Surgically) 
Treating OSA in 2012 and Beyond 

Edward M. Weaver, MD, MPH 
Seattle VA Medical Center 
University of Washington 
Harborview Medical Center 

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Disclosures

• No industry disclosures
• Adult sleep apnea
• I am a surgeon
• Surgery concepts

Objectives

Discuss:
1. Definition of surgery
2. Approaches
3. Realistic expectations
4. Roles of surgery
Definition of Surgery

• Broad array of procedures, often
  – Combined
  – Staged
  – Anatomically & functionally directed
• NOT just isolated procedures

Sample of Nasal Surgeries

• Septoplasty
• Septum submucous resection
• Turbinate fracture
• Turbinate intramural cautery
• Turbinate submucous resection
• Turbinate excision
• Turbinate radiofrequency reduction
• Turbinate cryotherapy
• Turbinate sclerosis
• Concha bullosa reduction
• Nasal valve suspension
• Nasal valve stabilization
• Spreader grafts
• Park flaring suture susp
• Batten grafts
• Columellar strut graft
• Columellar reduction
• Other functional rhinoplasty procedures
• Polypectomy
Sample of UPPP Variations

- UPPP
- Uvulopalatal flap
- Z-palatoplasty
- Lateral palatopharyngoplasty
- Palatal advancement

- LAUP
- Cautery-assisted palatal stiffening op
- RF palate reduction
- Injection snoreplasty
- Palatal implants

Sample of Retrolingual Airway Surgeries

- Genioglossus advancement
- Hyoid suspension
- Midline glossectomy
- Lingualplasty
- SMILE

- Lingual tonsillectomy
- RF tongue reduction
- Tongue suspension
- Epiglottoplasty
- Mandibular sliding osteotomy
Sample of Global Airway Surgeries

- Maxillomandibular advancement
- Tracheotomy
- Bariatric surgery

Objectives

Discuss:
1. Definition of surgery
2. Approaches
Range of Approaches

- From minimally-invasive ...
  - Partial treatments
- ... to maximally aggressive
  - Definitive single-stage surgery
- Depends on surgeon and patient

Approaches

- Conservative
- Anatomic
- Functional
- Staged
Conservative Approach

• Do least surgery necessary
  – Often aggressive surgery necessary
• Discuss non-surgical therapies
  – Initially
  – Between surgical stages

Anatomic Approach

• Identify obstructing site(s)
• Anticipate secondary obstruction
• Tailor surgery to the anatomy
  – E.g., UPPP variations
Functional Approach

• Identify functional obstruction
  – Nasal valve collapse
  – Tongue collapse
• Preserve normal functions
  – Turbinate air conditioning
  – Swallowing

Staged Surgery

• Primary obstruction first (usually)
• Secondary obstructions
• Minimize risks
• Minimize surgery
• Improve recovery
• Improve outcomes
Staged Surgery

• Examples where I stage:
  – Separate nasal from pharyngeal procedures

Risk of Serious Complication with UPPP

<table>
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<th>Risk Factor</th>
<th>Adj OR</th>
<th>95%CI</th>
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<td>Any nasal proc</td>
<td>7.0</td>
<td>5.2-9.3</td>
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</table>

Weaver, OtoHNS 2004; 131:P55-6
Risk Factors for Serious Complication After Uvulopalatopharyngoplasty

Eric J. Kezirian, MD, MPH; Edward M. Weaver, MD, MPH; Bevan Yuch, MD, MPH; Shukri F. Khari, MD; Jennifer Daley, MD; William G. Henderson, PhD

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Adj OR</th>
<th>95%CI</th>
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<tr>
<td>Any nasal proc</td>
<td>0.88</td>
<td>0.50-1.55</td>
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</table>

Table 3
Kezirian, Arch OtoHNS 2006; 132:1091-8

Staged Surgery

• Examples where I stage:
  – Separate nasal from pharyngeal procedures
  – Separate advancements with competing forces
Competing Forces

Genioglossus Adv  Maxillomandibular Adv
Objectives

Discuss:
1. Define surgical treatment
2. Approaches
3. Realistic expectations

Realistic Expectations

• History of unrealistic expectations
  – Surgery “cures” OSA
  – Surgery “does nothing” for OSA
Realistic Expectations

