

Basics of Sleep

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Disclaimer

The information in this presentation is for basic information only and is not to be construed as a diagnosis or treatment for any medical condition. *ALWAYS* consult with your physician before trying any type of treatment.

Basic Sleep Hygiene

- Good sleep hygiene is critical for one's overall physical and mental health.
- Your body can be compared to a battery - it needs to be re-charged on a regular basis or it will get run down and maybe even die!
- It is best to go to bed at a regular time each night and get up at a regular time every morning - 7 days a week.
- The body needs 7 - 8 hours of **quality sleep** every night. Your overall health will pay the price eventually if you are constantly sleep deprived.

Definitions

Definitions may vary slightly depending on the philosophy of the individual, but in general, these are close definitions:

- **Apnea** : Cessation of airflow for greater than 10 seconds with continued chest and abdominal effort.
- **Hypopnea** : Decrease in amount of air breathed (some say by 50%) with a desaturation of at least 3%.

Apnea Hypopnea Index (AHI)

- Normal: less than 5 events per hour
- Mild: 5 - 15 events per hour
- Moderate: 16 - 30 events per hour
- Moderately severe: 31 - 39 events per hour
- Severe: over 40 events per hour

Sleep Latency

Normally it should take about 10 - 15 minutes to fall asleep after going to bed. If you are asleep in less than 5 minutes, that could be a sign of excessive sleepiness.

Normal REM latency ranges from 70 - 120 minutes with the average being about 90 minutes for a normal young adult.

Oxygen Saturation

- Normally the blood oxygen level should be above 90%. With obstructions, you can have varying degrees of desaturations. The severity of the problem depends on %.
- Mild problem: 85 - 90%
- Moderate problem: 80 - 84%
- Severe problem: below 80%

