Tonsillectomy or adeno-tonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis (Review)

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEADER</td>
<td>1</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>PLAIN LANGUAGE SUMMARY</td>
<td>2</td>
</tr>
<tr>
<td>BACKGROUND</td>
<td>2</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>METHODS</td>
<td>3</td>
</tr>
<tr>
<td>RESULTS</td>
<td>4</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>13</td>
</tr>
<tr>
<td>AUTHORS’ CONCLUSIONS</td>
<td>15</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>16</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>16</td>
</tr>
<tr>
<td>CHARACTERISTICS OF STUDIES</td>
<td>17</td>
</tr>
<tr>
<td>DATA AND ANALYSES</td>
<td>24</td>
</tr>
<tr>
<td>Analysis 1.1. Comparison 1 Adenotonsillectomy versus no surgery, Outcome 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery).</td>
<td>25</td>
</tr>
<tr>
<td>Analysis 1.2. Comparison 1 Adenotonsillectomy versus no surgery, Outcome 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery).</td>
<td>26</td>
</tr>
<tr>
<td>Analysis 1.3. Comparison 1 Adenotonsillectomy versus no surgery, Outcome 3 Sore-throat days (including those immediately post-surgery).</td>
<td>26</td>
</tr>
<tr>
<td>Analysis 2.1. Comparison 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children, Outcome 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery).</td>
<td>27</td>
</tr>
<tr>
<td>Analysis 2.2. Comparison 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children, Outcome 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery).</td>
<td>28</td>
</tr>
<tr>
<td>Analysis 2.3. Comparison 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children, Outcome 3 Sore-throat days (including those immediately post-surgery).</td>
<td>29</td>
</tr>
<tr>
<td>Analysis 3.1. Comparison 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only, Outcome 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery).</td>
<td>30</td>
</tr>
<tr>
<td>Analysis 3.2. Comparison 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only, Outcome 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery).</td>
<td>30</td>
</tr>
<tr>
<td>Analysis 3.3. Comparison 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only, Outcome 3 Sore-throat days (including those immediately post-surgery).</td>
<td>31</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>31</td>
</tr>
<tr>
<td>FEEDBACK</td>
<td>32</td>
</tr>
<tr>
<td>WHAT’S NEW</td>
<td>33</td>
</tr>
<tr>
<td>HISTORY</td>
<td>34</td>
</tr>
<tr>
<td>CONTRIBUTIONS OF AUTHORS</td>
<td>34</td>
</tr>
<tr>
<td>DECLARATIONS OF INTEREST</td>
<td>34</td>
</tr>
<tr>
<td>NOTES</td>
<td>34</td>
</tr>
<tr>
<td>INDEX TERMS</td>
<td>34</td>
</tr>
</tbody>
</table>
Tonsillectomy or adeno-tonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

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ABSTRACT

Background
Surgical removal of the tonsils, with or without adenoidectomy (adeno-/tonsillectomy), is a common ENT operation but the indications for surgery are controversial.

Objectives
To determine the effects of tonsillectomy, with and without adenoidectomy, in patients with chronic/recurrent acute tonsillitis.

Search methods
The Cochrane Ear, Nose and Throat Disorders Group Specialised Register, the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library 2008, issue 2), MEDLINE (1966 to 2008), EMBASE (1974 to 2008), bibliographies, and additional sources were searched for published and unpublished trials. The date of the last search was 11 April 2008.

Selection criteria
Randomised controlled trials comparing tonsillectomy, with or without adenoidectomy, with non-surgical treatment in adults and children with chronic/recurrent acute tonsillitis. We included trials which used reduction in the number and severity of tonsillitis and sore throat as main outcome measures.

Data collection and analysis
Two authors applied the inclusion/exclusion criteria independently.

Main results
This review includes five studies: four undertaken in children (719 participants) and one in adults (70 participants). Good information about the effects of tonsillectomy is only available for children and for effects in the first year following surgery.

Children were divided into two subgroups: those who are severely affected (based on specific criteria which are often referred to as the 'Paradise criteria') and those less severely affected.
For more severely affected children adeno-/tonsillectomy will avoid three unpredictable episodes of any type of sore throat, including one episode of moderate or severe sore throat in the next year. The cost of this is a predictable episode of pain in the immediate postoperative period.

Less severely affected children may never have had another severe sore throat anyway and the chance of them so doing is modestly reduced by adeno-/tonsillectomy. For them, surgery will mean having an average of two rather than three unpredictable episodes of any type of sore throat. The cost of this reduction is one inevitable and predictable episode of postoperative pain. The ‘average’ patient will have 17 rather than 22 sore throat days but some of these 17 days (between five and seven) will be in the immediate postoperative period. Whilst the concept of the ‘average’ patient is attractive, in practice, wide variability is likely.

One reason why the impact of surgery is so modest, is that many untreated patients get better spontaneously. There is a trade-off for the physician and patient who must weigh up a number of different uncertainties: what proportion of my throat symptoms are attributable to my tonsils, and will I get better without any treatment? Similarly, the potential ‘benefit’ of surgery must be weighed against the risks of the procedure.

Authors’ conclusions

Adeno-/tonsillectomy is effective in reducing the number of episodes of sore throat and days with sore throats in children, the gain being more marked in those most severely affected. The size of the effect is modest, but there may be a benefit to knowing the precise timing of one episode of pain lasting several days - it occurs immediately after surgery as a direct consequence of it.

It is clear that some children get better without any surgery, and that whilst removing the tonsils will always prevent ‘tonsilitis’, the impact of the procedure on ‘sore throats’ due to pharyngitis is much less predictable.

**PLAIN LANGUAGE SUMMARY**

Tonsillectomy for chronic or recurrent acute tonsillitis

Tonsillectomy is a common procedure. Children severely affected by recurrent tonsillitis may benefit from it but these benefits must be considered in the light of the risks of surgery and the possibility that they my ‘grow out’ of the problem. In less severely affected children the potential benefits are even more modest.

**BACKGROUND**

Surgical removal of the tonsils (tonsillectomy) is one of the commonest major operations carried out on children (Paradise 1996). Increasingly, it is performed on adults who in the past would almost certainly have had their tonsils removed in childhood as a matter of routine. However, the procedure is a controversial one, and opinions vary greatly as to the relative risks and benefits. The risks of surgery include those of the associated general anaesthetic and those specific to the procedure, for example bleeding immediately after surgery or as a result of secondary infection in the 10 to 14-day period after surgery.

The indications for surgery are equally controversial. It is generally accepted that tonsillectomy (with adenoectomy, if necessary) is indicated in children with obstructive sleep apnoea. In many countries large numbers of patients who have recurrent acute tonsillitis, chronic tonsillitis or recurrent ‘sore throats’ also have their tonsils removed. The frequency and severity of ‘infections’ required to justify surgery vary considerably.

A non-systematic review of tonsillectomy or adeno-tonsillectomy for recurrent throat infection was published in 1998 (Marshall 1998). Marshall draws conclusions from trials which either did not fulfil the inclusion criteria for the present systematic review or which appeared to the present authors to contain significant biases.

In an earlier version of the current review (Burton 1999) we found one fully published trial which addressed the effectiveness of tonsillectomy in severely affected children (Paradise 1984). We concluded that significant baseline differences between the surgical and non-surgical groups, and the inclusion of children who also underwent adenoectomy, prevented firm conclusions being drawn.
Several trials have been published since writing the original review. One included adults alone and three included children alone, all with recurrent tonsillitis or sore throats. In some trials all participants underwent adeno-tonsillectomy, in others tonsillectomy or adeno-tonsillectomy.

The remit of this review has therefore been broadened to ask four different but related questions, to be answered if sufficient information is available from the primary studies. In patients with chronic/recurrent sore throats associated with tonsillitis:

- What is the effect of tonsillectomy alone?
- What is the effect of adeno-tonsillectomy?
- Is there a difference in the effectiveness of tonsillectomy versus adeno-tonsillectomy?
- What is the effectiveness of a strategy of either tonsillectomy or adeno-tonsillectomy versus no surgery?

Although it was not a question specifically posed *a priori*, we also sought evidence about differences in effectiveness of the procedures in individuals who were severely affected compared to those mildly affected.

**OBJECTIVES**

To determine the effects of tonsillectomy or adeno-tonsillectomy, or a strategy combining either procedure, compared with non-surgical treatment in the management of (a) adults and (b) children with chronic or recurrent acute tonsillitis.

The non-surgical treatments included, but were not limited to:

1. intermittent courses of antibiotics;
2. long-term antibiotics;
3. analgesia (pain relief) only;
4. no therapy.

In particular, to determine if tonsillectomy and/or adeno-tonsillectomy is more effective in:

1. reducing the number and/or severity of episodes of tonsillitis or sore throat;
2. reducing the number of days with sore throat;
3. reducing the amount of time off work or away from school;
4. reducing the consumption of analgesics (pain killers);
5. reducing the consumption of antibiotics.

Finally, to compare the morbidity and mortality associated with adeno-/tonsillectomy with that associated with non-surgical or no treatment.

**METHODS**

Criteria for considering studies for this review

**Types of studies**

All identified randomised controlled trials which fulfilled the criteria outlined below were included. Controlled clinical trials were also identified.

**Types of participants**

Adults and children diagnosed as having either 'recurrent acute tonsillitis' or 'chronic tonsillitis' were included and considered separately. These clinical diagnoses had been reached by primary care physicians or specialists. No microbiological diagnosis was required; a clinical diagnosis of tonsillitis was deemed satisfactory. However, recurrence implied more than two distinct episodes in a 12-month period, and chronicity a period longer than three months.

**Types of interventions**

Surgical treatment in the form of tonsillectomy with or without adenoidectomy by any method (dissection, guillotine, laser) in any setting versus any other form of treatment, including but not limited to (1) no treatment, (2) repeated courses of antibiotics, (3) long-term antibiotics, (4) analgesia only. We intended to consider the different non-surgical treatments separately and together.

**Types of outcome measures**

Important primary clinical outcomes are:

1. reduction in the number and severity of episodes of tonsillitis or sore throat;
2. number of days with sore throat;
3. morbidity and mortality of surgery.

Secondary endpoints include:

1. reduction in time off work or school;
2. reduction in the consumption of analgesics;
3. reduction in the consumption of antibiotics.

Outcomes would ideally be assessed at three months, six months and 12 months, and in the second and subsequent years after randomisation.

**Search methods for identification of studies**

Systematic searches were conducted to identify randomised controlled trials and controlled clinical trials of surgical treatment (adeno-/tonsillectomy) versus non-surgical treatment (of any sort,
including no treatment). There were no language; publication year or publication status restrictions. The date of the last search was 11 April 2008.

The following databases were searched:
- the Cochrane Ear, Nose and Throat Disorders Group Specialised Register;
- the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library 2008, issue 2);
- MEDLINE (1966 to 2008);
- EMBASE (1974 to 2008);
- CINAHL;
- mRCT (includes ClinicalTrials.gov, UKCTG, and the archived National Research Register);
- LILACS;
- KoreaMed;
- IndMed;
- PakMediNet;
- Zetoc;
- ISI Proceedings; and
- Cambridge Scientific Abstracts.

Search strategies
Subject strategies for databases were modelled on the search strategy designed for CENTRAL. Where appropriate, subject strategies were combined with adaptations of the highly sensitive search strategy designed by the Cochrane Collaboration for identifying randomised controlled trials and controlled clinical trials (as described in The Cochrane Handbook for Systematic Reviews of Interventions (Handbook 2008)). Search strategies for key databases including CENTRAL are shown in Appendix 1.

Initial search results were scanned to identify trials which loosely met the inclusion criteria. Reference lists from identified publications were scanned to identify pre-1966 trials and authors were contacted as necessary. A forward search was undertaken on the authors of the identified trials. The full text articles of the retrieved trials were then reviewed by the two reviewers and the inclusion criteria applied independently. Any differences in opinion about which studies to include in the review were resolved by discussion. The reviewers were not blind to the names of journals, authors and the study results whilst applying the criteria for determining which studies to include in the review.

