Surgical Options for OSA

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Objectives:
• Discuss surgical options for the treatment of OSA
• Describe the expectation for surgical management
• Review a patient-centered team approach in management of patients failing PAP therapy
Maxillofacial Surgery and OSAS

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Oral & Facial
Reconstructive Surgeons
of Utah
Introduction

• OSA is a national public health problem

• Prevalence
  • >4% males, >2% females
  • Causing excessive daytime somnolence (EDS)
  • Causing other medical symptoms or problems

  • 13 million + males, 6 million + females
  • > $30 billion spent per year in US

• Multiple treatment modalities
• Positive-airway pressure remains gold standard
• ? What to do for those patients who fail PAP
Introduction

- Alternative treatments for PAP failures
  - Medical management
  - Oral Appliance Therapy
  - Weight loss (nonsurgical/surgical)
  - Tracheostomy
  - Nasal surgery (septoplasty/turbinoplasty, RFA)
  - Palatal surgery (UPPP, LAUP, RFA, stiffeners)
  - Tonsillectomy/adenoidectomy
  - Tongue surgery (suspension, reduction, RFA)
  - Tongue base surgery (excision)
  - Hyoid surgery (advancement/suspension)
  - Genial surgery (GGA, IBO)
  - Orthognathic surgery (traditional/MMA)
Objectives

• Review of disease

• Surgical Options

• Emphasize patient-centered, team-oriented approach to management of patients failing PAP

• Maximize value of treatment (Value = outcome/cost)
MD diagnosis

Medical Treatment

CPAP

OAT

Surgical Treatment

ENT ↔ OMS

Sleep MD

Patient-centered
Site-specific
Evidenced-based
Treatment Plan
Genial Surgery

- Genioglossus advancement
  - Variety of techniques - rectangular window, trephine technique
    - Rarely performed alone today (most have UPPP or other procedure)
  - Riley 1989 55 patients
    - All but 7 had UPPP at same time as GGA
    - Response rate 67% - success = red’ n RDI >50% and <20
    - Those who responded average RDI decreased from 59 to 12
      - Non-responders tended to be obese or those with mandibular deficiency
    - Complications –wound infections, incisor root injury 4%

Genial Surgery
Genial Surgery

After

Wider airway at base of tongue

Bone fragment with attached tongue tendon pulled through lower jaw
Genial Surgery

- Genioglossus advancement
  - Miller et al 2004
  - 35 consecutive pts UPPP with GGA (GBAT system)
    - 24 pts completed study with postop PSG
    - 67% success rate – postop RDI <20 and >50% red’ n

Genial Surgery

• Genioplasty
  • Important to distinguish between traditional genioplasty (IBO) and procedures that actually suspend the GG muscle such as mortised genioplasty
  • Hendler et al 2003
    • 33 patients had mortised genioplasty concurrent with UPPP
    • Mean BMI 33
    • Mean preop RDI 60, mean postop RDI 29
    • Success def’ n postop RDI <20, >50%
    • 10/14 pts with RDI <50 success
    • 6/19 pts with RDI >50 success
    • Success rate 63% BMI <30, 43% if BMI >30

Genial surgery

- Santos-Junior et al 2007
  - Standard inferior border osteotomy/genioplasty +/- UPPP
  - 10 patients chosen based on AHI <30, BMI <30
    - All patients had clear mandibular retrognathia
  - Had genioplasty +/- UPPP
  - Average preop AHI 12, avg postop AHI 4
  - 7/10 achieved success - def’ n >50% red’ n preop AHI

Orthognathic Surgery

- MMA
- Mandibular advancement
Orthognathic Surgery

• Maxillomandibular Advancement
  • Can be combined with other modalities of treatment including UPPP and intranasal surgery
  • Used as a salvage procedure in those patients who fail initial procedures
  • Isolated procedure
Maxillomandibular Advancement (MMA)

- Has effects at all pharyngeal levels
  - Nasopharynx
  - Oropharynx
  - Hypopharynx
Maxillomandibular Advancement (MMA)

- Has effects at all pharyngeal levels
  - **Nasopharynx**
    - Septoplasty
    - Removal of septal spurs
    - Inferior turbinectomy
    - Removal of bone at pyriform apertures, maxillary rostrum, posterior nasopharynx
  - **Oropharynx**
  - **Hypopharynx**
Maxillomandibular Advancement (MMA)

• Has effects at all pharyngeal levels
  • Nasopharynx
  • Oropharynx
    • Advances maxilla anteriorly - pulls soft palate up and out of airway
    • Enlarges area posterior and above junction of soft palate and posterior pharyngeal wall
    • Creates tension in connections between the maxilla and lateral pharyngeal soft tissues
  • Hypopharynx
Maxillomandibular Advancement (MMA)

