Sleep Apnea from an Anatomical, Anthropologic and Developmental Perspective.

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Warning

Some pictures in this presentation are of cadaver dissections and one surgery case that may not be suitable viewing for some people.
Anatomical Characteristics of Obstructive Sleep Apnea (OSA) and Sleep Disordered Breathing (SDB).
Morphometric formula


This is one of the most important formulas in the medical field today.

Challenge – Can the research be duplicated?
Stanford Morphometric Model

\[ P + (Mx - Mn) = 3 \times OJ + 3 \times (BMI - 25) \times \left(\frac{NC}{BMI}\right) \]

- \( P = \text{palatal height} \)
- \( Mx = \text{maxillary intermolar distance} \)
- \( Mn = \text{mandibular intermolar distance} \)
- \( OJ = \text{overjet} \)
- \( NC = \text{neck circumference} \)
- \( BMI = \text{body mass index} \)

“Model has clinical utility and predictive values for patients with suspected obstructive sleep apnea”
Summarizing formula

Anyone with a high palate, narrow dental arches, overjet, large neck and/or large body mass is at risk for sleep apnea. If the individual does not have a large neck size or body mass, the predictive value of the formula is based on the height of the palate, arch wide and overjet.
A7  Class I occlusion - Arrows indicate proper alignment.
Class II - retrognathic malocclusion.
A retruded mandible can drive tongue back into throat and can block off airway. A retruded tongue can also elevate the soft palate which in turn can block off the airway and eustachian tubes.

Black arrow shows insertion point of tongue into lingual(tongue) side of mandible (lower jaw).
Herbst appliance in the mouth for treatment for OSA.
Permanent Herbst appliance - age 11 1/2 years
Patient with OSA who exhibits features of the formula.

Note large 20 inch neck size.
Note large body mass and large neck - both risk factors for OSA.

Chin strap is used to try to keep mouth closed while sleeping.
Overjet - Risk for OSA as per Morphometric Model
Overjet as seen from inferior view.
Patient has high palate and narrow arch.
Compromised oropharynx - too high of a risk for surgery.
Added problem is that he has a large tongue.
Elastics aid in keeping mouth closed.
Neck size and BMI

A neck size over 16 inches and/or a body mass index (BMI) over 25 puts an individual at risk for sleep apnea.
Calculating Body Mass Index (BMI)

\[ \text{BMI} = \frac{\text{Weight in lbs.} \times 704}{\text{height in inches}} \]

Ranges for BMI

- **Normal** - 18.5 - 24.9
- **Overweight** - 25.0 - 29.9
- **Obese** - 30.0 - 39.9
- **Extremely obese** - > 40
Upper and lower models of an adult demonstrating a high palate and narrow upper dental arch. Tongue force has created wide lower arch. See next slide.
Patient’s left side is in crossbite.
Models in crossbite - indicates a high palate and narrow arch.
Example of a high palate and narrow arch. This person is at high risk for having OSA.
A27  Example of a high palate and narrow arch.
Ideal “U” shaped arch and nice palate form of breastfed individual.

Collapsed “V” shaped arch and high palate of bottle-fed individual who was also a thumb sucker. Note 1st bicuspids are missing.
Rapid palatal expansion – one method of expanding arch.

Studied 10 young adults: mean age 27±2 years.

Age range: 14 - 37

Expansion: 12.1±1.5 mm over 24±2 days

Significant reduction in AHI - 19 ±4 vs 7 ±4.

**Challenge:** Surgical assistance was required in 6 of the 10 patients – especially needed after the age of 25.
There is growing consensus that upper airway obstruction is a causative factor in nocturnal enuresis. In the 10 cases examined in this study, nocturnal enuresis ceased within a few months of maxillary expansion. Snoring was associated with all cases.


Treatment of persistent, long-standing bed wetting problem in a 12-year-old boy with a skeletal II facial pattern was successfully treated by mandibular advancement.

Research suggests that enuresis is most prevalent in the US with as many as 8% of boys and 4% of girls still enuretic at age 12.

Christopher J. Robertson, Treatment of Long-Standing Nocturnal Enuresis by Mandibular Advancement. Sleep and Breathing, 2004; 8(1):57-60. (NZ)
Other factors

Other anatomical factors that may contribute to OSA not covered by the morphometric formula.
Tongue activity and OSA

Genetics and Craniofacial Dysmorphism in Family Studies of OSA

Paper presented by Dr. Clete Kushida, - June 1996, APSS Conference, Washington, DC.

Looking for genetic markers that may be a result of inherited factors such as abnormal tongue motor activity.
Tongue activity and OSA

“Apnea patients demonstrated greater genioglossal and tensor palatini EMG activity than did controls during wakefulness.”

Another patient with high palate and narrow arch.
Significant overjet.
Patient has overjet - inferior view.
This ‘abnormal tongue activity’ is what I generically refer to as a ‘tongue thrust’.
Note very elongated soft palate.
Massive uvula could obstruct airway.
Massive tonsils could obstruct airway – 12-year-old.
Same patient with tonsils removed.
OSAS is a common pediatric disorder affecting up to 2% of children aged 2 to 8 years. There is increasing evidence to support an association between OSAS and ADHD. OSAS may result in significant clinical consequences, including growth retardation... behavior and learning problems. Adenotonsillar hypertrophy is the most common cause of OSAS in otherwise healthy children. Behavior problems and quality of life tend to improve after adenotonsillectomy and resolution of the sleep-disordered breathing.

Study showed an improvement of 11 points in IQ in the Mental Processing Composite following adenotonsillectomy.

Study confirms an impaired neurocognitive function in otherwise healthy children with mild to moderate OSAS due to hypertrophied adenoids and tonsils.

Patient MUST sleep with CPAP every night for his sleep apnea.
A46  Person has had UPPP as one form of treatment.
Massive tongue in patient with severe OSA.
Close-up of lateral indentation on tongue.
Demonstrates tight frenulum and large tongue (macroglossia). Similar to Down’s Syndrome case.
Tongue thrusting between teeth during swallow.
A51 Subtle open bite due to tongue thrust.
Too much tissue removed during this UPPP.
Obturator attached to upper denture.
Obturator and denture in mouth.
Large tongue was contributing factor to OSA.
Snor-X in mouth.

Warning - Surgery-5
Preparing for tongue reduction surgery.
Laser being used to outline area of tongue to be removed.
Front-middle-section of tongue being removed.
Mid-section of tongue removed.
Tongue being sutured.
Massive tori take up tongue space.
A high narrow nose can easily collapse and obstruct air flow.
Crossbite on both sides indicates a narrow dental arch.
Removing 4 bicuspids for ortho reasons can be deadly!
PM Positioner on models.