Data collection and analysis
The following methods were initially proposed.

Quality assessment
The quality of all included trials was assessed blindly and independently by the two reviewers. A modification of the method used by Chalmers et al (Chalmers 1990) was used. The selected studies were assessed for the following characteristics:
1. the adequacy of the randomisation process;
2. the potential for selection bias after allocation to study group, i.e. losses to follow up and whether analysis was by intention-to-treat;
3. whether there was blinding of outcome assessors to the patients’ study group;
4. quality of outcome assessment.

Studies were graded A, B or C for their overall methodological quality:
A: minimisation of bias in all four categories above, i.e. adequate randomisation; few losses to follow up and intention-to-treat analysis; blinding of outcome assessors; high quality outcome assessment;
B: each of the criteria in A partially met;
C: one or more of the criteria in A not met.
We intended to use study quality for sensitivity analysis.

Data extraction
Data from the studies were independently extracted by the authors using standardised forms. Data were extracted so as to allow an intention-to-treat analysis. Where data were missing, the reviewers wrote to the authors of the study requesting further information. Where necessary we obtained further information from authors.

Data analysis
If appropriate data had been available, we planned to analyse these according to the intention-to-treat principle.

RESULTS

Description of studies
See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of ongoing studies.

Searches in April 2008 retrieved 2746 references, of which nine studies were considered to be possibly relevant. One (Kaiser 1930) was excluded as a non-randomised cohort study, leaving eight trials for consideration (Alho 2007; Mawson 1967; McKee 1963; Paradise 1984; Paradise 2002a; Paradise 2002b; Roydhouse 1970; van Staaij 2004). The two Paradise 2002 studies are reported in the same paper, but in such a manner that they can be considered as two separate studies (see further details below).

No studies were excluded solely on the basis that all the participants randomised to surgical treatment underwent adenotonsillectomy or an indeterminable proportion did so (the others undergoing tonsillectomy alone). We pointed out in the original review that
removal of the adenoids is often associated with a reduction in mouth breathing and snoring. Both these factors may influence the tendency to experience recurrent sore throat or tonsillitis.

Three studies (Mawson 1967; McKee 1963; Roydhhouse 1970) were excluded because it was not clear whether the included children had suffered from recurrent acute or chronic tonsillitis, as trial admission criteria were poorly defined (for example, it was possible to be included in the Mawson study by experiencing cervical adenitis (inflamed glands in the neck) alone). This left five studies which satisfied all aspects of our inclusion criteria (Alho 2007; Paradise 1984; Paradise 2002a; Paradise 2002b; van Staaij 2004). Searching the bibliographies of these papers did not reveal any further trials. The methods, participants, interventions and outcomes of the included studies are listed in the table of ‘Characteristics of included studies’.

Paradise 1984

The 1984 paper by Paradise et al reports two distinct studies conducted as part of the ‘Pittsburgh Tonsillectomy and Adenoidectomy Study’ that took place at the Children’s Hospital of Pittsburgh between 1971 and 1994. The studies were prospective, controlled open trials (1971 to 1982) comparing the efficacy of tonsillectomy with non-surgical treatment in children ‘severely’ affected with recurrent tonsillitis. Participants were included only if their episodes of throat infection met strict, pre-defined standards in each of four categories: (1) frequency of occurrence (seven or more episodes in the preceding year, or five or more in each of the preceding two years, or three or more in each of the preceding three years); (2) clinical features (each episode had to be characterised by specific clinical features); (3) treatment (they had to have been treated with antibiotics when streptococcal infection was proven or suspected); and (4) documentation (each episode had to have been documented in a clinical record).

The first study was a randomised trial and this is referred to as Paradise 1984 in this review. The second study was a non-randomised study of 96 children whose parents withheld consent to the randomised study. They were assigned according to parental preference and were studied and analysed separately. This non-randomised study and group will not be considered in this review.

In the randomised study the 91 children were stratified into three age levels (three and four years, five and six years, seven to 15 years) and assigned randomly, within categories and balanced within each block of four subjects, to either a surgical group (tonsillectomy or adeno-tonsillectomy: 43 children) or a non-surgical control group (48 children).

As some children were deemed to merit adenoidectomy in addition to tonsillectomy, the randomised study therefore included four groups of children: a tonsillectomy group (27 children) and a control group (29 children), and an adeno-tonsillectomy group (16 children) and a second control group (19 children). Follow up included standardised enquiries about day-to-day status bi-weekly, and standardised clinical assessments by study-team paediatric nurses or paediatricians at six-week intervals and at the time of acute illness. Post-treatment throat infection, in both groups, were treated with intermittent courses of antibiotics. The primary outcome measure was the number of throat infection episodes (see details below) recorded during each of three successive follow-up years. Secondary outcome measures were occurrence of cervical lymphadenopathy at non-throat infection visits, sore-throat days, and sore-throat-associated school absences during the same period. The quality of the outcome assessment was considered to be good in all the Paradise studies (Paradise 1984, Paradise 2002a and Paradise 2002b).

Paradise 2002 trials

Paradise 2002 describes two parallel randomised controlled trials: a three-arm trial in which participants were randomised to either a tonsillectomy group, an adeno-tonsillectomy group, or a non-surgical control group (Paradise 2002a), and a two-arm trial in which participants were randomised to either an adeno-tonsillectomy group or a non-surgical control group (Paradise 2002b).

To be eligible, children had to have had a history of recurrent episodes of throat infection but were required to be “less severely affected” and to meet “slightly less stringent criteria” than those included in Paradise 1984. The full eligibility criteria are detailed in an appendix to the paper.

Follow up and outcomes were as for Paradise 1984 (above).

Paradise 2002a

In the three-arm trial, the 177 children meeting the eligibility criteria and with no indications for adenoidectomy (obstructing adenoids or histories of recurrent or persistent otitis media) were stratified into three age levels (three and four years, five and six years, and seven to 15 years) and assigned randomly, within history and age categories and in balanced blocks of three children, to one of three treatment groups: tonsillectomy (58 children; 52 receiving treatment as allocated), adeno-tonsillectomy (59 children) or control (60 children).

Paradise 2002b

In the two-arm trial, 151 children meeting the eligibility criteria and also with one or more indications for adenoidectomy were entered. After being stratified into three age levels (three and four years, five and six years, and seven to 15 years) they were assigned randomly, within history and age categories and in balanced blocks of four children, to one of two treatment groups: adeno-tonsillectomy (73 children) or control (78 children).
van Staaij 2004

This open, multicentre, randomised controlled trial was undertaken between March 2000 and February 2003 in the Netherlands. Any child between two and eight years in whom the referring otolaryngologists felt adeno-tonsillectomy was indicated ‘according to current medical practice’ was eligible. The enrolling otolaryngologist noted the most important indication for surgery - recurrent throat infections (three or more per year) or ‘other’ (such as obstructive problems or upper respiratory tract infections). Children eligible for the Paradise 1984 study (a history of seven or more throat infections in the preceding year, with five or more in the preceding two years, or with three or more in the preceding three years), or who had obstructive sleep apnoea, were specifically excluded. The remaining group of children therefore comprised those who were not as severely affected as those in Paradise 1984.

A total of 300 children were randomised within each participating hospital. Of the 151 allocated to adeno-tonsillectomy, 144 underwent surgery as planned within six weeks of randomisation, and 149 were allocated to watchful waiting. Follow-up data were collected by parents using a diary of upper respiratory tract infections (including sore throat, pain, swallowing difficulty, cough, rhinorrhoea, carache and otorrhoea), absence from school or day-care. Daily temperature measurements were made using an electronic thermometer which stored data. Data from diaries and thermometers and Quality of Life forms were collected during follow-up visits at 3, 6, 12, 18 and 24 months. Upper respiratory tract infections and sore throats were managed "according to regular practice". The primary outcome in this study was the incidence of fever (38.0°C) for at least one day. Secondary outcomes included episodes and days of throat infections (sore throat, pain or difficulty swallowing combined with fever) and episodes and days of sore throats (sore throat or pain or difficulty swallowing with or without fever). The quality of the outcome assessment was considered to be good.

Alho 2007

This trial recruited 70 adults from the Oulu region of Finland between October 2001 and May 2005. Participants had documented recurrent episodes of pharyngitis due to group A streptococcus, having had three or more episodes of pharyngitis in six months or four episodes in 12 months. Symptoms and signs had to be "typical of streptococcal pharyngitis". The episodes had to be severe enough for the patient to seek medical attention and at least one episode (but not necessarily all) had to be microbiologically proven by culture or rapid antigen test. Participants were allocated by replacement randomisation to either tonsillectomy or a period on a waiting list (control). The median time before tonsillectomy took place was 13 days (inter-quartile range 8 to 21 days). Those in the control group ‘waited’ for between three and six months.

The primary outcome was an acute episode of culture-proven group A streptococcal pharyngitis during a 90-day (three-month) follow-up period. Secondary endpoints were episodes of pharyngitis at 90 days, the time to such episodes and the mean rates of episodes and days with symptoms during the whole follow-up period (never more than 210 days). The quality of the outcome assessment was considered to be good.

Risk of bias in included studies

Paradise 1984

The investigators attempted to conduct the study in a rigorous fashion to avoid biases in a situation where blinding was impossible. However, their randomisation process resulted in important baseline differences which we felt at the time of our original review may make interpretation of the results problematic. The children in the surgery groups (tonsillectomy alone or adeno-tonsillectomy) differed from the control group in terms of the history of episodes of throat infection before entry into the study and in terms of parental socioeconomic status (Paradise 1984, Table 1). Those in the surgical group were more often admitted to the trial on the basis of frequent infection in the year prior to entry rather than less frequent infections over a longer period. However, in his response to our review (see ‘Feedback’ below), Professor Paradise indicates that a number of children met more than one of the frequency-related eligibility criteria (seven or more episodes per year for one year, or five per year for two years, or three per year for three years) and that such children were categorised as meeting the criterion involving the largest number of episodes. It seems that by chance more children in the surgical rather than control group met the seven plus episodes per year for one year criterion. We stated in the original review that “The surgical group may therefore have included children with more severe disease” and still believe that this is a possibility. However, as Professor Paradise points out, the resulting bias would favour control subjects and result in a potential underestimate of the treatment effect. We went on to say “Alternatively, these [the children entered because of seven plus episodes in one year] may have been children with less severe, but more short-lived disease in whom a period of frequent infections is more likely to be followed by spontaneous resolution than in those with longer more chronic histories". We accept the observation that some of these children may also have had episodes in previous years, but would continue to argue that our own comment is not counter-intuitive. There may be a difference between those children who have a short, relatively brief, period with many sore throats in whom spontaneous resolution then occurs, and those who grumble on with several sore throats per year for many years. A second baseline imbalance was noted. The children in the non-surgical group were more likely to have parents with higher socioeconomic status than those in the surgical group. Professor Paradise
argues that this difference is likely to favour the control group and
again lead to an underestimate of any treatment effect.
In this study the authors compared the outcomes of the tonsil-
lectomy alone and adeno-tonsillectomy groups. Finding no “large
or statistically significant” differences between them, the data sets
were pooled and reported as a single ‘surgical’ group. All the results
thereafter thus refer to a population which includes a proportion
of children who had had their adenoids removed. It is not clear
whether the sizes of the two original subgroups were large enough
to detect any true difference between the effects of tonsillectomy
alone and adeno-tonsillectomy. Some part of the effect of ‘surgery’
could be due to removal of the adenoids.
Follow up was incomplete. At the end of the first, second and
third years respectively, the cumulative losses to follow up were
12% (5/43), 28% (12/43) and 49% (21/43) in the surgical group
and 27% (13/48), 40% (19/48) and 58% (28/48) in the control
group. Large losses to follow up are associated with a significant
degree of bias. As a result, only data from the first 12 months of
follow up are included in this review. In this group, 16 children
(33% of the whole control group) had elected to undergo surgery.
We had hoped to undertake an intention-to-treat analysis, analysing
the outcomes in children originally allocated to the non-
surgical arm as members of that group. However, the results per-
taining to children who elected to have surgery appear to have
been excluded from the results of the control group. Table 2 of
Paradise 1984 indicates that the number of subjects in each con-
trol group refers only to those children who completed the year
without having surgery.

