The efficacy of surgical modifications of the upper airway in adults with obstructive sleep apnea syndrome

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Authors' objectives
To review the efficacy of surgical modifications of the upper airway in treating adults with obstructive sleep apnoea syndrome.

Searching
MEDLINE was searched from January 1966 to April 1993; the search was updated in February 1995. The MeSH terms included 'sleep apnea syndromes', 'snoring' and 'surgery'. Only publications in the English language were considered.

Study selection
Study designs of evaluations included in the review
Non-randomised concurrent cohort comparison between contemporaneous patients who did and did not have therapy, or case series without controls. No randomised controlled trials were found. At least nine patients were included in each study.

Specific interventions included in the review
Nasal septal reconstruction (septoplasty, turbinectomy, polypectomy or a combination of these procedures); uvulopalatopharyngoplasty (UPPP); laser midline glossectomy (LMG); uvulopalatopharyngoglossoplasty (UPPGP); lingualplasty; inferior sagittal mandibular osteotomy and genioglossal advancement with hyoid myotomy and suspension (GAHM); maxillomandibular osteotomy (MMO) and advancement; tracheotomy.

Participants included in the review
Adult patients aged older than 18 years. The mean age in the included studies was 48.1 years and, where reported (22 studies), 91% were male.

Outcomes assessed in the review
The primary outcome of interest appears to have been the change in the patient's apnoea index (AI) or respiratory disturbance index (RDI), calculated from pre-operative and post-operative measurements. Other outcomes were also reported, where they were given in individual studies.

How were decisions on the relevance of primary studies made?
It was not stated how the studies were selected for the initial screening. After the inclusion criteria had been applied, the remaining articles were reviewed by two of the authors.

Assessment of study quality
The authors do not state that they assessed validity.

Data extraction
Quantitative information was collected independently by the two authors who reviewed the included papers.

Methods of synthesis
How were the studies combined?
The data were presented as a narrative synthesis for all procedures but UPPP.
Papers on UPPP were analysed statistically, using the meta-analytic techniques of Rosenthal (see Other Publications of Related Interest) to combine p-values from different studies into an overall p-value. Where the p-values were not presented for the individual studies they were computed by the authors. The sample sizes in the individual studies were used to weight the meta-analysis.

Pearson's correlation coefficient, weighted by sample size, was used to combine aggregate data from the individual studies. Where studies reported individual patient data, these were found to be skewed and Spearman's correlation coefficients were used for this group.

How were differences between studies investigated?
Two-tailed paired Student's t tests or Wilcoxon's rank-sum test were used to examine the baseline characteristics of responders and nonresponders.

Results of the review
There were 37 studies (n=992) on UPPP, of which 29 (n=819) contained sufficient patient data to allow the response rate to be calculated, and 17 contained individual patient data. To this last group was added 2 publications, which were duplicates of studies in the other 2 groups, but which now contained individual patient data (n=345).

There was 1 study (n=20) of nasal operations.

There was 1 study (n=20) of UPPGP.

There were 2 studies (n=34) of LMG.

There was 1 summary of 9 studies (by the same authors) of GAHM (n=55), plus one further report (n=9) which was not included in the meta-analysis.

There were 4 studies (n=489) of MMO and advancement.

There were 3 studies (n=99) of tracheotomy.

Nasal operations: there were no significant differences between the baseline and post-operative values of RDI in the one study reviewed.

UPPP operations: changes in AI and RDI were highly significant (p<0.0001). The weighted Pearson correlation coefficient (20 of the 37 papers) between the mean baseline AI and percentage change in AI was 0.502 (p=0.024), suggesting that a high baseline AI was associated with a lower percentage decrease in AI. The correlation between the baseline RDI and the percentage change in RDI (18 papers) was 0.106.

The response rate was 65.8% (129 out of 196 patients) when defined as a 50% drop in AI.

The response rate was 52.8% (114 out of 216 patients) when defined as a 50% drop in RDI.

