 82.27 ± 15.83 G2: 82.78 ± 16.12 24 mo *N* respondents G1: 96 G2: 25 PedsQL 4.0 Physical Health G1: 91.35 ± 14.48 G2: 91.88 ± 9.59 *N* respondents G1: 95 G2: 25 PedsQL 4.0 Psychosocial Health G1: 85.85 ± 13.78 G2: 87.46 ± 10.38

who had no surgery (0.56/person-year vs 0.77/person-year, P = not reported).[12–14] Of note, many children originally allocated to no surgery/watchful waiting (n = 50 of 149) crossed over to the surgery arm. One retrospective cohort study reported that children who did not undergo tonsillectomy were 3.1 times (95% CI: 2.1 to 4.6, $P < .001$) more likely to test positive for GAS infection that those who underwent surgery.[11] Children who did not have tonsillectomy also experienced GAS infections at a shorter time interval than the tonsillectomized children.

Another retrospective cohort study included children who had <3 throat infections in the previous year and used Read-coded data to identify provider visits.[15] The study reported a net reduction in 3-year mean sore throat visits (which included visits for sore throat symptoms, tonsillitis, pharyngitis, and nonspecific upper respiratory infection) for children who underwent tonsillectomy compared with those who did not. This reduction decreased over time with 2.46 fewer visits (95% CI: 2.29 to 2.63, $P < .001$) in years 1 to 3 and 1.21 fewer visits (95% CI: 1.04 to 1.38, $P < .001$) in years 4 to 6, or 0.61 sore throat visits per child per year (over the 6-year study period). This study captured provider visits and is subject to inaccuracies in medical coding. Episodes of sore throat that did not lead to a provider visit or visits with multiple concerns, which may have included throat infection, and were coded under another primary complaint were not captured. Table 2 outlines key outcomes.

Quality of Life

Quality of life was not markedly different between groups at any time point in 3 studies reporting these data.[8–10,12] Fewer days of missed school or work were associated with tonsillectomy in the short term, with differences diminishing over

TABLE 2 Continued

Author, Year Study Type Risk of Bias	Outcome Measure Baseline (mean)	Outcome Measure Follow-up (mean)
Orvidas 2006[11] Retrospective cohort G1: tonsillectomy (145) G2: watchful waiting (undefined) (145) Moderate ROB	Throat infections Infection within 1 year before tonsillectomy/study entry, *n* (%) G1: 141 (97.2) G2: 130 (89.7)	Throat infections Cumulative incidence of developing group A β-hemolytic streptococcal throat infection, % (95% CI) At 6 mo G1: 13.2 (7.5 to 18.6) Number still at risk: 124 G2: 39.3 (30.8 to 46.8) Number still at risk: 87 At 1 y G1: 23.1 (15.9 to 29.7) Number still at risk: 107 G2: 58.5 (49.6 to 65.9) Number still at risk: 57 At 2 y G1: 38.5 (29.8 to 46) Number still at risk: 83 G2: 74.8 (66.4 to 81.1) Number still at risk: 34 At 3 y G1: 46.1 (37.1 to 53.9) Number still at risk: 65 G2: 82.2 (74.5 to 87.6) Number still at risk: 21 At 4 y G1: 51.9 (42.4 to 59.8) Number still at risk: 39 G2: 84.6 (76.7 to 89.8) Number still at risk: 12
Van Staaij 2004[12–14] RCT Moderate ROB	Throat infections Throat infections in year before study, median (range) G1: 3 (0–6) G2: 3 (0–6)	Throat infections Episodes of throat infection/person year, *n* G1: 0.56 G2: 0.83 Difference: –0.21 (95% CI: –0.36 to –0.06) Incidence rate G1 + G2: 0.73 (95% CI: 0.58 to 0.92) Quality of life Data in figures only; study notes no clinically significant differences Difference in school absences G1 vs G2: 0.09 (95% CI: –0.27 to 0.44)
Paradise 2002[3] RCT A Moderate ROB	Throat infections G1 + G2: NR	Throat infections Episodes of any throat infection, mean (95% CI) years 1–3 G1: 1.55 (95% CI: 1.33 to 1.82) G2: 1.63 (95% CI: 1.37 to 1.93) G3: 2.77 (95% CI: 2.52 to 3.13) G1 vs. G3: $P < .001$ G2 vs. G3: $P < .001$ Episodes of group A β-hemolytic streptococcal throat infection, mean (95% CI) years 1–3 G1: 0.29 (95% CI: 0.20 to 0.41) G2: 0.20 (95% CI: 0.12 to 0.32) G3: 0.82 (95% CI: 0.67 to 1.01) G1 vs. G3: $P < .001$ G2 vs. G3: $P < .001$