Sleep Stages

“Light Sleep” - Stage 1

4-5% of total sleep time is considered normal

Increases to 15% by age 70

“Restful Sleep” - Stage 2

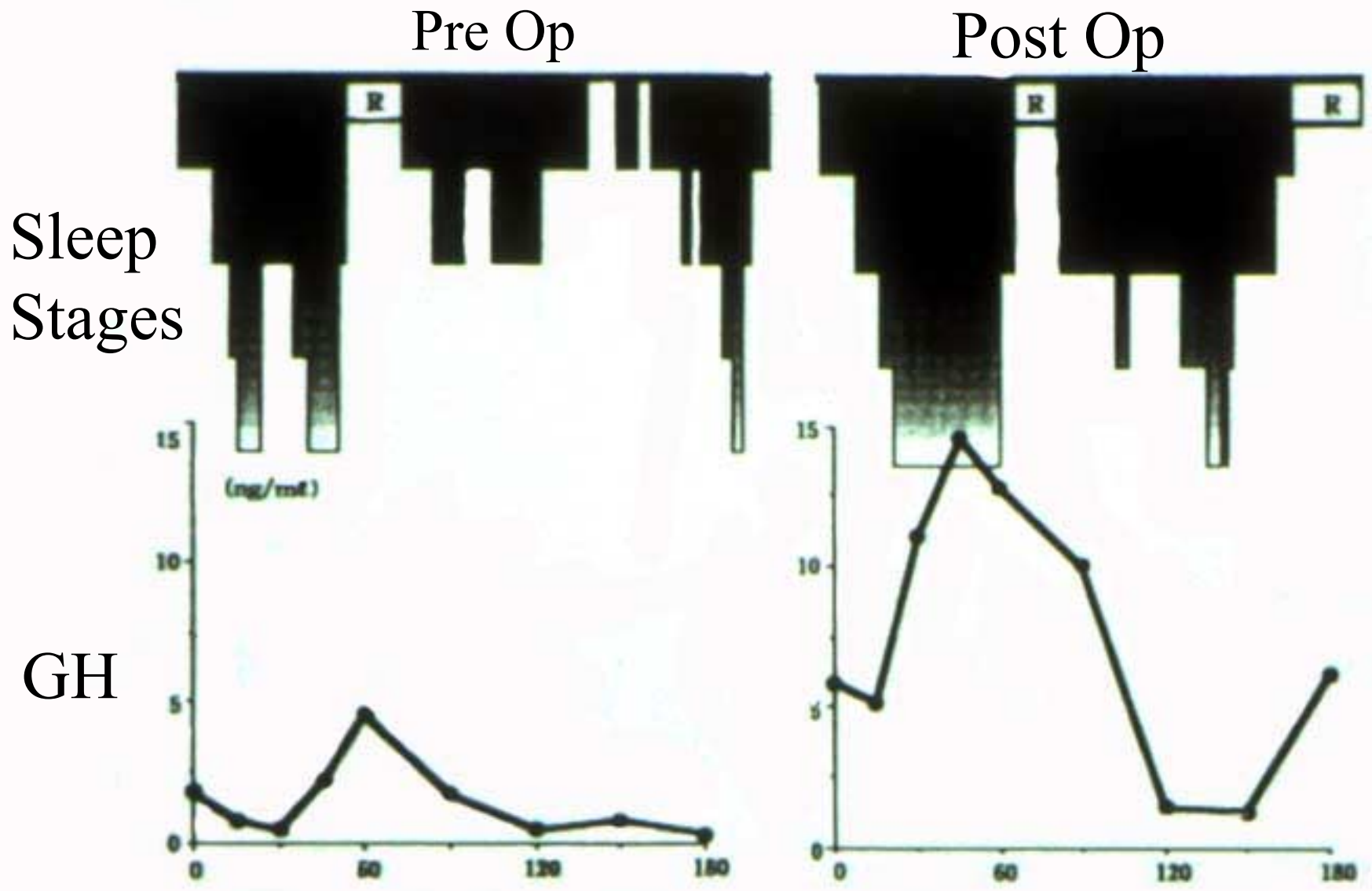
45 - 55% of total time

“Deep Sleep” - Delta or Slow Wave Sleep

- composed of Stages 3 and 4 - Range of total sleep: 10 - 20%
- % decreases with age
- about 40 - 50% in children - to total absence by age 40 - 50
- Growth hormone reaches peak levels in Stage 4
- usually appears only in the first 1/3 of the sleep episode

“REM” - Rapid Eye Movement sleep - 20 - 25% total time

- get body paralysis - atonia
- mind very active
- very vivid hallucinatory imagery or dreaming
- do problem solving