Paradise 2002a
This was an open (unblinded) trial in which the methods of
randomisation and allocation concealment were adequately de-
scribed. The authors state that “there was no statistically significant
difference in characteristics between surgical and control groups”.
However, a substantial loss to follow up during the three follow-
up years means only the first year results are reliable. In this review;
only data from the first 12 months of follow up are included.
At the end of the first, second and third years respectively, the
cumulative losses to follow up were 19%, 29% and 38% in the
58 tonsillectomy patients; 21%, 38% and 52% in the 58 adeno-
tonsillectomy patients and 18%, 33% and 53% in the 60 control
patients. In this group, 12 children (20% of the whole control
group) had elected to undergo surgery. Conversely, in the tonsil-
lectomy group, five children did not actually receive surgery and
one child also underwent an adenoidectomy, and in the adeno-
tonsillectomy group, five children did not receive surgery and four
had tonsillectomy alone.

Paradise 2002b
The comments above about the nature of the trial, randomisa-
tion and baseline differences are equally applicable in the two-arm
trial. Similarly, there were problems with losses to follow up. The
cumulative losses at the end of the first, second and third years
respectively were 19%, 32% and 40% in the 73 surgical patients
and 29%, 42% and 53% in the 77 control patients group. In
this group, 19 children (25% of the whole control group) had
elected to undergo surgery. Once again however, the authors per-
formed the outcome analysis on an intention-to-treat basis, in-
cluding those control group children who underwent surgery in
the original control group.

van Staaij 2004
This was also an open (unblinded) trial in which the methods of
randomisation and allocation concealment were adequately de-
scribed. The cumulative loss to follow up at two years was 17% 
(25/151) in the surgical group and 17% (25/149) in the control
group. However, 50 children (34%) in the control group under-
went surgery and seven allocated to adeno-tonsillectomy did not
undergo surgery (5%) . The authors did, however, perform an
intention-to-treat analysis. The authors of this study kindly pro-
vided us with data on the outcomes at one year.

Alho 2007
This was an adequately randomised trial with appropriate alloca-
tion concealment. Follow up was for a minimum period of only 90
days. There were no losses to follow up but two subjects allocated
to the waiting list control received tonsillectomy.

Effects of interventions
Although all the studies extended over several years, large losses
to follow up mean that for the majority of studies sufficient data are
only available to allow consideration of results in the first year fol-
lowing surgery. Before considering combining data across studies,
we will review the results of the individual trials.
Estimating effects on sore throat episodes is complicated by two
issues. First, the definition of an episode of sore throat involves a
spectrum: some sore throats are relatively trivial whilst others are
severely debilitating. Second, tonsillectomy is a painful procedure:
the days with postoperative pain might reasonably be conside red
clinically significant. For adults (age > 15) in Alho 2007 the mean
duration of continuous throat pain following surgery was 13 days
(SD 4). For children, Paradise in his 1984 study reports a mean
figure of 4.9 days. In the later studies (Paradise 2002a; Paradise
2002b) a mean of 6.3 days is given with a wide range from 0 to
21 days.
These days may be included (or excluded) in two ways. When
considering the ‘number of episodes of sore throat in first year post-
randomisation’ or ‘number of sore throat days’, the episode of pain that follows surgery could be included or excluded. It is important, when looking at each study, to appreciate which strategy has been adopted.

**Variation in the definition of sore throat episodes and days**

In the Paradise studies (Paradise 1984; Paradise 2002a; Paradise 2002b) results for episodes of ‘throat infection’ are reported in four ways: (a) ‘moderate or severe’ (based on a scoring system), (b) streptococcal, (c) ‘counting’ (characterised by one or more qualifying clinical features of episodes used in determining trial eligibility), and (d) all combined. van Staaij 2004 defined an episode ‘throat infection’ as one of sore throat or pain or difficulty swallowing combined with fever, whilst an episode of ‘sore throat’ was sore throat or pain or difficulty swallowing without fever.

### A: Episodes of sore throats of any severity

Compared to the more specific categories (a), (b) and (c), the Paradise category (d) - ‘all combined’ includes broader spectrum that is more analogous to the van Staaij category of ‘sore throat episode’ than ‘throat infection’. Thus in the analyses that follow, results of ‘episodes of sore throat’ refer in the Paradise studies to the ‘all types combined’ category, and in van Staaij to the ‘episodes of sore throat’ data.

### B: Episodes of moderate or severe sore throats

The Paradise category (a) ‘moderate or severe’ was felt to be most analogous to the van Staaij ‘throat infection’ data. In our analyses these two categories are assumed equivalent.

### C: Sore throat days

In all the Paradise studies a ‘sore throat day’ was defined as one on which a sore throat lasted an hour or longer. The comparable data from the van Staaij study were the number of sore throat days as defined above.

Alho 2007 primarily looks for pharyngitis due to a group A streptococcus with a positive culture, and secondarily for ‘all episodes of pharyngitis’.

We present the results of the five individual studies first, then consider how these might be combined.

**Study 1: Paradise 1984**

The results of the Paradise 1984 study are based on surgical intervention in 43 severely affected children compared to 48 control subjects. Of those having surgery, 27 underwent tonsillectomy alone and 16 adeno-tonsillectomy; the results for the two procedures are pooled and inseparable.

### A: Episodes of sore throat of any severity

For sore throats of any severity within 12 months the control group experienced 3.1 episodes (SD 2.64 N = 35) and the surgical group 1.2 (SD 1.62, N = 38). The rate reduction of 1.9 episodes (95% CI -2.87 to -0.83) is statistically significant (data have been recalculated from the table of episodes).

### B: Episodes of moderate/severe sore throat

For episodes of moderate or severe sore throats within 12 months the control group experienced 1.2 episodes (SD 1.42 N = 35) compared to 0.1 (SD 0.27 N = 38) in the surgical group. Again, the rate reduction of 1.1 episodes (95% CI 0.62 to 1.56) is statistically significant (data have been recalculated from the table of episodes).

We must assume that the data for the surgical groups cannot include the immediate postoperative period as one episode of sore throat (because if they did, the mean in the surgical group would have to be > 1).

### C: Sore throat days (including those immediately following surgery)

Data on the number of sore throat days in the surgical and control groups are only available for 31 and 33 children respectively (72% and 69% of those enrolled) (see Paradise 1984 Table 5). Here sore-throat days immediately after surgery are included and “the number of days for each subject for each follow-up year was standardised on the basis of 365 days”. The published results show the number of sore-throat days to be 18.9 (SD 14.6 N = 33) in the surgical and 16.3 (SD 14.3 N = 31) in the non-surgical groups. The difference of 2.6 days (95% CI -9.68 to 4.48) is not statistically significant.

Despite the absence of a difference in the total number of sore-throat days, there must inevitably be a difference in the timing and predictability of those days. The number of days with sore throat postoperatively varies considerably. In this 1984 study a mean figure of 4.9 days is reported. In the later studies (Paradise 2002a; Paradise 2002b) there is a mean of 6.3 days with a wide range from 0 to 21 days.

It is interesting to note that despite the fact that the study included only children who were severely affected by throat infections, following enrolment in the trial, many of those in the control (non-operated) group had few episodes of infection and these few were usually mild. Of the 48 children in the original control group, seven (15%) had elected to have surgery before the end of the first year. Of those 35 who remained, however, 26 (74% of that group; 54% of the whole group) had either a single episode of moderate or severe sore throat or none at all.

**Adverse events associated with surgery**

Of the 95 subjects treated with surgery (in the randomised and non-randomised studies combined) 13 (14%) had surgery-related
complications. The primary and secondary haemorrhage rates were both 2%.

Study 2: Paradise 2002a

In the studies reported in 2002, Paradise and his co-authors present their results in a slightly different way. Data are presented about the number of episodes in the first year (Paradise 2002a; Paradise 2002b Table 2). However, the mean number of episodes and the range is given, along with the 95% confidence interval for the mean. For the purposes of this review, the standard deviation of the mean has had to be imputed, by dividing the confidence interval by four and multiplying by the $\sqrt{(N-1)}$, where N is the number of subjects in the relevant group.

The results of the Paradise 2002a study are presented as mean numbers and by intention-to-treat.

A: Episodes of sore throat of any severity

For the mean number of episodes of “all [degrees of sore throat] combined” in the first year results are (*SD imputed as described):

- tonsillectomy group: 2.0 episodes (95% CI 1.58 to 2.4; SD* 1.39 N = 47);
- adeno-tonsillectomy group: 1.9 episodes (95% CI 1.51 to 2.34; SD* 1.39 N = 46);
- control group: 2.8 episodes (95% CI 2.35 to 3.26; SD* 1.66 N = 54).

Combining the data from the tonsillectomy and adeno-tonsillectomy groups results in a mean of 1.9 episodes (SD 1.39 N = 93).

B: Episodes of moderate/severe sore throat

For the mean number of episodes of moderate or severe sore throat in the first year results are (*SD imputed as described):

- tonsillectomy group: 0.2 episodes (95% CI 0.07 to 0.34; SD* 0.46 N = 47);
- adeno-tonsillectomy group: 0.1 episodes (95% CI 0.02 to 0.23; SD* 0.35 N = 46);
- control group: 0.2 episodes (95% CI 0.13 to 0.41; SD* 0.51 N = 54).

Combining the data from the tonsillectomy and adeno-tonsillectomy groups results in a mean of 0.1 episodes (SD 0.41 N = 93). The data for the surgical groups cannot include the immediate postoperative period as one episode of sore throat. The difference between the surgical and control groups is statistically significant: -0.9 episode reduction in any sore throat (95% CI -1.4 to -0.4) but no statistically significant difference in the number of episodes of moderate/severe sore throat (-0.1, 95% CI -0.27 to 0.05). The clinical interpretation must be that the ‘benefit’ of avoiding 0.9 episodes of any sore throat is offset by the episode of sore throat attributable to the surgery, whilst there was no benefit in terms of a reduction in the number of episodes of moderate/severe sore throat after the immediate postoperative period despite having experienced the postoperative episode of pain that naturally follows the surgery.

C: Sore throat days (including those immediately following surgery)

Data are available on the number of sore-throat days in the first 12 months. These are presented as mean and standard deviations. As in the 1984 study the data are “limited to subjects with at least 270 days of reportage in a follow-up year”, the sore-throat days immediately after surgery are included and “the number of days for each subject for each follow-up year was standardised on the basis of 365 days”. Data are available for slightly more children:

- tonsillectomy group: 20 days (SD 14 N = 48);
- adeno-tonsillectomy group: 19 days (SD 15 N = 47);
- control group: 25 days (SD 21 N = 54).

Combining the data from the tonsillectomy and adeno-tonsillectomy groups results in a mean of 20 days (SD 14.5 N = 93). The difference between the surgical and control groups is not statistically significant: -6 days (95% CI -11.81 to -0.81). The comments above relating to the timing and predictability of the immediate postoperative sore throat days apply equally here.

Adverse events associated with surgery

See below.

Study 3: Paradise 2002b

The results of the Paradise 2002b study are presented in an identical way to Paradise 2002a as mean numbers and by intention-to-treat.

A: Episodes of sore throat of any severity

For the mean number of episodes of “all [degrees of sore throat] combined” in the first year results are (*SD imputed as described):

- adeno-tonsillectomy group: 1.9 episodes (95% CI 1.56 to 2.28; SD* 1.37 N = 59);
- control group: 3.6 episodes (95% CI 3.16 to 4.08; SD* 1.87 N = 67).