- Has effects at all pharyngeal levels
  - Nasopharynx
  - Oropharynx
  - Hypopharynx
     - Advances insertions of tongue musculature
       - Genioglossus, geniohyoid
     - Creates tension in lateral pharyngeal sidewalls, stylohyoid, digastric muscles
     - Enlarges retroglossal airway
MMA - Diagnostic Workup

- CC, HPI, PMHx, PSHx…
- Review of PSG, Sleep Medicine workup
- Careful review of previous interventions
  - Non-surgical
  - Surgical
- Complete head and neck examination
- Airway anatomy
  - Nasal cavity, nasopharynx
  - Oral cavity, oropharynx
  - Hypopharynx, hyoid position
- Bony anatomy/facial proportions
MMA - Diagnostic Workup

- Flexible fiberoptic nasopharyngoscopy
  - Müller’s maneuver
  - Fujita Classification

- Cephalometric Radiography
  - Standardized lateral skull plain film
  - Standardized skeletal landmarks
  - Can be compared to anthropometric standards

- Helical CT with volumetric evaluation

- MRI???

- Overall goal is to localize the site(s) of anatomic airway obstruction

Diagnosis

- Flexible Fiberoptic Nasopharyngoscopy
- Müller’s Maneuver
  - Supine and Upright positions

Mueller’s maneuver: Fiberoptic endoscope positioned just above (L) and below (R) oropharyngeal inlet.
Fujita Upper airway anatomy classification
Fujita Upper airway anatomy classification
Fujita Upper airway anatomy classification
Bony Anatomy
Facial Proportions

Facial Proportions

Rules-of-Thumb
Bony Anatomy
Facial Proportions

Profile Analysis

Class III Dental
Concave

Class I Dental
Orthognathic

Class II Dental
Convex

Angle of Convexity
Cephalometric Analysis

- Common findings include:
  - Retro-positioned maxilla
  - Retro-positioned mandible
  - Short mandibular length
  - Narrow posterior airway
  - Large tongue and long soft palate length
  - Inferiorly-positioned hyoid

- Many obese OSAS patients have normal cephalometric indices

- 2 films taken:
  - Retruded mandible
  - End-to-end incisor position

<table>
<thead>
<tr>
<th></th>
<th>Posterior airway space</th>
<th>Narrow in OSA 17+/- 6mm</th>
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<tbody>
<tr>
<td>S-N</td>
<td>Cranial base length</td>
<td>Decr in OSA 75 +/- 3 mm</td>
</tr>
<tr>
<td>S-N-A</td>
<td>Maxillary Position</td>
<td>Decr in OSA 83 +/- 4º</td>
</tr>
<tr>
<td>S-N-B</td>
<td>Mandibular Position</td>
<td>Decr in OSA 80 +/- 4º</td>
</tr>
<tr>
<td>N-S-Ba</td>
<td>Cranial base angle</td>
<td>Acute in OSA 129 +/- 5º</td>
</tr>
<tr>
<td>PNS-P</td>
<td>Soft palate length</td>
<td>Incr in OSA 42 +/- 5 mm</td>
</tr>
<tr>
<td>MPH</td>
<td>Mand Plane to Hyoid</td>
<td>Inferior position in OSA 17 +/- 6 mm</td>
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</tbody>
</table>
3D Airway Analysis

Total Volume: 26.2cc
Min Area: 237.9mm²

Total Volume: 18.3cc
Min Area: 116.7mm²
3D Airway Analysis
3D Airway Analysis
3D Airway Analysis
3D Airway Analysis
Treatment options in OSA

• Limitations of some of the previous procedures have led to the development of multi-level pharyngeal reconstructive protocols, carrying overall success rates of around 95%
  • RDI < 20
  • > 50% Reduction in RDI from pre-op study
  • LSaO₂ > 90
  • Normal sleep architecture
  • Subjective improvement

• Riley-Powell Stanford Surgical Protocol has two phases of airway reconstruction
Definition of Success

• Why are rates of success not based on outcomes of AHI < 5 and or < 10?

• Acceptable nCPAP compliance standard:
  • 4 hours use per night
  • 70% of the nights

• What is the goal of treatment?
  • Improve or control the symptoms and risk of OSA by decreasing severity.