• Surgery rarely cures OSA
• Surgery poses risks
• Surgery often a prolonged process
• Surgery is often 2\textsuperscript{nd} line treatment

However…

Realistic Expectations

• Surgery helps
• Patients often happy with surgery
  – When they have realistic goals
  – Especially when other options exhausted
Objectives

Discuss:
1. Define surgical treatment
2. Approaches
3. Realistic expectations
4. Roles of surgery

Non-Surgical Therapies
Often Tried First
Roles of Surgery

- Adjunct to non-surgical therapy
  - Objective: improve effectiveness
- Salvage non-surgical failures
  - Objective: improve clinical outcomes
- When should surgery be used?

Vignette

- 38 year old man
- Profound OSA
  - Cor pulmonale
  - Motivated to use CPAP but unable
- Surgery consultation
Nasopharyngoscopy

Obstructing Adenoid
Adenoidectomy

Radiofrequency Treatment of Turbinate Hypertrophy in Subjects Using Continuous Positive Airway Pressure: A Randomized, Double-Blind, Placebo-Controlled Clinical Pilot Trial

Method: 22 met inclusion criteria

\[ \text{R} \]

Sham n=5  RF n=17

Powell, Laryngoscope 2001; 111:1783-90
RF Turbinate Reduction

From Tables IV - VI
Powell, Laryngoscope 2001; 111:1783-90
Turbinate Reduction and CPAP Use: A Randomized Blinded OSA Trial

Baseline ➔ Turbinate Reduction ➔ ↑ Nasal Airway ➔ ↑ CPAP Use ➔ ↑ Quality of Life

Aim 1 ➔ Aim 2 ➔ Aim 3

ClinicalTrials.gov
NCT 00503802
Upper airway surgery: the effect on nasal continuous positive airway pressure titration on obstructive sleep apnea patients

Figure 1
Zonato, Eur Arch ORL 2006;263:481-6

Impact of Upper Airway Surgery on CPAP Compliance in Difficult-to-Manage Obstructive Sleep Apnea

Figure 2
Chandrashekariah, Arch OtoHNS 2008; 134:926-30
Turbinate Reduction and OA Use: A Randomized Blinded OSA Trial

Influence of Nasal Resistance on Oral Appliance Treatment Outcome in Obstructive Sleep Apnea

Zeng, M.D., Ph.D.; Andrew T. Ng, M.B.B.S.; Jin Qian, M.B.B.S.; Peter Petocz, Ph.D.; M. Ali Darendelker, Ph.D.; Peter A. Costello, M.B.B.S., Ph.D.
Roles of Surgery

• Adjunct to non-surgical therapy
  – Objective: improve effectiveness
• Salvage non-surgical failures
  – Objective: improve clinical outcomes
• When should surgery be used?

Surgery
&
Death
Mortality in severe sleep apnoea/hypopnoea syndrome patients: impact of treatment


ABSTRACT: The aim of this study was to determine mortality in patients with sleep apnoea/hypopnoea syndrome (SAHS) according to the treatments employed and compliance.

An historical cohort of patients with SAHS diagnosed at a university hospital between 1982 and 1992 and followed until 1996 was studied. From a total of 475 SAHS patients, 444 (94%) with a mean 230 apnoea/hypopnoea index at diagnosis of 55±27, were located and included in the study. SAHS treatments employed were surgery (86), weight loss (134), continuous positive airway pressure (124) and 98 patients were not treated.

By the end of follow-up, 49 patients had died. According to Cox regression analysis, mortality in treated patients was lower than in those not treated, but higher in those with a history of severe chronic obstructive pulmonary disease. Mortality in untreated patients compared with that of the general population, adjusted for age and sex, showed excess relative mortality, which decreased in treated patients. Stratification by age showed a greater mortality rate ratio in patients <50 yrs. These findings were maintained when mortality from cardiovascular causes was compared.

In conclusion, a rise in mortality was found in untreated sleep apnoea/hypopnoea syndrome patients compared with the general population, whereas mortality in those treated for sleep apnoea/hypopnoea syndrome did not differ significantly from that of the general population.