The response rate was 40.7% (137 out of 337 patients) when defined as a 50% drop in AI or RDI, with consequent achievement of an AI of less than 10 or an RDI of less than 20.

The Spearman's rank correlation coefficients showed that patients with high baseline AIs tended to have smaller percentage reductions in AI (n=196, correlation -0.202, p=0.005) and greater reductions in RDI (n=80, correlation 0.249, p=0.026).

Information on the location of pharyngeal narrowing or collapse, and complications of UPPP, was also reported.

UPPGP operations: there was a mean percentage decrease in RDI of 42.6% (no p-value given). Ten of the 20 patients had at least a 50% reduction in RDI.

A further 19 patients had a response rate of 67% at 6 months, when response was defined as a 50% reduction in AI.
LMG operations: the response rate was 41.7% (5 out of 12 patients) when defined as a 50% reduction in RDI.

Lingualplasty operations: the response rate was 77% (17 out of 22 patients) when defined as a post-operative RDI of less than 20 per minute and at least a 50% reduction from pre-operative RDI.

GAHM operations: only 6 out of 55 patients had GAHM alone; 49 out of 55 patients in this group had UPPP and GAHM, either synchronously or at different times.

The response rate was 67% (37 out of 55 patients) when defined as a combination of a post-operative RDI of 20 or less, at least a 50% reduction from pre-operative RDI and minimal oxygen desaturation.

MMO operations: the mean pre- and post-operative RDIs were 72.0 (plus or minus 25.8) and 8.8 (plus or minus 6.1), respectively (n=30).

In another study, the response rate was 61.1% (146 out of 239 patients) when defined as a RDI of less than 20 at 6 months, at least a 50% reduction from pre-operative RDI, and lowest oxygen saturation equivalent to that of a second night of continuous positive airway pressure titration. The likelihood of response tended to diminish with increasing pre-operative apnea severity.

In a third study, the response rate (defined as a RDI of less than 10 at 6 months) was 20% (1 out of 5 patients), rising to 77.8% (14 out of 18 patients) when at least one adjunctive procedure was used and 100% (7 out of 7 patients) when UPPP was used as an adjunct.

In a fourth study, the response rate was 95.2% (20 out of 21 patients) when defined as a post-operative RDI of less than 10.

Tracheotomy: in a series of 11 patients, excessive daytime sleepiness and sleep disruption were resolved in 9 of the patients; the mean follow-up was 17 months. The data on the AI or RDI were not given.

In a series of 50 patients (mean follow-up 32 months), all patients achieved an AI of less than 5; pre-operatively, all AIs were greater than 50.

In a third series of 38 patients, excessive daytime sleepiness was resolved in all patients within 48 hours post-operatively. No data were given on the AI or RDI values.

Authors' conclusions
UPPP is at best effective in treating less than 50% of patients with obstructive sleep apnoea syndrome. The site of pharyngeal narrowing or collapse, although identified by different and unvalidated methods, has a marked effect on the probability of success of UPPP. Patients who achieve a favourable response with UPPP tend to have less severe obstructive sleep apnoea than those who do not. For patients who demonstrate retrolingual narrowing or collapse, other surgical modifications have been described, such as lingualplasty, GAHM and MMO and advancement. The studies supporting the use of surgical treatment for obstructive sleep apnoea syndrome contain biases related to small sample size, limited follow-up and patient selection.

CRD commentary
The review was contained within an overview of the surgical treatment of obstructive sleep apnoea syndrome. Hence, some details of the studies and their results were difficult to pick out. Details of the thirty-seven papers on the UPPP procedure were tabulated, whereas details of the other procedures were not.

The literature search was restricted to English language publications, which may have resulted in some studies being missed. Different study designs were pooled together, which was inappropriate. In addition, there was no validity assessment with which to weight the UPPP meta-analysis (it was weighted by sample size).

A strength of this review was a section dedicated to discussing the weaknesses and limitations of the data.
No clear conclusions were drawn in the review.

**Bibliographic details**

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**Other publications of related interest**

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Subject indexing assigned by NLM

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