time in 2 RCTs,[3] whereas another RCT noted comparable school absences between groups.[12–14] Overall, comparative effectiveness assessment of tonsillectomy versus no surgery to improve number of throat infections, associated health care utilization, days of work/school missed, and quality of life shows a benefit in the first postsurgical year, with diminishing benefit over time.

SOE

Compared with no surgery, tonsillectomy reduced utilization (clinician contacts) and missed school/work in the short term. We have low confidence in this conclusion (low SOE). We have greater confidence that compared with no surgery, tonsillectomy reduced sore throats/throat infections or streptococcal infections in the short term (<12 months; moderate SOE). In the longer term (>12 months), we found no difference between groups in reduction of streptococcal infections (low SOE). We also found no significant differences between groups in missed school/work or quality of life in the long term (>12 months) and have low confidence in these conclusions (low SOE).

We could not make a conclusion about longer-term effects on sore throats/throat infections (insufficient SOE) because few studies reported longer-term data, and those that did had high attrition rates. Only 1 study included children with <3 episodes of throat infection in the year before surgery[15]; we could not make conclusions about outcomes reported in this single study (insufficient SOE). Table 3 outlines SOE ratings.

DISCUSSION

Overall, children undergoing tonsillectomy to improve number of sore throats/throat infections, associated health care utilization (clinician visits), and days of work/

TABLE 2 Continued

Author, Year Study Type Risk of Bias	Outcome Measure Baseline (mean)	Outcome Measure Follow-up (mean)
		Episodes of moderate or severe throat infection, mean (95% CI) years 1–3 G1: 0.09 (95% CI: 0.04 to 0.17) G2: 0.08 (95% CI: 0.03 to 0.17) G3: 0.33 (95% CI: 0.24 to 0.45) G1 vs G3: *P* = .002 G2 vs G3: *P* = .003 School absences, mean d/y Year 1 G1: 3.3 ± 4.0 (42) G2: 3.9 ± 3.7 (44) G3: 5.3 ± 4.7 (50) G1 vs G3: *P* < .05 Year 2 G1: 3.2 ± 3.9 (39) G2: 2.4 ± 3.2 (38) G3: 5.0 ± 5.2 (44) G2 vs G3: *P* < .05 Year 3 G1: 2.5 ± 3.2 (37) G2: 2.9 ± 2.9 (29) G3: 3.7 ± 3.2 (42) G2 vs G3: *P* = NS
Paradise 2002[3] RCT B Moderate ROB	Throat infections G1 + G2: NR	Throat infections Episodes of any throat infection, mean (95% CI) years 1–3 G1: 1.74 (95% CI: 1.54 to 2.00) G2: 2.93 (95% CI: 2.69 to 3.22) G1 vs G2: *P* < .001 Episodes of group A β-hemolytic streptococcal throat infection, mean (95% CI) years 1–3 G1: 0.29 (95% CI: 0.21 to 0.40) G2: 0.77 (95% CI: 0.65 to 0.92) G1 vs G2: *P* < .001 Episodes of moderate or severe throat infection, mean (95% CI) years 1–3 G1: 0.07 (95% CI: 0.03 to 0.13) G2: 0.28 (95% CI: 0.21 to 0.37) G1 vs G2: *P* = .003 School absences, mean days/year Year 1 G1: 3.5 ± 4.2 (52) G2: 6.6 ± 6.2 (58) G1 vs G2: *P* < .01 Year 2 G1: 3.2 ± 4.1 (47) G2: 5.4 ± 6.7 (56) G1 vs G2: *P* = NS Year 3 G1: 2.6 ± 3.4 (45) G2: 4.2 ± 5.2 (55) G1 vs G2: *P* = NS