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**OSA Survival**

![OSA Survival Graph](image)

**Figure 1**
From Table 4
Marti, Eur Resp J 2002;20:1511-18

*Adjusted for age, sex, smoking, BMI, AHI, AHT, CHD, COPD.
Upper airway reconstructive surgery long-term quality-of-life outcomes compared with CPAP for adult obstructive sleep apnea

Sam Robinson, MB, FRACS, Michael Chia, MB, FRACP, A. Simon Carney, MB, ChB, MD, FRACS, Sharad Chawla, MB, MS, Penelope Harris, BSc, and Adrian Esterman, PhD, MSc, BSc, Adelaide, Australia

OBJECTIVE: To measure long-term quality-of-life (QOL) improvement following contemporary multilevel upper airway reconstruction surgery, compared with continuous positive airway pressure (CPAP) therapy. Secondary aims were to investigate factors determining clinical effectiveness and QOL impact of reported side effects.

DESIGN: Cohort study.

SETTING AND PARTICIPANTS: Consecutive, multidisciplinary treated adult patients with moderate-severe obstructive sleep apnea (OSA) having upper airway surgery (N = 77) or CPAP (N ≈ 89) therapy were studied by questionnaire: Glasgow Benefit Inventory (GBI), change in scoring status and Epworth Sleepiness Scale (ESS), subjective CPAP compliance, and side effects in both groups were measured at mean ± SEM 44.12 ± 5.78 months (3.68 ± 0.48 years) after commencement of therapy.

RESULTS: No significant difference was seen between surgical outcomes for GBI scoring, or ESS and CPAP controls. Multivariate analysis showed reduction in Respiratory Disturbance Index (RDI) predicted postoperative scoring and ESS, but not GBI outcomes. Snoring control and GBI were related to CPAP compliance (P < 0.001). CPAP side effects (reported in 20%) significantly reduced the GBI benefit of treatment independent of compliance. Surgical complications (occurring in 44%) did not affect QOL treatment benefit.

CONCLUSION: Patients with poor CPAP compliance and/or significant side effects of CPAP therapy (45% of cases in this series) should be evaluated for contemporary upper airway reconstructive surgery.

Quality of Life

![Quality of Life Chart]

Robinson, OtoHNS 2009;141:257-63
Symptoms

Surgery Improves Clinical Outcomes

- Death risk
- Cardiovascular risk
- Accident risk
- Reaction time
- Quality of life
- Symptoms

Robinson, OtoHNS 2009;141:257-63
Surgery Salvage

Surgery is better than:
• Nothing
• Partial CPAP use

How Much Is Too Little CPAP?

When Should We Consider Surgery?
Roles of Surgery

- Adjunct to non-surgical therapy
  - Objective: improve effectiveness
- Salvage non-surgical failures
  - Objective: improve clinical outcomes
- When should surgery be used?

Mortality of Veterans with Sleep Apnea: Untreated versus Treated

Weaver EM,1,4,5,2 Maynard C,3,3,6 Yueh B1,2,4,6

- UPPP = 3,977
- CPAP = 28,612
- No Tx = 116,678

Level 2
Weaver, Sleep 2004;27:A208
**Mortality of Veterans with Sleep Apnea: Untreated versus Treated**

*Weaver EM,1,4,5,7 Maynard C,3,2,6 Yueh B1,2,4,6*

![Graph showing adjusted hazard ratio of death for CPAP vs UPPP](image)

- **Adjusted* Hazard Ratio of Death**
  - CPAP (N=28,612): 1.00
  - UPPP (N=3,977): 0.57
  - P < 0.01

*Adjusted for age, sex, race, comorbidity, inception year.

**Problem Inadequate use and imperfect titration not accounted in CPAP outcomes.**

**Solution:** Formulas developed to calculate mean nightly AHI while accounting for baseline AHI, titrated AHI, and use.

**May allow more legitimate AHI comparison between CPAP and surgery.**

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**CALCULATION OF SURGICAL AND NON-SURGICAL EFFICACY FOR OSA**

*Reliable Calculation of the Efficacy of Non-Surgical and Surgical Treatment of Obstructive Sleep Apnea Revisited*

M.J.J. Ravesloot, MD, N. de Vries, MD, PhD

- Problem: Inadequate use and imperfect titration not accounted in CPAP outcomes.
- Solution: Formulas developed to calculate mean nightly AHI while accounting for baseline AHI, titrated AHI, and use.
- May allow more legitimate AHI comparison between CPAP and surgery.
Minimum CPAP use to achieve mean AHI <5 (CURE).