B: Episodes of moderate/severe sore throat

For the mean number of episodes of moderate or severe sore throat in the first year results are (*SD imputed as described):

- adeno-tonsillectomy group: 0.2 episodes (95% CI 0.07 to 0.29; SD* 0.42 N = 59);
- control group: 0.4 episodes (95% CI 0.29 to 0.62; SD* 0.67 N = 67).
The data for the surgical groups cannot include the immediate postoperative period as one episode of sore throat. The difference between the surgical and control groups is a statistically significant reduction in any sore throat of 1.7 episodes (95% CI -2.27 to -1.13) and in the number of episodes of moderate/severe sore throat of 0.3 episodes (95% CI -0.47 to -0.09).

Again, the benefit of avoiding 1.7 episodes of any sore throat, or 0.3 fewer episodes of moderate/severe sore throat if a patient undergoes surgery, must be offset against the postoperative episode of pain that naturally follows the surgery.

C: Sore throat days (including those immediately following surgery)

Data are available on the number of sore-throat days in the first 12 months. These are presented as mean and standard deviations. As in the 1984 study the data are “limited to subjects with at least 270 days of reportage in a follow-up year”, the sore-throat days immediately after surgery are included and that “the number of days for each subject for each follow-up year was standardised on the basis of 365 days”. Data are available for slightly more children:

- adeno-tonsillectomy group: 23 days (SD 20 N = 60);
- control group: 14 days (SD 17 N = 68).

The difference between the surgical and control groups is not statistically significant: -1 day (95% CI -7.48 to 5.48), and the issues of timing and predictability apply again.

Adverse events associated with surgery

Of the 203 children who underwent surgery (in the entire study, Paradise 2002a and Paradise 2002b combined) 7.9% had intra- or postoperative complications. The primary and secondary haemorrhage rates were 1.5% and 3.4% respectively.

Study 4: van Staaij 2004

The primary outcome measure in this trial was the incidence and duration of fever (temperature of 38.0°C or higher) for at least one day. Secondary outcome measures included throat infections (fever plus sore throat or pain or difficulty swallowing) and sore throats (sore throat or pain or difficulty swallowing with or without fever). Data relating to outcomes at 12 months, comparable to those in the Paradise studies, are not presented in the paper reporting the results of this trial but have been obtained from the trialists.

A: Episodes of sore throat of any severity

The number of episodes of sore throat in the first year of the trial, including as one of these episodes the sore throat immediately following surgery (unlike the Paradise studies), were as follows:

- adeno-tonsillectomy group: 2.7 episodes (SD 1.76 N = 111);
- control group: 3.3 episodes (SD 2.42 N = 107).

To allow a similar comparison to be made between these data and those of Paradise, it is necessary to exclude one of the episodes of sore throat in the surgical group. The data then become:

- adeno-tonsillectomy group: 1.7 episodes (SD 1.76 N = 111);
- control group: 3.3 episodes (SD 2.42 N = 107).

The difference between the surgical and control groups is statistically significant: -1.53 episodes (95% CI -2.09 to -0.97). In this case offsetting this gain against the postoperative episode of pain following surgery may seem more worthwhile.

B: Episodes of moderate/severe sore throat

The number of episodes of throat infection in the first year of the trial, were as follows:

- adeno-tonsillectomy group: 0.7 episodes (SD 0.91 N = 111);
- control group: 0.9 episodes (SD 1.12 N = 107).

In this case, the episode of sore throat following surgery cannot have routinely been included as an episode of ‘throat infection’. The difference between the surgical and control groups is not statistically significant: -0.2 episodes (95% CI -0.64 to 0.30). These data do not demonstrate a benefit of surgery, in terms of throat infection, despite the episode of postoperative pain.

C: Sore throat days (including those immediately following surgery)

The number of sore throat days (also including sore throat days immediately following surgery) in the first year of the trial were:

- adeno-tonsillectomy group: 12.7 days (SD 9.5 N = 111);
- control group: 18.9 days (SD 24.59 N = 107).

The difference between the surgical and control groups is statistically significant: -6.2 days (95% CI -11.22 to -1.26). The issues of timing and predictability apply equally here.

Van Staaij year two data

In contrast to the Paradise studies, losses to follow up at two years were low and data were available on 88% and 83% of the adeno-tonsillectomy and control groups respectively. The published data (referring to rates per year) record the incidence of symptoms at a median follow-up interval of 22 months. These are:

A: Episodes of sore throat of any severity

- Adeno-tonsillectomy group: 2.25 per year
- Control group: 2.85 per year
B: Episodes of moderate/severe sore throat
- Adeno-tonsillectomy group: 0.56 per year
- Control group: 0.77 per year

C: Sore throat days (including those immediately following surgery)
- Adeno-tonsillectomy group: 9.81 days per year
- Control group: 15.71 days per year

Each of these published comparisons reveal statistically significant differences in episodes per year of -0.60 (95% CI -0.90 to -0.30), -0.21 (95% CI -0.36 to -0.06) and in sore throat days of -5.91 (95% CI -6.57 to -5.24). Again, note that some of these data include sore throats in the immediate postoperative period. It may be useful to consider these data as total number of episodes/days over the two year period. The numbers then become:

A: Episodes of sore throat of any severity
- Adeno-tonsillectomy group: 4.4 over two years (if the episode due to surgery is excluded, 3.4 over two years)
- Control group: 5.7 over two years

B: Episodes of moderate/severe sore throat
- Adeno-tonsillectomy group: 1.12 over two years (plus the episode due to surgery, 2.12 over two years)
- Control group: 1.54 over two years

C: Sore throat days (including those immediately following surgery)
- Adeno-tonsillectomy group: 19.6 days over two years (including the five to seven days due to surgery)
- Control group: 31.4 days over two years

Adverse events associated with surgery
Of the 195 children who underwent surgery (145 in the adeno-tonsillectomy group and 50 in the watchful waiting group) 12 (6%) had complications related to surgery. The primary haemorrhage rate was 4% (secondary rate not given).

Study 5: Alho 2007
The primary outcome measure in this study was the proportion of patients with an acute episode of group A streptococcal pharyngitis during a 90-day follow-up period. Secondary outcomes included patient-recorded episodes (defined as at least two consecutive days) of sore throat and ‘days with symptoms’. The secondary outcomes are reported as means and standard deviations “at the end of whole follow-up”. The data reported relate to a “mean length of follow-up 164 days (SD 63) in control group and 170 days (SD 12) in tonsillectomy group”. The follow-up period in this study thus differs greatly from that in all the other studies.

A: Episodes of sore throat
The data for the surgical group cannot include the immediate postoperative period as one episode of sore throat because the mean is less than one. For ‘all episodes of pharyngitis’ the reported data are:
- tonsillectomy group: 0.6 episodes (SD 0.9 N = 36);
- control group: 2.1 episodes (SD 2.3 N = 34).

The difference is reported as significant (P = 0.002; Mann-Whitney U test). This difference in 1.5 episodes, occurring in the first five to six months after surgery, must again be considered in the context of the one episode of postoperative pain.

B: Sore throat days (NOT including those immediately following surgery)
Data are reported on the number of days with sore throat “not including postoperative throat pain in tonsillectomy group”:
- tonsillectomy group: 3.2 days (SD 5.3 N = 36);
- control group: 12.1 days (SD 14.1 N = 34).

The difference is reported as significant (P = 0.001; Mann-Whitney U test). In this study, the gain of 8.9 sore throat free days was bought at the cost of the days of postoperative pain.

Adverse events associated with surgery
There were no “serious adverse effects related to tonsillectomy” in any of the 70 adult participants. Two patients (6%) had secondary haemorrhages.

Comparing data across studies
The severity of symptoms required to enter the trials differs significantly. Paradise looked at severely affected children in 1984, and less severely affected in 2002. Van Staaij specifically excluded the type of severely affected child included in the Paradise 1984 study and their participants are likely to be more similar to the Paradise 2002 children. Alho 2007 specifically looked at a group of adults with proven group A streptococcal pharyngitis. The study by Alho 2007 differs significantly from the others; follow-up was significantly shorter, the patients were adults, not children, and comprised a set of individuals with one particular type of recurrent tonsillitis/pharyngitis. It is not possible to combine the data from this study with any others, nor to make direct comparisons between this and other studies. In order to compare the number of episodes of sore throat across studies, a decision must be made about whether or not the immediate postoperative period is counted as one episode. If it is,
the mean number of episodes of ’moderate or severe sore throat’) in the Paradise studies must be increased by one in all the adenotonsillectomy groups. Alternatively, excluding the postoperative sore throat requires the mean number of episodes of sore throat in the van Staaij study to be decreased by one in the surgical group. No such adjustments are required to the data about number of sore throat days as all the included studies that are combined below include the days in the immediate postoperative period in their results.

**What is the effect of tonsillectomy alone?**

Two studies address this issue: Paradise 2002a and Alho 2007. Data relating to tonsillectomy alone in children is limited to the Paradise 2002a study in which 47 children undergoing tonsillectomy can be compared to 54 controls. There was no significant difference in terms of episodes of sore throat (immediate postoperative period excluded) nor in the number of sore throat days (data above) in the first year post-surgery.

Alho 2007 included ’severely affected’ adults but looked at outcomes over a short period. One episode of postoperative pain led to 1.5 fewer episodes of sore throat in the first six months, and a gain of about nine sore throat free days over the same period at a ‘cost’ of perhaps five to ten days of postoperative pain.

**What is the effect of adeno-tonsillectomy?**

To examine the effects of adeno-tonsillectomy alone (as distinct from tonsillectomy with or without adenoidectomy) the adeno-tonsillectomy results from Paradise 2002a and Paradise 2002b can be combined with the results from van Staaij 2004 (Analysis 1). Just over 200 children, all of whom underwent adeno-tonsillectomy, are compared with a similar number of controls. It is important to note that all these children were ones who had less severe disease than those in Paradise 1984.

There is no significant heterogeneity between studies when the number of sore throat days are considered (Analysis 1.3). Meta-analysis shows a statistically significant reduction of 4.7 days (95% CI -8.14 to -1.25) in the surgical group. Rather than having about 22 days of sore throat in the year, patients had 17 and a significant proportion of those days were those immediately following surgery, and as such were predictable.

There is no significant heterogeneity between the studies when more severe episodes of sore throat are considered (Analysis 1.2). Meta-analysis demonstrates a statistically significant, but modest, reduction of 0.20 episodes (95% CI -0.32 to -0.08) in the surgical group. The clinical significance of this is debatable; the ‘cost’ of this gain is 1.0 episodes of postoperative pain, which is likely to have been ‘moderate or severe’.

There is definite heterogeneity (the I² value is 45.2%) when meta-analysis is performed looking at the ‘any sore throat’ outcome (Analysis 1.1). A statistically significant reduction of 1.4 episodes (95% CI: -1.74 to -1.07) in the surgical group is evident, again at the ‘cost’ of 1.0 episodes of moderate or severe postoperative pain in that group.

**Is there a difference in the effectiveness of tonsillectomy versus adeno-tonsillectomy?**

Data from the Paradise 2002a study allow direct comparison between tonsillectomy and adeno-tonsillectomy. No significant differences were found in either the number of episodes of sore throat or sore-throat days. As reported above, in his earlier study (1984) Paradise combined the results from those children undergoing tonsillectomy and adeno-tonsillectomy having found no difference between the groups. It is not possible to combine the data from these two comparisons, nor to undertake the appropriate power calculation. We may never know whether the absence of evidence of a difference between the effects of the procedures is because no such difference exists, or a lack of statistical power in these studies to detect a difference. There remains doubt about whether or not removing the adenoids (reducing or preventing as it does the incidence of mouth breathing) has an effect on the frequency and/or severity of sore throats.