school missed had improvements in these outcomes in the first postsurgical year compared with children not receiving surgery.[3,8,11,12,15] These benefits did not persist over time. Most studies in this review included children with a history of mild to moderate throat infection (at least 3 episodes of sore throat in the year before surgery), and benefits of tonsillectomy were moderate in this population. Studies including children with a well-documented greater number of infections, such as the seminal Paradise et al study, may provide evidence for more marked benefits but were excluded from this review due to high risk of bias (due to potential selection bias and high attrition).[1]

As noted, most evidence addresses short-term effects. Although studies consistently reported reductions in sore throats and health care utilization in the first postsurgical year, evidence about long-term benefits of tonsillectomy for throat infection is limited. Thus, individual decision-making needs to balance the benefits of reducing illness-related outcomes (including missing school and work) with the risks associated with surgery. Caregivers and providers may wish to consider the potential benefits and drawbacks of attempting to manage children's illnesses for a period of time to see if they outgrow the propensity for infection to avoid surgery.

Despite substantial research, the literature is largely silent on the natural history of throat infections that would provide a basis for the need for tonsillectomy in the long term. More data are needed to describe the potential to outgrow frequent infections and population factors that may predict resolution.[21–23] Long-term data are needed to enable caregivers to weigh the benefits of surgery versus the reality of managing their child's condition as they wait for it to resolve, although obtaining

TABLE 2 Continued

Author, Year Study Type Risk of Bias	Outcome Measure Baseline (mean)	Outcome Measure Follow-up (mean)
Koshy 2015	Utilization	Utilization
Retrospective cohort	No. throat infection consultations in 3 y before study index date, mean ± SD	No. throat infection consultations 4–6 y after index date, mean
		G1: 0.6
G1: Tonsillectomy and ≤3 acute throat infection consultations (450)	G1: 1.3 ± 1.1	G2: 0.93
	G2: 0.4 ± 0.8	Mean difference in consultations, baseline to follow-up
	G1 vs G2: $P < .001$	G1: −0.72 (95% CI: −0.88 to −0.56), $P < .001$
G2: No tonsillectomy and ≤3 acute throat infection (13 442)		G2: 0.49 (95% CI: 0.46 to 0.52), $P < .001$
Moderate ROB		

CI, confidence interval; G, group; NR, not reported; NS, not significant; PedsQL, Pediatric Quality of Life Questionnaire; ROB, risk of bias; RR, relative risk.

longer-term data is difficult, as evidenced by the high rate of attrition in most studies with >6 months' follow-up included in this review.

Future studies should also attempt to characterize patient populations completely, including severity of throat infections, such that applicability can be much more specifically described and potential candidates for surgery or watchful waiting identified. Indeed, the literature lacks a consistent, consensus definition of infection; defining infection consistently is critical for promoting synthesis of research in the area. Tonsillitis or "sore throat" may also include cases of entities such as periodic fever, aphthous stomatitis, pharyngitis, cervical adenitis syndrome (PFAPA); clear characterization of children in studies is key for understanding effects on subpopulations. Relatively few data exist regarding predictable factors contributing to recurrence of symptoms of throat infections after tonsillectomy for primary management. A better understanding of these factors would also allow for more specific patient selection.

This review may be limited by our inclusion of studies published in English only; however, we identified few non-English studies of apparent relevance in a preliminary scan. Patient populations were generally poorly characterized, and little information was available on first-line treatment attempts before surgery. Particularly in studies intended to assess effects of tonsillectomy on throat infections, parents of more severely affected children were noted to refuse randomization and crossover to surgery at high rates. Among those

TABLE 3 Summary of Evidence in Studies Addressing Effectiveness of Tonsillectomy in Children With Recurrent Throat Infections