Maxillomandibular Advancement

• Systematic Review & Meta Analysis
  • 53 reports including 22 unique patient populations
  • 627 Adults met the inclusion criteria
  • Results:
    • Mean AHI decreased from 63.9/h to 9.5/h
    • Pooled surgical success = 86.0%
    • Cure rate (AHI <5) = 43.2%
  • Predictors of Success
    • Younger age
    • Lower pre-op weight and AHI
    • Greater degree of maxillary advancement

Riley-Powell
Stanford Surgical Protocol

Presurgical Evaluation
Hx, PE, Ceph Analysis, Nasopharyngoscopy

Phase I Treatment

Type I
Palatal obstruction
UPPP

Type II
Palatal + Tongue base obstruction
UPPP + Tongue base procedure

Type III
Tongue base obstruction
Tongue base procedure

Post-procedure Polysomnogram
at 6 months

Maxillomandibular Advancement

Phase II Treatment for failures
## Phase I Surgical Results
### Comparing Disease Severity

<table>
<thead>
<tr>
<th>OSA Severity</th>
<th>#Successful/Total Pts</th>
<th>Success rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>20/26</td>
<td>77%</td>
</tr>
<tr>
<td>RDI&lt;20 LSAT&gt;85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>45/58</td>
<td>78%</td>
</tr>
<tr>
<td>RDI 20-40 LSAT&gt;80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate-Severe</td>
<td>36/51</td>
<td>71%</td>
</tr>
<tr>
<td>RDI 40-60 LSAT&gt;70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>44/104</td>
<td>42%</td>
</tr>
<tr>
<td>RDI&gt;60 LSAT&lt;70</td>
<td></td>
<td></td>
</tr>
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## Phase II Surgical Results (MMA)

<table>
<thead>
<tr>
<th>Surgical Group</th>
<th>#Successful/Total Pts</th>
<th>Success rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed Phase I Therapy</td>
<td>83/86</td>
<td>97%</td>
</tr>
<tr>
<td>Not treated with Phase I Therapy due to presence of Skeletal Deformity</td>
<td>10/11</td>
<td>91%</td>
</tr>
</tbody>
</table>

**Success = RDI<15, LSAT>90**

Maxillomandibular Advancement

• Efficacy
  • Isolated procedure - 80-90% success rate
  • Salvage procedure in failed cases - 90-95%

Goh YH et al.  Modified MMA for treatment of OSA.  Laryngoscope 2003 Sep;113(9):1577-82.
Costella BJ et al.  The role of maxillofacial osteotomies in the treatment of OSA.  Curr Opin
Gilon Y et al.  Surgical Management of MMA in Sleep Apnea Patients  Int J Adult Orthodon
Prinsell JR.  MMA surgery in a site-specific treatment approach for OSA.
Can MMA be used as an isolated treatment?

- MMA can be done prior to UPPP
- Opening airway with MMA likely to lessen risk of airway compromise during subsequent UPPP
- UPPP should not be done concurrent with MMA unless temporary tracheostomy done
- If MMA works, patient may not need UPPP
- Debate continues
  - ?? Which approach is better tolerated by patients
  - ?? Which approach is most cost effective
Patient Perceptions of MMA/Genioplasty

- Two distinct groups of OSAS patients
  - Obese with relatively normal cephalometric parameters
  - Non-obese with abnormal parameters - “facial deformity patients”

- Non-obese patients predictably have good functional as well as excellent esthetic results
  - More like “routine” facial deformity population
Patient Perceptions of MMA/Genioplasty

- Obese OSAS patients also seem to tolerate this procedure very well
  - 56% reported favorable changes
  - 33% reported neutral changes

- 89% favorable or neutral change in appearance

- Facial morphology seems to “absorb” an alteration in bony position very well, despite the fact that they no longer have “normal” skeletal relationships based on population studies

Summary

• OSAS associated with significant long-term morbidity and decreased life expectancy
• Variety of medical and surgical modalities available to successfully manage
• Careful pre-treatment evaluation allows logical approach to therapy
• Knowledge of risks allows safer treatment
• Multi-level surgical reconstruction of the airway today provides 95% chance of long-lasting success
• Team approach to management critical
Putting it all together

Powell’s pearl “the algorithm”
The question I am most often asked by my patients, or while teaching residents, visitors or travelling is, what is your algorithm for the treatment of OSAS? From the surgical standpoint the answer is that there is no such algorithm that can be applied to all patients. It is almost impossible to state, even in an individual patient, because of the multifactorial etiologies in this syndrome. This is one of the reasons a systematic diagnostic and phased protocol is applied at our sleep center, but this does not suggest an algorithm that would serve all patients. The question will continue to be asked until our field gains sufficient knowledge and understanding of sleep to permit a reliable and consistent answer.

Contemporary Surgery for Obstructive Sleep Apnea Syndrome

Nelson B. Powell, MD

Adjunct Clinical Professor, Department of Otolaryngology Head and Neck Surgery, Department of Psychiatry and Behavioral Science, Stanford University Sleep and Research Center, Stanford University School of Medicine, Palo Alto, USA
Thank You
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