**What is the effectiveness of a strategy of either tonsillectomy or adeno-tonsillectomy versus no surgery?**

Analysis 2 shows the results of combining all those children undergoing surgery (tonsillectomy or adeno-tonsillectomy) versus no surgery across all studies with follow up for a year. Note that the degree to which the included children suffer from recurrent throat infections varies from the severely affected of Paradise 1984 to the less severely affected of Paradise 2002a, Paradise 2002b and van Staaij 2004.

The first analysis (Analysis 2.1) shows the number of episodes of sore throat of any severity not including the immediate postoperative period. Surgery is associated with 1.4 fewer episodes (95% CI -1.69 to -1.08). The episode of postoperative pain is again important in interpreting this figure. The ‘cost’ of benefiting from 1.4 fewer episodes of sore throat in the first 12 months post-surgery is 1.0 episodes of sore throat in the immediate postoperative period. When only episodes of moderate/severe sore throats are considered (Analysis 2.2), surgery is associated with a modest 0.2 fewer episodes (95% CI -0.35 to -0.12) in exchange for 1.00 episodes of sore throat in the immediate postoperative period.

In both these comparisons there is significant heterogeneity as measured by the I² statistic (49.5% and 79.9% respectively). In the case of the second comparison (Analysis 2.2), episodes of moderate/severe sore throat, the benefit accruing to the more severely affected children of the Paradise 1984 study appears significantly greater than to the children in the other studies. There is no demonstrable heterogeneity in the meta-analysis of the outcome ‘sore throat days’ (Analysis 2.3). The number of sore
throat days is about four days less in the surgical group (−4.3, 95% CI: −7.2 to −1.43). Again, the clinical correlate of this is that rather than having about 21 days of sore throat in the year, patients had 17, but some of these (between five and seven on average) were those immediately following surgery, and as such were entirely predictable.

We considered that the heterogeneity seen in Analysis 2.1 and Analysis 2.2 might relate to the clinical heterogeneity of the included children. Were the results influenced by the inclusion of the more severely affected children of Paradise 1984? Analysis 3 includes all the data in Analysis 2 but removes the Paradise 1984 study containing the ‘severely affected’ children. This table differs slightly from Analysis 1 because the tonsillectomy alone children from Paradise 2002a are now included. The heterogeneity seen in the outcome ‘episodes of moderate/severe sore throat’ is no longer present suggesting that when the included children are a more homogeneous collection of less severely affected children, the impact of treatment on the occurrence of more severe sore throats is similar. However, there is still significant heterogeneity (I² = 60.4%) in the outcome of ‘sore throat of any severity’ despite removing the ‘severely affected’ children (Analysis 3.1). This is also present in Analysis 1.1 and appears to be due to a difference between Paradise 2002a and the other studies.

**What is the effectiveness of surgery after the first postoperative year?**

Data from the van Staaaij 2004 study throw some light on the ongoing effects of surgery on less severely affected children. For moderate/severe sore throats, the reduction in episodes produced by surgery is not dramatic: 1.54 (control) versus 1.12 (surgery) over two years. If one adds in the episode due to the surgery itself, the operated children had had more: 1.54 (control) versus 2.12 (surgery). But for episodes of sore throat of any severity, and sore-throat days, the benefits of surgery are more marked: 5.7 episodes of sore throat of any severity over two years in the control groups compared with 4.4 in the surgical group. This last figure comprises one episode immediately after surgery and 3.4 others. In terms of sore-throat days, over two years the control children had on average 31 days, whilst those undergoing surgery had 20, although some of these (between five and seven on average) were immediately postoperative.

**Discussion**

In regards to the available trials of surgery for recurrent or chronic tonsillitis or sore throats there are several caveats.

- Only one study examines the effectiveness of surgery in severely affected children. This suggests that surgery may be beneficial.
  - Most studies include individuals with relatively modest degrees of disease.
  - It is not possible to determine whether or not the effects of tonsillectomy and adenotonsillectomy are different.
  - Adequate data are only available to evaluate the effects of surgery on severely affected children in the first postoperative year.
  - There are no good data on the medium to long-term effectiveness of tonsillectomy in adults.

Given these caveats, the results of this review may be summarised as follows:

- Less severely affected children having surgery benefit from 1.3 fewer episodes of sore throat of any severity in the first year, at a ‘cost’ of one episode of sore throat in the immediate postoperative period (3.3 episodes in the control group; 1.8 in the surgical group + 1 episode postoperatively).
- Less severely affected children having surgery had four fewer days with sore throats in the first year. Rather than 22 days they had 17 but some of these (between five and seven on average) are in the immediate postoperative period.

- Looking across a two-year period, less severely affected children have not been shown to benefit from surgery in terms of reducing the number of moderate/severe sore throat episodes they experience.
- However, across a two-year period, less severely affected children have slightly fewer episodes of sore throat of any severity (5.7 episodes in the control group; 3.4 in the surgical group + 1 episode postoperatively) and fewer sore throat days (rather than 31 days over two years they had 20 but some of these (between five and seven on average) are in the immediate postoperative period).

While an adult or child who has had their palatine tonsils removed cannot suffer from tonsillitis they can suffer from sore throats. Unfortunately, the palatine tonsils are just part of Waldeyer’s ring of lymphoid tissue within the pharynx. The aggregates of lymphoid tissue in the tongue base, nasopharynx and within the pharyngeal walls, along with the remaining soft tissues of the pharynx, remain after tonsillectomy. This at least in part explains why tonsillectomy is not a panacea for all sore throats.

Patients with chronic or recurrent sore throats are heterogeneous in both causation and in severity. Some have symptoms primarily due to infection of the tonsils, others do not. Thus an important issue is the role the palatine tonsils play in producing the clinical condition of ‘tonsillitis’, or indeed ‘sore throat’ or ‘throat infection’. It is self-evident that removal of the palatine tonsils will prevent ‘tonsillitis’ just as removing the appendix will prevent appendicitis.

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Tonsillectomy or adenotonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis (Review)

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However, many patients with ‘tonsillitis’ will have inflammation, or infection, of other pharyngeal lymphoid tissue and other soft tissues of this region. If inflammation/infection of these tissues is critically dependent on inflammation/infection of the tonsils themselves, tonsillectomy might be effective. If inflammation/infection of non-tonsillar tissue is independent of tonsillar infection, removing the tonsils may be irrelevant.

Only one trial examined tonsillectomy in adults (Alho 2007) and this only looked at the short-term effectiveness of the procedure in one specific subgroup of patients. We must conclude that we do not know, one way or the other, whether tonsillectomy is generally helpful for adults suffering from sore throats. If we could be certain that (a) the symptoms were solely attributable to inflammation of their tonsils, and (b) that these symptoms were going to continue, then tonsillectomy would be a reasonable treatment option. Ensuring both conditions hold is problematic.

The studies provide limited information on the effect of adeno-/tonsillectomy in certain types of children. While some of the children probably suffered from a clinical condition in which the palatine tonsils played a major (perhaps exclusive) role in the pathogenesis of their symptoms and signs, others might have been included in whom the palatine tonsils were not the source of their symptoms? In his initial study (Paradise 1984) Paradise tried extremely hard to identify children who fell into the first group. As a result the ‘Paradise criteria’ have become a widely recognised standard for children with severe throat symptoms due to tonsillar disease. Equally, when following up children post-randomisation, Paradise had strict criteria for episodes of throat infection. The later Paradise studies specifically looked at less severely affected children and it is certainly possible that this group included children in whom the palatine tonsils played a less important role in their symptoms.

The van Staaij study (van Staaij 2004) is unique because the eligibility criteria were much broader. ANY child whose otolaryngologist felt should undergo adeno-/tonsillectomy was potentially eligible. Those fulfilling the ‘Paradise criteria’ were excluded, leaving as the included group children who might have been similar to the Paradise 2002 ‘less severely affected’ children. But equally, some children may have fulfilled even less stringent criteria. To reiterate, these were children who otolaryngologists working in 21 general hospitals and three academic centres in the Netherlands had deemed fulfilled their normal criteria for surgery.

Whilst specific information on the nature and severity of sore throats prior to randomisation is lacking in the van Staaij study, no such criticism can be made of the follow-up period. A sore throat was defined as sore throat or pain or difficulty in swallowing combined, with or without a fever.

In summary, what the included studies actually evaluate is the effect of adeno-/tonsillectomy on the symptoms experienced by three more or less heterogeneous groups of children, and these studies themselves are heterogeneous.

- In Paradise 1984 many (possibly most) included children had symptoms related to their palatine tonsils so this group likely to be least heterogeneous.
- Paradise 2002a and Paradise 2002b had a heterogeneous group of less severely affected children. What proportion had symptoms related to their palatine tonsils?
- van Staaij 2004 had potentially the most heterogeneous group of less severely affected children. Again, the proportion with symptoms related to their palatine tonsils is uncertain.

In these circumstances, is it rational to combine the studies? Combining results would lead to an underestimate of a positive treatment effect from surgery in the most severely affected children and an overestimate in the least severely affected.

**Severely affected children**

So is there a positive treatment effect in the most severely affected children? These children from Paradise 1984 are included in Analysis 2. In terms of moderate/severe sore throat, the benefit of surgery is exchanging the 1.2 episodes experienced by the control group for 0.1 episodes following surgery but at a ‘cost’ of the 1.0 episode following surgery. A net gain of 0.1 episodes. The postoperative episode might be thought to be preferable because it can be timed and anticipated. However, this is a modest benefit and, given the breadth of the confidence interval, the true value for the reduction may be even less. The commensurate reduction in any type of sore throat was 1.9 episodes - 3.1 versus 1.2 (+1 for the surgery), again with a wide confidence interval. No significant reduction was found in terms of number of sore throat days in the first year (18.9 in the control group versus 16.3 in the surgical) but again, five to seven (on average) of these 16.3 days were in the immediate postoperative period and hence highly predictable. We might speculate that had sufficient data been available for the second and third years post-surgery, a difference may have been apparent.

**Less severely affected children**

As might be expected the benefits seen in the less severely affected children are less (Analysis 3), with a reduction in more severe sore throat episodes of 0.2, and of any sore throat of 1.3, both at a cost of 1.0 predictable episode following surgery. In this analysis there was a statistically significant reduction in sore throat days from 22 days to 17. That period of 17 days includes the predictable five to seven days of pain in the immediate postoperative period.
Effects in the second year post-surgery

Limited, but potentially valuable, information is available from van Staaij 2004 about the effects of surgery over a two-year period. These data suggest that over a two-year period the less severely affected children studied had fewer sore throats of any severity post-surgery: 4.4 (one of which was the postoperative episode) versus 5.7 (control group). They also experienced fewer sore throat days (rather than 31 days over two years they had 20). Moreover, five to seven (on average) of these 20 days were in the predictable, postoperative category.

The number of moderate/severe sore throats experienced by children in this study was not great and perhaps therefore it is not surprising that the reduction produced by surgery is not dramatic: 1.54 (surgery) versus 1.12 (control group) over two years. In fact, if one adds in the episode due to the surgery itself, the operated children have had more: 2.12 (surgery) versus 1.54 (control).

Summary

Good information about the effects of tonsillectomy is only available for children and the majority relates to the first year following surgery.

For more severely affected children (who fulfil the ‘Paradise criteria’) adeno-/tonsillectomy will avoid one unpredictably timed episode of moderate or severe sore throat in the first year post-surgery. The cost of this is a predictable episode of pain in the immediate postoperative period.

These severely affected children will on average have one rather than three unpredictable episodes of any type of sore throat in the first year post-surgery, again at the cost of one additional episode of postoperative pain.

Less severely affected children who have adeno-/tonsillectomy may never have had another severe sore throat anyway; the chance of them so doing is modestly reduced by adeno-/tonsillectomy. For them, surgery will mean having an average of two rather than three unpredictable episodes of any type of sore throat. The cost of this reduction is one inevitable and predictable episode of postoperative pain. They will have 17 rather than 22 sore throat days but something between five to seven (on average) of these 17 will be in the immediate postoperative period.