Required CPAP use:
- Baseline AHI = 15 requires 67% TST use
- Baseline AHI = 30 requires 83% TST use
Minimum CPAP use to achieve mean AHI drop 50% and AHI<20 (SUCCESS).

Ravesloot, Sleep 2011;34:105-10

Studying Life Effects & Effectiveness of Palatopharyngoplasty (SLEEP) Study: Subjective Outcomes of Isolated Uvulopalatopharyngoplasty

Edward M. Weaver, MD, MPH, B. Tucker Woodson, MD, Bevan Yuen, MD, MPH, Timothy Smith, MD, MPH, Michael G. Stewart, MD, MPH, Maureen Hantley, PhD, Kristine Schulz, MPH, Miles M. Patel, MS, David Witsell, MD, MHS, and the SLEEP Study Investigators

Objective. To test the hypothesis that uvulopalatopharyngoplasty (UPPP) improves sleep apnea-related quality of life (measured on the Functional Outcomes of Sleep Questionnaire [FOSQ]) at 3-weeks follow-up. Secondary objectives were to test (i) the stability of the outcomes at 6 months, (ii) the effect on global sleep quality-of-life changes, and (iii) the effect on sleep apnea symptoms.

Study Design. Multicenter, prospective, longitudinal case series.

Setting. Diverse university- and community-based otolaryngology practices.

Subjects and Methods. The cohort included 68 patients from 17 practices, with a mean ± standard deviation age of 44 ± 12 years and mean apnea-hypopnea index of 35 ± 32 events/hour. All patients underwent UPPP, defined as an open procedure modifying the shape and size of the palate, pharynx, and uvula, with or without tonsillectemy. Baseline data were collected on site before surgery, and outcome data were collected by mail 3 and 6 months after surgery with follow-up rates of 91% and 50%, respectively.

Results. FOSQ scores improved from 14.3 ± 3.4 (scale 0-20, normal = 17.9) at baseline to 17.7 ± 7.7 or 3 months (mean improvement 2.6; 95% confidence interval, 1.8-4.0; P < .001) and 17.5 ± 2.5 at 6 months (mean improvement 3.3; 95% confidence interval, 2.6-4.2; P < .001). All quality-of-life and symptom measures improved significantly at 3 and 6 months (all P < .05).

Conclusion. This prospective, multicenter, university- and community-based study provides evidence that UPPP significantly improves disease-specific quality of life and sleep apnea symptoms in patients with sleep apnea. Validity may be limited.

Weaver EM, OtoHNS 2011;144:623-31
Relationship Between Hours of CPAP Use and Achieving Normal Levels of Sleepiness and Daily Functioning

Terry E. Weaver, FNP, BSN, FAAN*, Greg Marin, MS, MA**, David Dinges, PhD*, Thomas Slouka, MD, Charles P. George, MD, Harly Greenberg, MD; Gihan Kadir, MD; Mark Mohabadi, MD; Joel Younger, MD; Allen I. Pach, MD, PhD#

*Biobehavioral and Health Sciences Division, School of Nursing, University of Pennsylvania, Philadelphia, PA; **Division of Sleep Medicine, Department of Medicine, School of Medicine, University of Pennsylvania, Philadelphia, PA; ***Center for Sleep and Respiratory Neurology, School of Medicine, University of Pennsylvania, Philadelphia, PA; Department of Sleep and Chronobiology, Department of Psychiatry, School of Medicine, University of Pennsylvania, Philadelphia, PA; Sleep Medicine Center of Kansas Westside, University of Western Ontario, London, Ontario, Canada; North Shore-Long Island Jewish Health System, New Hyde Park, NY; St. Luke’s Hospital, Chesterfield, MO; Hennepin County Medical Center, Minneapolis, MN.