Number, Type of Studies (*N* Participants)	Key Outcome(s)	SOE Grade	Findings
4, RCT[3,8,12] (761) 1, non-RCT[8] (303) 1, retrospective cohort[11] (290)	Throat infection	Moderate SOE for modest reduction in throat infection after tonsillectomy vs no treatment in short term (12 mo)	Fewer throat infections in tonsillectomy arms in short term
3, RCT[3,8] (260) 1 non-RCT[8] (138)	Throat infection	Insufficient SOE for reduction after tonsillectomy vs no surgery over longer term (>12 mo)	Insufficient data based on lack of long-term data and high attrition rates in studies
2, RCT[3] (273) 1, retrospective cohort[11] (290)	Streptococcal infection	Moderate SOE for reduction in streptococcal infection after tonsillectomy versus no tonsillectomy in short term (≤12 mo)	Fewer streptococcal infections in tonsillectomy arms in short-term
2, RCT[3] (203) 1, retrospective cohort[11] (290)	Streptococcal infection	Low SOE for no difference in reduction in streptococcal infection after tonsillectomy vs no surgery over longer term (2–3 y)	Similar proportion of infections in retrospective cohort and significantly more infections in nonsurgical groups in 2 RCTs
1, retrospective cohort[11] (290)	Streptococcal infection	Insufficient SOE for no difference in effects after 4 y of follow-up	Insufficient evidence in 1 study
1, RCT[8] (231) 1, non-RCT[8] (303)	Utilization (clinician visits or contacts)	Low SOE for reduction in clinician visits or contacts after tonsillectomy vs no surgery in short term (<12 mo)	Fewer consultations in tonsillectomy arms versus no surgery, but high loss to follow-up and differences in outcome assessment
2, RCT[8,12] (373) 1, non-RCT[8] (123)	Quality of life	Low SOE for no difference in longer-term quality of life after tonsillectomy vs no tonsillectomy	Improvements in quality of life in both groups; high attrition in both studies
3, RCT[3,12] (503)	Missed school or work	Low SOE for greater improvements in missed school after tonsillectomy vs no surgery in short term (≤12 mo)	Significantly fewer missed days in tonsillectomy arms vs no surgery in 2 RCTs with medium study limitations at 12 mo follow-up; no differences in third RCT
3, RCT[3,12] (245)	Missed school or work	Low SOE for no difference in effects in longer term (>12 mo)	No significant differences between groups in all studies at longer-term follow-up; medium study limitations

Intervention and comparator: tonsillectomy versus no surgery in children with ≥3 throat infections in year before study.

studies focused on throat infection that did characterize patients more fully, most had low numbers of reported infections, and few reported culture-confirmed bacterial infections. Studies also did not describe the medical interventions children who did not undergo tonsillectomy may have received. Given heterogeneity and limited reporting in the literature, we were unable to identify potential subgroups that may respond more favorably to tonsillectomy or to supportive care.

Long-term effects are limited in the literature base, particularly regarding outcomes that include growth and development and quality-of-life outcomes. Exploration of demographics of patient populations more likely to be refractory to initial management strategies is also limited. It appears clear that throat infections decline in children over time regardless of treatment group, but with high loss to follow-up, the relative contribution of this decline on apparent effectiveness is unknown. Definitions of severity have been assigned somewhat arbitrarily, based on best evidence or consensus approach, and until there is a robust literature surrounding natural history of throat infections in childhood, it may be difficult to achieve consistency in this description.

CONCLUSIONS

Tonsillectomy can produce short-term reduction in throat infections compared with no surgery in children with ≥3 throat infections in the previous 1 to 3 years. Children undergoing tonsillectomy to improve number of throat infections, associated health care utilization (clinician visits), and days of work/school missed had improvements in these outcomes in the first postsurgical year compared with children not receiving surgery. These benefits did not persist over time, and data on longer-term results are lacking. Quality of life improved regardless of surgery. Additional research to assess longer-term benefits of tonsillectomy compared with no surgery, as well as subgroups of children who may experience greater benefit, is needed to inform decision-making for caregivers and clinicians.

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ABBREVIATIONS

CI: confidence interval
GAS: group A streptococcus
RCT: randomized controlled trial
SOE: strength of evidence

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