One reason why the impact of surgery is so modest is that many patients in the control group get better spontaneously. There is a trade-off for the physician and patient who must weigh up a number of different uncertainties. These are:

Uncertainty 1: Are my symptoms primarily attributable to disease of my palatine tonsils?

Uncertainty 2: Am I going to continue to have sore throats and if so will they be as bad, better or worse?

Decision: Do I want to exchange the uncertainties of both the possibility and timing of my sore throats in the year ahead for the certainty of a predictable period of postoperative pain that may be followed by less sore throats than I might have had?

Many thousands of patients have undergone adeno-/tonsillectomy and are likely to continue to do so. Some will undergo this surgery ‘unnecessarily’ because they would not have had any further throat problems had they not had surgery. During a period in the 1980s and 1990s in the United Kingdom, when waiting lists for surgery were long, a proportion of patients who were listed for surgery according to strict criteria eventually declined the operation because they had improved spontaneously. Perhaps the price society pays for the prevention of recurrent sore throats in one group of patients is that for each of these individuals an indeterminable number of other individuals will have their tonsils removed ‘unnecessarily’. It has been shown that many patients who undergo tonsillectomy are pleased to have done so (Blair 1996). Anecdotal evidence suggests that some children are ‘transformed’ by the procedure. Some of this effect may be due to removing a source of infection. In others, the tonsils may have produced mild obstructive symptoms, the relief of which is responsible for their improvement. Tonsillectomy for obstructive sleep apnoea has not been considered in this review, but is considered in other Cochrane Reviews (Lim 2001; Sundaram 2005). It is likely that some children undergoing tonsillectomy have symptoms that fall short of full sleep apnoea but that may affect the quality of their sleep. Postoperative improvement may, at least in part, be due to improvement in their sleep patterns.

Those who choose surgery for themselves or their child must be fully informed of the risks of the procedure; this is critical in conducting the appropriate harm-benefit analysis. Evidence from the included studies confirms that primary and secondary haemorrhages are still significant complications. Even more robust data are provided by the United Kingdom National Tonsillectomy Audit, undertaken between 2003 and 2004. The audit (Brown 2005) collected information from 40,515 patients undergoing tonsillectomy. Overall the rates of primary and secondary haemorrhage were 1.3% and 3.9% respectively; the rates varied according to the surgical technique used to remove the tonsils. One postoperative death was reported. A number of anaesthetic-related complications were noted in the included trials.

Authors’ Conclusions

Implications for practice

Those considering tonsillectomy or adeno-tonsillectomy for themselves or their children, and those advising them, should be aware of two important uncertainties which may affect their treatment decisions. They must acknowledge some uncertainty about whether or not their symptoms are primarily due to their tonsils and realise that adeno-/tonsillectomy is not a panacea for all types of sore throat. There is also uncertainty about the likelihood that these will continue in the future, which is only partly predictable.
from the frequency and severity of symptoms they have experienced in the past.

The benefits of surgery are greatest in those fulfilling the 'Paradise criteria'. In their original setting these were very strict, requiring a child to have had each of the following: (1) seven or more episodes in the preceding year, or five or more in each of the preceding two years, or three or more in each of the preceding three years, comprising (2) characteristic clinical features, having been (3) treated with antibiotics when streptococcal infection was proven or suspected, and (4) each episode had to have been documented in a clinical record. In day-to-day practice these criteria are often 'watered down', with most emphasis being placed on the aspect of 'counting' the number of episodes, and less on proving the 'certainty' of each episode.

Surgery is associated with a reduction in the number of unpredictable days with sore throat and the number of episodes of sore throat even in those who are less severely affected. One of the key practical issues is that the episode of a period of days with sore throat that follows surgery is entirely predictable, lasting between about five and seven days on average, but in some cases being shorter, and in others considerably longer.

What are the risks of surgery? Tonsillectomy is associated with a small but significant degree of morbidity in the form of primary and secondary haemorrhage and, even with good analgesia, is particularly uncomfortable for adults.

It may have to be accepted that some patients will undergo 'unnecessary surgery' in order for others to benefit, and that even well-informed and appropriately counselled patients are prepared to accept the risks and uncertainty of surgery.

**Implications for research**

If it were certain that an individual's throat problems were entirely due to their tonsils, and that these problems were bound to continue without surgery, there would be little need to consider further studies to evaluate the effectiveness of tonsillectomy. There would certainly be no need for a randomised trial. Two appropriate research questions therefore might be:

1. Is it possible to identify those individuals in whom the presence of the palatine tonsils is a critical determinant of their clinical condition?
2. Is it possible to better predict which individuals will continue to have problems and the severity of those problems?

It is unlikely to be easy, and may not be possible, to address these uncertainties.

One implication drawn from the studies is that greater benefit can potentially be obtained by more severely affected individuals. If the 'Paradise' criteria are accepted for identifying such children, what are the equivalent criteria for adults? If the most severely affected adults could be identified, would a randomised trial, looking at outcomes over several years, be appropriate or practicable?

Finally, what outcomes should be included in any future research? If adenotonsillectomy has an effect on aspects of an individual's health other than sore throats - general well-being, for example - these outcomes should also be evaluated.

**ACKNOWLEDGEMENTS**

The authors acknowledge the support of the members of the UK Cochrane Centre.

Dr Bernie Towler was a co-author of the original review and was involved in protocol development, quality assessment of trials, data extraction and development of the original review.

**REFERENCES**

References to studies included in this review

---

**Alho 2007** *(published data only)*


**Paradise 1994** *(published data only)*


**Paradise 2002b** *(published data only)*


**van Staaij 2004** *(published data only)*

van Staaij BK, van den Akker EH, Rovers MM,

References to studies excluded from this review

Kaiser 1930 {published data only}


Mawson 1967 {published data only}


McKee 1963 {published data only}


Roydhouse 1970 {published data only}


Van den Akker 2000 {published and unpublished data}


References to ongoing studies

NESTAC {unpublished data only}


Additional references

Blair 1996


Brown 2005


Chalmers 1990


Handbook 2008


Lim 2001


Marshall 1998


Paradise 1996


Sundaram 2005


References to other published versions of this review

Burton 1999


* Indicates the major publication for the study
### Characteristics of included studies  
*ordered by study ID*

**Alho 2007**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
</tr>
</thead>
</table>
| **Methods**     | Random allocation: replacement randomisation, computer generated  
|                 | No blinding |
| **Participants**| Adults aged > 15 with 3 or more episodes of pharyngitis in 6 months or 4 in 12 months, at least 1 episode being proven due to group A streptococcal infection |
| **Interventions**| Tonsillectomy or watchful waiting |
| **Outcomes**    | PRIMARY: Proportion of patients with an acute episode of group A streptococcal pharyngitis during 90-day follow-up period  
|                 | SECONDARY: Percentage change in proportion of patients with all episodes pharyngitis at 90 days  
|                 | Time to episodes  
|                 | Difference in mean rates of episodes  
|                 | Days with symptoms during whole follow up |
| **Notes**       | Methodological quality score: B  
|                 | Follow up: complete at 90 days |

**Risk of bias**

<table>
<thead>
<tr>
<th>Item</th>
<th>Authors’ judgement</th>
<th>Description</th>
</tr>
</thead>
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<tr>
<td>Adequate sequence generation?</td>
<td>Yes</td>
<td>Quote: “randomisation sequence” generated with “computer random number generator”</td>
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<tr>
<td>Allocation concealment?</td>
<td>Yes</td>
<td>Quote: “sequentially numbered sealed opaque envelopes”</td>
</tr>
<tr>
<td>Blinding?</td>
<td>No</td>
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<tr>
<td>Free of selective reporting?</td>
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<td></td>
</tr>
<tr>
<td>Free of other bias?</td>
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<td></td>
</tr>
</tbody>
</table>
Paradise 1984

| Methods | Random allocation: balanced blocks, three age groups, exact method uncertain  
No blinding |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Children aged 3 to 15 years meeting strict criteria for tonsillectomy</td>
</tr>
<tr>
<td>Interventions</td>
<td>Tonsillectomy or adeno-tonsillectomy or control (courses of antibiotics as necessary in both groups)</td>
</tr>
</tbody>
</table>
| Outcomes | PRIMARY:  
Episodes of throat infection  
SECONDARY:  
Isolated cervical lymphadenopathy  
Parent-reported sore-throat days  
Sore throat associated school absence |
| Notes | Methodological quality score: B  
Follow up: cumulative proportion of patients lost to follow up at the end of each of 3 years were respectively:  
Tonsillectomy group: 12%, 30%, 49%  
Control group: 13%, 15%, 25%  
Cumulative proportion of control group electing for surgical treatment at end of each year: 15%, 25%, 33% |

**Risk of bias**

<table>
<thead>
<tr>
<th>Item</th>
<th>Authors’ judgement</th>
<th>Description</th>
</tr>
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<td>Quote: “assigned randomly” within blocks of 4 subjects</td>
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<td>Allocation concealment?</td>
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<td>Comment: Small block (four subjects) size potentially allowing foreknowledge of allocation</td>
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<td>Blinding? All outcomes</td>
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<tr>
<td>Incomplete outcome data addressed? All outcomes</td>
<td>No</td>
<td>Comment: Significant losses to follow up especially in 2nd and 3rd years. Data not available on subjects in control group who received the intervention (surgery)</td>
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<tr>
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<tr>
<td>Methods</td>
<td>Random allocation: balanced blocks, 3 age groups, exact method uncertain No blinding</td>
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<td>---------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Participants</td>
<td>Children aged 3 to 15 moderately affected with recurrent throat infection</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Tonsillectomy or adeno-tonsillectomy or control (standard treatment)</td>
<td></td>
</tr>
<tr>
<td>Outcomes</td>
<td><strong>PRIMARY:</strong> Episodes of throat infection <strong>SECONDARY:</strong> Cervical lymphadenopathy found at non-throat-infection visits Sore-throat days Sore throat associated school absence</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>Methodological quality score: B Follow up: cumulative proportion of patients lost to follow up at the end of each of the 3 follow-up years were respectively: Tonsillectomy group: 19%, 29.3%, 38% Adeno-tonsillectomy group: 22%, 39%, 52.5% Control group: 10%, 21.7%, 33.3% Cumulative proportion of control group electing for surgical treatment at end of each year: 8.3%, 11.7%, 20%</td>
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</table>

**Risk of bias**

<table>
<thead>
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<td>Comment: Significant losses to follow up especially in 2nd and 3rd years</td>
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</tr>
<tr>
<td>Free of other bias?</td>
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</table>
Paradise 2002b

Methods

Random allocation: balanced blocks, 3 age groups, exact method uncertain
No blinding

Participants

Children aged 3 to 15 moderately affected with recurrent throat infection

Interventions

adeno-tonsillectomy or control (standard treatment)

Outcomes

PRIMARY:
Episodes of throat infection
SECONDARY:
Cervical lymphadenopathy found at non-throat-infection visits
Sore-throat days
Sore throat associated school absence

Notes

Methodological quality score: B
Follow up: cumulative proportion of patients lost to follow up at the end of each of the 3 follow-up years were respectively:
Adeno-tonsillectomy group: 16%, 27.4%, 34%
Control group: 11.5%, 18%, 23%
Cumulative proportion of control group electing for surgical treatment at end of each year: 15.4%, 21.8%, 24.4%

Risk of bias

<table>
<thead>
<tr>
<th>Item</th>
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</thead>
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<tr>
<td>Blinding? All outcomes</td>
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</table>
van Staaij 2004

**Methods**
Random allocation: computer generated block
No blinding

**Participants**
Children between 2 and 8 years with indications for adeno-tonsillectomy “according to current medical practice” in the Netherlands. Children meeting strict Paradise 1984 criteria excluded

**Interventions**
Adeno-tonsillectomy or watchful waiting

**Outcomes**
PRIMARY: Incidence of fever >= 30.0 °C for at least 1 day
SECONDARY:
Throat infections
Sore throat
URTI
Absence from day-care or school due to URTI
Health related quality of life
Patterns of sleep and eating
Height
Weight