Study Objectives: Evidence suggests that, to maintain treatment effects, noncontinuous positive airway pressure (CPAP) therapy for obstructive sleep apnea (OSA) needs to be used every night. What remains unknown is the nightly duration of use required to normalize functioning. This study, employing probit analysis and nonparametric regression to estimate dose-response functions, estimated likelihoods of return to normal levels of sleepiness and daily functioning relative to nightly duration of CPAP.

Design: Multicenter, quasi-experimental study.

Setting: Seven sleep centers in the United States and Canada.

Participants: Patients with severe OSA (total cohort n = 146), the numbers of included participants from 85–100, depending on outcome analyzed.

Interventions: CPAP.

Measurements and Results: Before treatment and again after 3 months of therapy, participants completed a day trialing that included measures of objective and subjective daytime sleepiness and functional status. There were significant differences in mean nightly CPAP duration between treatment responders and nonresponders across outcomes. Thresholds above which further improvements were less likely relative nightly duration of CPAP were identified for Epworth Sleepiness Scale score (4 hours). Multiple Sleep Latency Test (6 hours), and Functional Outcomes associated with Sleepiness Questionnaire (6.5 hours). A linear dose-response relationship (6–9.0) between increased use and achieving normal levels was shown for objective and subjective daytime sleepiness, but only up to 7 hours use for functional status.

Conclusions: Our analyses suggest that a greater percentage of patients will achieve normal functioning with longer nightly CPAP durations, but what combination adequate use varies between different outcomes.

Keywords: Obstructive sleep apnea, dose response, nightly duration, daytime sleepiness, quality of life, CPAP, adherence, daily functioning, sleepiness.

Citations: Weaver TE, Marin G, Dinges DF et al. Relationship between hours of CPAP use and achieving normal levels of sleepiness and daily functioning. SLEEP 2007;30(9):711-719.

Weaver TE, Sleep 2007;30:711-9
CPAP: Quality of Life

Weaver TE, Sleep 2007;30:711-9

Quality of Life – UPPP v CPAP

Weaver EM, OtoHNS 2011;144:623-31

UPPP Baseline FOSQ 13.8±3.2
CPAP Baseline FOSQ 13.8±2.6
UPPP ≡ CPAP 2-4h
Sleepiness – UPPP v CPAP

<table>
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<tr>
<th></th>
<th>UPPP</th>
<th>CPAP 0-2h</th>
<th>CPAP 2-4h</th>
<th>CPAP 4-5h</th>
<th>CPAP 5-6h</th>
<th>CPAP 6-7h</th>
<th>CPAP 7+ h/nt</th>
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<tr>
<td>ESS</td>
<td>15.9±3.0</td>
<td>16.7±3.3</td>
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UPPP Baseline ESS 15.9±3.0
CPAP Baseline ESS 16.7±3.3
UPPP ≥ CPAP 4-5h or more

Weaver EM, OtoHNS 2011;144:623-31
Weaver TE, Sleep 2007;30:711-9

UPPP v CPAP Use

- UPPP ≥ CPAP 2-4h FOSQ
- UPPP ≥ CPAP 4-5h ESS
- Note: UPPP is a single-level, PARTIAL surgical treatment
How Often Is Surgery Used?

225,000,000 adults (20+ yrs)
34,000,000 adult OSA (15%)
7,000,000 adult OSAS (3%)
2,500,000 PSGs (2007)
1,000,000 CPAP (2007, $1B)
350,000 CPAP failures (2007, est.)
35,000 OSA Surgery (2006, Kezirian)

Surgery Under-Utilized

- Surgery in 3.5% of CPAP pts
- Surgery in 1.4% of PSGs
- Surgery in 0.5% of OSAS patients

- Opportunity to improve OSAS outcomes by considering surgery in CPAP failures (or in inadequate CPAP users).
Roles of Surgery

• Adjunct to non-surgical therapy
  – Objective: improve effectiveness
• Salvage non-surgical failures
  – Objective: improve clinical outcomes
• When should surgery be used?
  – Inadequate CPAP use, tolerance, effect

Objectives

Discuss:
1. Definition of surgery
2. Approaches
3. Realistic expectations
4. Roles of surgery
REFERENCES