**Notes**
Methodological quality score: B
Follow up: proportion available at Year 1: adeno-tonsillectomy group 111/151 (73.5%); control group 107/149 (71.8%)

**Risk of bias**

<table>
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<tr>
<th>Item</th>
<th>Authors' judgement</th>
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<td>Quote: “randomisation was by a computer generated list of 4 numbers in each block and fixed blocks within each hospital”</td>
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<td>Allocation concealment?</td>
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<td>Comment: Small block (4 subjects) size potentially allowing foreknowledge of allocation</td>
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<td>Blinding?</td>
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<tr>
<td>Incomplete outcome data addressed?</td>
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<td>Comment: Low loss to follow up</td>
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<td>Free of other bias?</td>
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### Characteristics of excluded studies [ordered by study ID]

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser 1930</td>
<td>Allocation: non-randomised retrospective cohort study</td>
</tr>
<tr>
<td>Mawson 1967</td>
<td>Allocation: randomised</td>
</tr>
<tr>
<td></td>
<td>Participants: children (4 to 12 years) with recurrent tonsillitis and/or sore throats and/or cervical adenitis</td>
</tr>
<tr>
<td></td>
<td>Interventions: tonsillectomy alone or adeno-tonsillectomy</td>
</tr>
<tr>
<td></td>
<td>Notes: (a) Recurrent adenitis alone considered an indication for inclusion, (b) Some participants had no attacks in year prior to trial or number was unknown (Mawson 1967, Table VI), (c) Impossible to separate data for tonsillectomy patients from data for adeno-tonsillectomy patients</td>
</tr>
<tr>
<td>McKee 1963</td>
<td>Allocation: randomised using hospital number</td>
</tr>
<tr>
<td></td>
<td>Participants: children (&lt; 15 years) with throat infections or “acute upper respiratory infections with cervical adenitis”</td>
</tr>
<tr>
<td></td>
<td>Interventions: adeno-tonsillectomy</td>
</tr>
<tr>
<td>Roydhouse 1970</td>
<td>Allocation: “Selection of cases [as] described by McKee” (randomised using hospital number)</td>
</tr>
<tr>
<td></td>
<td>Participants: children (2 to 13 years) with “recurrent ... tonsillitis and other respiratory tract infections”</td>
</tr>
<tr>
<td></td>
<td>Interventions: adeno-tonsillectomy</td>
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</table>

### Characteristics of ongoing studies [ordered by study ID]

**NESTAC**

<table>
<thead>
<tr>
<th>Trial name or title</th>
<th>NESTAC: North of England Study of Tonsillectomy and Adeno-tonsillectomy in children</th>
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</thead>
<tbody>
<tr>
<td>Methods</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>Participants</td>
<td>Children &lt; 16 years with recurrent sore throat</td>
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<tr>
<td>Interventions</td>
<td>Surgical intervention versus non-surgical intervention (tonsillectomy and adeno-tonsillectomy)</td>
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<tr>
<td>Outcomes</td>
<td>Primary outcome measure: number of reported episodes of sore throat in the 2 years following date of randomisation</td>
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<tr>
<td>Starting date</td>
<td>01/06/2001</td>
</tr>
<tr>
<td>Contact information</td>
<td>Professor John Bond: <a href="mailto:john.bond@newcastle.ac.uk">john.bond@newcastle.ac.uk</a></td>
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<td>Notes</td>
<td>All information obtained from Current Controlled Trials at: <a href="http://www.controlled-trials.com/ISRCTN47891548">www.controlled-trials.com/ISRCTN47891548</a> (accessed 19 August 2008)</td>
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</table>
## DATA AND ANALYSES

### Comparison 1. Adenotonsillectomy versus no surgery

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Episodes of sore throat of any severity (not including as one episode the period post-surgery)</td>
<td>3</td>
<td>444</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-1.40 [-1.74, -1.07]</td>
</tr>
<tr>
<td>2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery)</td>
<td>3</td>
<td>444</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-0.20 [-0.32, -0.08]</td>
</tr>
<tr>
<td>3 Sore-throat days (including those immediately post-surgery)</td>
<td>3</td>
<td>447</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-4.70 [-8.14, -1.25]</td>
</tr>
</tbody>
</table>

### Comparison 2. Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
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<td>1 Episodes of sore throat of any severity (not including as one episode the period post-surgery)</td>
<td>4</td>
<td>564</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-1.39 [-1.69, -1.08]</td>
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<tr>
<td>2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery)</td>
<td>4</td>
<td>564</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-0.23 [-0.35, -0.12]</td>
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<tr>
<td>3 Sore-throat days (including those immediately post-surgery)</td>
<td>4</td>
<td>559</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-4.26 [-7.29, -1.23]</td>
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### Comparison 3. Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only

<table>
<thead>
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<th>No. of participants</th>
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<tbody>
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<td>1 Episodes of sore throat of any severity (not including as one episode the period post-surgery)</td>
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<td>-1.34 [-1.66, -1.02]</td>
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<tr>
<td>2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery)</td>
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<td>491</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-0.18 [-0.29, -0.07]</td>
</tr>
<tr>
<td>3 Sore-throat days (including those immediately post-surgery)</td>
<td>3</td>
<td>495</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-4.63 [-7.98, -1.28]</td>
</tr>
</tbody>
</table>

### Analysis 1.1. Comparison 1 Adenotonsillectomy versus no surgery, Outcome 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery).

Review: Tonsillectomy or adenotonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 1 Adenotonsillectomy versus no surgery

Outcome: 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Adenotonsillectomy</th>
<th>No Surgery</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference (IV, Fixed, 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paradise 2002a</td>
<td>46</td>
<td>54</td>
<td>1.85 (1.39)</td>
<td>30.9%</td>
<td>-0.93 [-1.53, -0.33]</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>59</td>
<td>67</td>
<td>1.9 (1.37)</td>
<td>34.3%</td>
<td>-1.70 [-2.27, -1.13]</td>
</tr>
<tr>
<td>van Staaaij 2004</td>
<td>111</td>
<td>107</td>
<td>1.74 (1.76)</td>
<td>34.8%</td>
<td>-1.53 [-2.09, -0.97]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>216</strong></td>
<td><strong>228</strong></td>
<td></td>
<td></td>
<td><strong>100.0 % -1.40 [-1.74, -1.07]</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 3.65, \text{df} = 2 (P = 0.16); I^2 = 45$

Test for overall effect: $Z = 8.27 (P < 0.00001)$

Test for subgroup differences: Not applicable
### Analysis 1.2. Comparison 1 Adenotonsillectomy versus no surgery, Outcome 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery).

**Review:** Tonsillectomy or adenotonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

**Comparison:** 1 Adenotonsillectomy versus no surgery

**Outcome:** 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Treatment</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (Mean(SD))</td>
<td>N (Mean(SD))</td>
<td>N (Mean(SD))</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>46 (0.09 (0.35))</td>
<td>54 (0.24 (0.51))</td>
<td>46.3 %</td>
<td>-0.15 [ -0.32, 0.02 ]</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>59 (0.15 (0.42))</td>
<td>67 (0.43 (0.67))</td>
<td>35.7 %</td>
<td>-0.28 [ -0.47, -0.09 ]</td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111 (0.69 (0.91))</td>
<td>107 (0.86 (1.12))</td>
<td>18.0 %</td>
<td>-0.17 [ -0.44, 0.10 ]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>216</strong> (Mean(SD))</td>
<td><strong>228</strong> (Mean(SD))</td>
<td><strong>100.0 %</strong></td>
<td><strong>-0.20 [ -0.32, -0.08 ]</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 1.04$, df = 2 ($P = 0.59$); $I^2 =0.0$

Test for overall effect: $Z = 3.40$ ($P = 0.00067$)

Test for subgroup differences: Not applicable

### Analysis 1.3. Comparison 1 Adenotonsillectomy versus no surgery, Outcome 3 Sore-throat days (including those immediately post-surgery).

**Review:** Tonsillectomy or adenotonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

**Comparison:** 1 Adenotonsillectomy versus no surgery

**Outcome:** 3 Sore-throat days (including those immediately post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Adenotonsillectomy</th>
<th>No Surgery</th>
<th>Mean Difference</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (Mean(SD))</td>
<td>N (Mean(SD))</td>
<td>N (Mean(SD))</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>47 (19 (15))</td>
<td>54 (25 (21))</td>
<td>23.9 %</td>
<td>-6.00 [ -13.05, 1.05 ]</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>60 (23 (20))</td>
<td>68 (24 (17))</td>
<td>28.3 %</td>
<td>-1.00 [ -7.48, 5.48 ]</td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111 (12.68 (9.5))</td>
<td>107 (18.92 (2439))</td>
<td>47.8 %</td>
<td>-6.24 [ -11.22, -1.26 ]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>218</strong></td>
<td><strong>229</strong></td>
<td><strong>100.0 %</strong></td>
<td><strong>-4.70 [ -8.14, -1.25 ]</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 1.75$, df = 2 ($P = 0.42$); $I^2 =0.0$

Test for overall effect: $Z = 2.67$ ($P = 0.0075$)

Test for subgroup differences: Not applicable
Analysis 2.1. Comparison 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children, Outcome 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery).

Review: Tonsillectomy or adeno-tonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children

Outcome: 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Combined Surgery</th>
<th>No Surgery</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Paradise 1984</td>
<td>38</td>
<td>1.24 (1.62)</td>
<td>35</td>
<td>3.09 (2.64)</td>
<td>9.0 %</td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>93</td>
<td>1.91 (1.39)</td>
<td>54</td>
<td>2.78 (1.66)</td>
<td>33.4 %</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>59</td>
<td>1.9 (1.37)</td>
<td>67</td>
<td>3.6 (1.87)</td>
<td>28.6 %</td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111</td>
<td>1.74 (1.76)</td>
<td>107</td>
<td>3.27 (2.42)</td>
<td>29.0 %</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>301</td>
<td>263</td>
<td>100.0 %</td>
<td>-1.39 [ -1.69, -1.08 ]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 5.94, df = 3 (P = 0.11) ; I² = 49%
Test for overall effect: Z = 8.95 (P < 0.00001)
Test for subgroup differences: Not applicable
Analysis 2.2. Comparison 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children, Outcome 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery).

Review: Tonsillectomy or adenotonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children

Outcome: 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Treatment</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
<td>N(Fixed,95% CI)</td>
</tr>
<tr>
<td>Paradise 1984</td>
<td>38</td>
<td>0.08 (0.27)</td>
<td>35</td>
<td>1.17 (1.42)</td>
<td>5.8 %</td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>93</td>
<td>0.13 (0.41)</td>
<td>54</td>
<td>0.24 (0.51)</td>
<td>52.4 %</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>59</td>
<td>0.15 (0.42)</td>
<td>67</td>
<td>0.43 (0.67)</td>
<td>35.8 %</td>
</tr>
<tr>
<td>van Staaaj 2004</td>
<td>111</td>
<td>0.69 (0.91)</td>
<td>107</td>
<td>0.86 (2.34)</td>
<td>5.9 %</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>301</strong></td>
<td><strong>263</strong></td>
<td><strong>100.0 %</strong></td>
<td><strong>-0.23 [-0.35, -0.12]</strong></td>
<td><strong>-0.23 [-0.35, -0.12]</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 14.92, df = 3 (P = 0.002); I² = 80%
Test for overall effect: Z = 3.93 (P = 0.000085)
Test for subgroup differences: Not applicable
### Analysis 2.3. Comparison 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children, Outcome 3 Sore-throat days (including those immediately post-surgery).

Review: Tonsillectomy or adeno-tonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 2 Combined tonsillectomy + adenotonsillectomy versus no surgery - severe and moderately affected children

Outcome: 3 Sore-throat days (including those immediately post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Surgery</th>
<th>No Surgery</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
<th>Weight</th>
<th>Mean Difference</th>
<th>95% CI</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paradise 1984</td>
<td>31</td>
<td>33</td>
<td>16.3 (14.3)</td>
<td>18.9 (14.6)</td>
<td>18.3%</td>
<td>-2.60 [-9.68, 4.48 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>95</td>
<td>54</td>
<td>19.5 (14.5)</td>
<td>25 (21)</td>
<td>23.0%</td>
<td>-5.50 [-11.81, 0.81 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>60</td>
<td>68</td>
<td>23 (20)</td>
<td>24 (17)</td>
<td>21.8%</td>
<td>-1.00 [-7.48, 5.48 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111</td>
<td>107</td>
<td>12.68 (9.5)</td>
<td>18.92 (24.59)</td>
<td>36.9%</td>
<td>-6.24 [-11.22, -1.26 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>297</td>
<td>262</td>
<td>100.0%</td>
<td>-4.26 [-7.29, -1.23 ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 1.94, df = 3 (P = 0.59); I² =0.0%

Test for overall effect: Z = 2.76 (P = 0.0058)

Test for subgroup differences: Not applicable
**Analysis 3.1.** Comparison 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only, Outcome 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery).

Review: Tonsillectomy or adeno-tonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only

Outcome: 1 Episodes of sore throat of any severity (not including as one episode the period post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Treatment</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
<td>N/Weight</td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>93</td>
<td>1.91 (1.39)</td>
<td>54</td>
<td>2.78 (1.66)</td>
<td>36.7%</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>59</td>
<td>1.9 (1.37)</td>
<td>67</td>
<td>3.6 (1.87)</td>
<td>31.4%</td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111</td>
<td>1.74 (1.76)</td>
<td>107</td>
<td>3.27 (2.42)</td>
<td>31.9%</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>263</td>
<td>228</td>
<td></td>
<td>100.0%</td>
<td>-1.34 [-1.66, -1.02]</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 5.06, df = 2 (P = 0.08); I^2 = 60$

Test for overall effect: $Z = 8.26 (P < 0.00001)$

Test for subgroup differences: Not applicable

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**Analysis 3.2.** Comparison 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only, Outcome 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery).

Review: Tonsillectomy or adeno-tonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only

Outcome: 2 Episodes of moderate/severe sore throat (not including as one episode the period post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Treatment</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
<td>N/Weight</td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>93</td>
<td>0.13 (0.41)</td>
<td>54</td>
<td>0.24 (0.51)</td>
<td>49.3%</td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>59</td>
<td>0.15 (0.42)</td>
<td>67</td>
<td>0.43 (0.67)</td>
<td>33.7%</td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111</td>
<td>0.69 (0.91)</td>
<td>107</td>
<td>0.86 (1.12)</td>
<td>17.0%</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>263</td>
<td>228</td>
<td></td>
<td>100.0%</td>
<td>-0.18 [-0.29, -0.07]</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 1.78, df = 2 (P = 0.41); I^2 = 0.0$

Test for overall effect: $Z = 3.11 (P = 0.0019)$

Test for subgroup differences: Not applicable
Analysis 3.3. Comparison 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only, Outcome 3 Sore-throat days (including those immediately post-surgery).

Review: Tonsillectomy or adenotonsillectomy versus non-surgical treatment for chronic/recurrent acute tonsillitis

Comparison: 3 Combined tonsillectomy + adenotonsillectomy versus no surgery - moderately affected children only

Outcome: 3 Sore-throat days (including those immediately post-surgery)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Treatment</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
<td></td>
</tr>
<tr>
<td>Paradise 2002a</td>
<td>95 19.5 (14.5)</td>
<td>54 25 (21)</td>
<td>28.1 %</td>
<td>-5.50 [-11.81, 0.81]</td>
<td></td>
</tr>
<tr>
<td>Paradise 2002b</td>
<td>60 23 (20)</td>
<td>68 24 (17)</td>
<td>26.7 %</td>
<td>-1.00 [-7.48, 5.48]</td>
<td></td>
</tr>
<tr>
<td>van Staaij 2004</td>
<td>111 12.68 (9.5)</td>
<td>107 18.92 (24.59)</td>
<td>45.1 %</td>
<td>-6.24 [-11.22, -1.26]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>266</td>
<td>229</td>
<td>100.0 %</td>
<td>-4.63 [-7.98, -1.28]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi$^2$ = 1.68, df = 2 (P = 0.43); I$^2$ =0.0%
Test for overall effect: Z = 2.71 (P = 0.0067)
Test for subgroup differences: Not applicable

APPENDICES

Appendix 1. Search strategies
Paradise 2000

Summary

Editor’s note: These comments relate to the original (1999) version of the review.

In a recent Cochrane review (Burton 1999) critiquing our randomized clinical trial of tonsillectomy in severely affected children (Paradise 1984), Burton, Towler, and Glasziou concluded that “significant baseline differences (in the history of antecedent throat infections and in parents’ socioeconomic status) between the surgical and non-surgical groups and the inclusion of children who also underwent adenoidectomy prevent firm conclusions being drawn from the . . . trial.” However, the Burton review fails to take into account a number of study features and findings that argue strongly against the importance of these factors as potential invalidators of our trial results.

First, consider the large differences in key outcomes favoring surgical over control subjects: in the first follow-up year a 14-fold reduction in throat infection episodes rated as moderate or severe (3 episodes in 38 surgical subjects vs 41 episodes in 35 control subjects), and in the second follow-up year, a 6-fold reduction (5 episodes in 31 surgical subjects vs 30 episodes in 29 control subjects). Other outcome differences were less dramatic but consistently in the same direction and also significant statistically.

Second, as we reported, tests for interaction albeit their limited power showed no significant differences in treatment outcomes that were related to any of the three factors cited by Burton et al (i.e. history of antecedent episodes, socioeconomic status, and presence or absence of indications for adenoidectomy), nor were any of these factors related significantly to outcomes within the control group. Imbalances in factors that are not prognostic cannot fairly be considered sources of bias. Moreover, as we also reported, within each identifiable clinical and sociodemographic subgroup rates of throat infection were, without exception, lower for subjects treated surgically than for controls.

Third, consider the differences in antecedent history, which in any case may have been more apparent than real. Eligibility for our trial required a history of seven or more episodes of throat infection in the preceding year, five or more in each of the two preceding years. The selection of children with these histories was not random, but it was not biased in any way to favor the surgical group.

FEEDBACK

Paradise 2000

Summary

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In a recent Cochrane review (Burton 1999) critiquing our randomized clinical trial of tonsillectomy in severely affected children (Paradise 1984), Burton, Towler, and Glasziou concluded that “significant baseline differences (in the history of antecedent throat infections and in parents’ socioeconomic status) between the surgical and non-surgical groups and the inclusion of children who also underwent adenoidectomy prevent firm conclusions being drawn from the . . . trial.” However, the Burton review fails to take into account a number of study features and findings that argue strongly against the importance of these factors as potential invalidators of our trial results.

First, consider the large differences in key outcomes favoring surgical over control subjects: in the first follow-up year a 14-fold reduction in throat infection episodes rated as moderate or severe (3 episodes in 38 surgical subjects vs 41 episodes in 35 control subjects), and in the second follow-up year, a 6-fold reduction (5 episodes in 31 surgical subjects vs 30 episodes in 29 control subjects). Other outcome differences were less dramatic but consistently in the same direction and also significant statistically.

Second, as we reported, tests for interaction albeit their limited power showed no significant differences in treatment outcomes that were related to any of the three factors cited by Burton et al (i.e. history of antecedent episodes, socioeconomic status, and presence or absence of indications for adenoidectomy), nor were any of these factors related significantly to outcomes within the control group. Imbalances in factors that are not prognostic cannot fairly be considered sources of bias. Moreover, as we also reported, within each identifiable clinical and sociodemographic subgroup rates of throat infection were, without exception, lower for subjects treated surgically than for controls.

Third, consider the differences in antecedent history, which in any case may have been more apparent than real. Eligibility for our trial required a history of seven or more episodes of throat infection in the preceding year, five or more in each of the two preceding years. The selection of children with these histories was not random, but it was not biased in any way to favor the surgical group.
years, or three or more in each of the three preceding years. Not stated in our report were the facts that a number of children met more than one of these criteria and that such children were categorized as meeting the criterion involving the largest number of episodes. As chance would have it, more children in the surgical group than in the control group (20/43 vs 11/48) met the criterion of seven or more episodes in the preceding year. From this, Burton et al concluded that “the surgical group may therefore have included children with more severe disease,” or “alternatively, these may have been children with less severe, but more short-lived disease.” Setting aside for a moment that the analyses cited above argue against any prognostically important differences in disease severity, if the surgical group did indeed include children with more severe disease, the resulting bias would have favored control subjects rather than surgical subjects, in which case trial results would have understated, not overstated, the efficacy of surgery. Burton et al advance no rationale for their contrary, counterintuitive speculation that such children might actually have had less severe disease, but even if that had been the case the imbalance would hardly seem sufficient to account for the large differences in outcome.

Fourth, the difference in socioeconomic status referred to by Burton et al favored the control group rather than the surgical group. Again setting aside that the analyses cited above argued against the possibility that the difference was important prognostically, any resulting bias again might be expected to have favored control subjects, not surgical subjects.

In summary, to explain the large outcome differences we found favoring the surgical group on the basis of confounding would have required extreme imbalances between the surgical and control groups in variables that were strongly prognostic. In fact, however, not only were the variables of concern not apparently prognostic and their imbalances limited, but further, the expected effect of the imbalances would have been to favour the control group.

Finally, with regard to the adenoidectomy issue, Burton et al suggest that “Some part—potentially the greatest part—of the effect of ‘surgery’ could be due to removal of the adenoids.” On the contrary—and again apart from the analyses described above—the addition of adenoidectomy in a minority of the surgically treated subjects could certainly not have accounted for the fact that moderate and severe throat-infection episodes were also virtually eliminated in the majority of such subjects who underwent tonsillectomy only. We stand by our conclusion that in these severely affected children, tonsillectomy was unequivocally efficacious in reducing the occurrence of throat infection.

REFERENCES

Reply
Professor Paradise’s comments have been addressed in this updated (2008) version of the review.

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WHAT'S NEW

Last assessed as up-to-date: 10 April 2008.

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<th>Event</th>
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<tr>
<td>11 November 2008</td>
<td>New citation required and conclusions have changed</td>
<td>Review substantially updated following new searches in April 2008</td>
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HISTORY

Protocol first published: Issue 1, 1999

Review first published: Issue 3, 1999

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<th>Event</th>
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<td>11 April 2008</td>
<td>Amended</td>
<td>Converted to new review format.</td>
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<tr>
<td>14 December 1998</td>
<td>New citation required and conclusions have changed</td>
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CONTRIBUTIONS OF AUTHORS

MARTIN BURTON: protocol development, searching for trials, quality assessment of trials, data extraction, review development.

PAUL GLASZIOU: protocol and review development.

DECLARATIONS OF INTEREST

None known.

NOTES

The original protocol for this review was titled "Tonsillectomy versus non-surgical treatment for chronic / recurrent acute tonsillitis". The title was changed to include adeno-tonsillectomy when the first version of the full review was published. This reflected a change of scope which paralleled both day-to-day clinical practice and the interventions studied by the available studies. This is commented upon in the text of the review.

The significant differences between this version of the review (2008) and the previous one (1999) are highlighted in the text. These relate (a) to the inclusion in this version of the only study identified in the earlier version (Paradise 1984) which was at that time excluded, and (b) the identification and inclusion of several newer studies.
INDEX TERMS
Medical Subject Headings (MeSH)
*Adenoidectomy; *Tonsillectomy; Acute Disease; Chronic Disease; Pharyngitis [diagnosis]; Randomized Controlled Trials as Topic; Recurrence; Tonsillitis [surgery; *therapy]

MeSH check words
Adult; Child; Humans