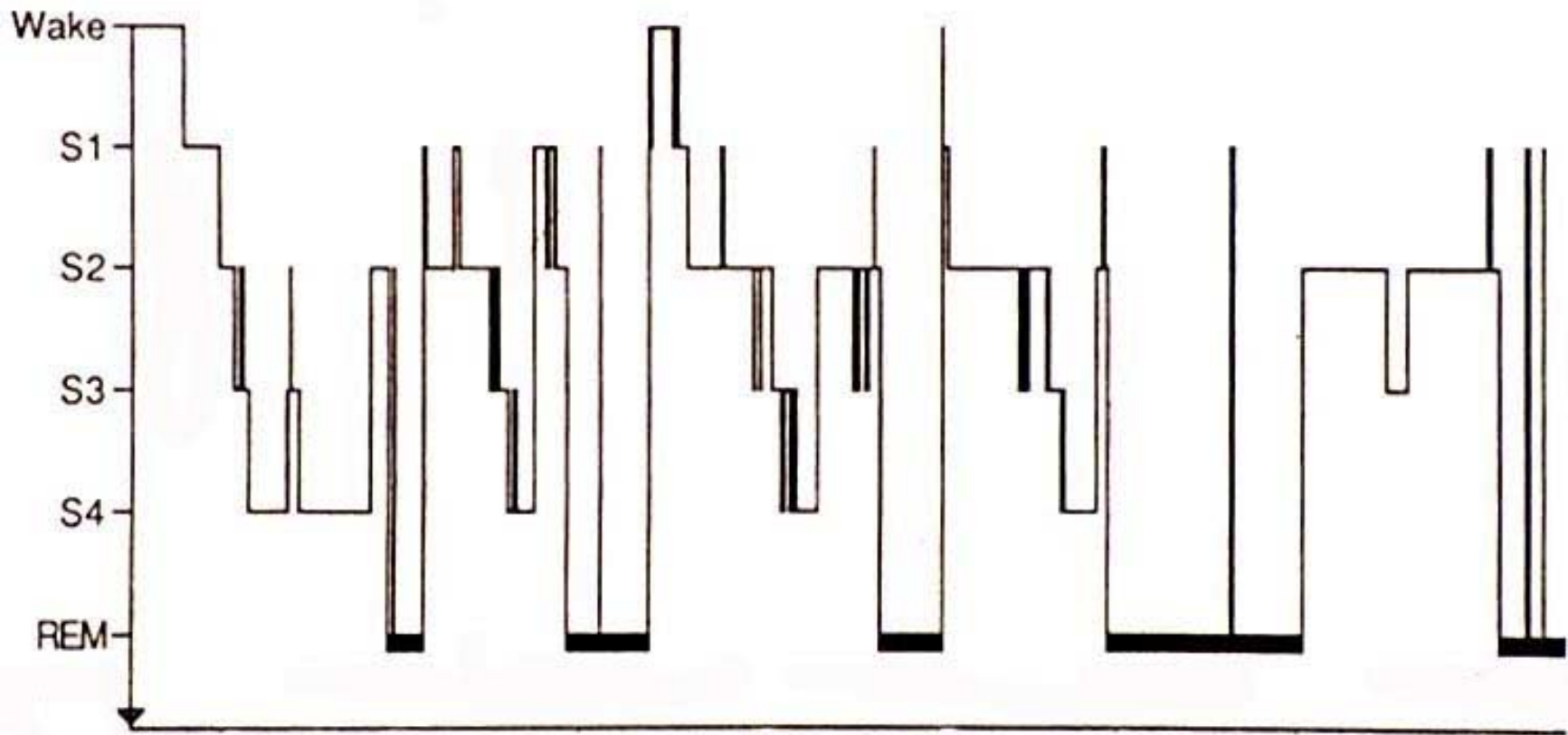


A10

More Growth Hormone secreted in Stage 4

Sleep Architecture

- Each NREM - REM couplet is equal to one cycle
- Normally go through a sleep cycle every 90 minutes
- Go thru about 4 - 5 cycles in a good 7 1/2 hour sleep
- REM cycles get longer and closer as the length of the sleep gets longer.



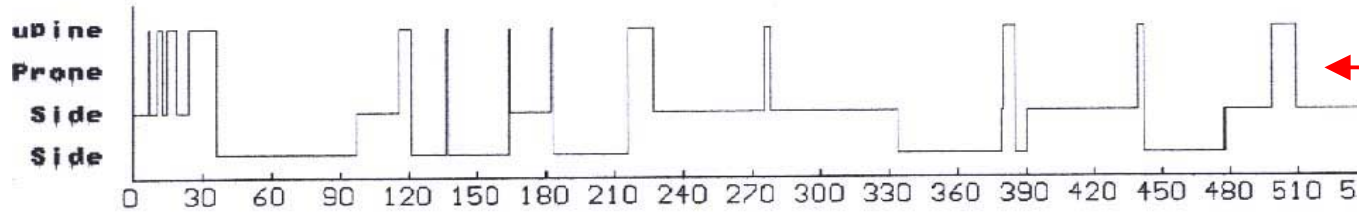
Normal sleep histogram of healthy young adult.

A12

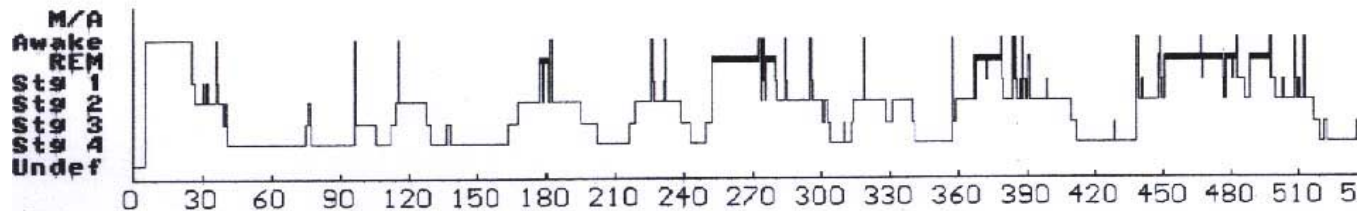
DATE : 2/23/01
CURSOR POSITION =

START MINU
STOP MINU
RESOLUTI

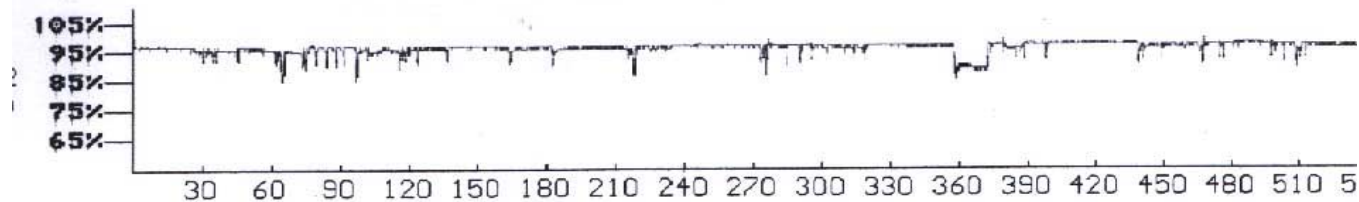
Epoch: 2 | Left Side | TX: 0.0 | Stage: - | Mean SaO2: 97.4



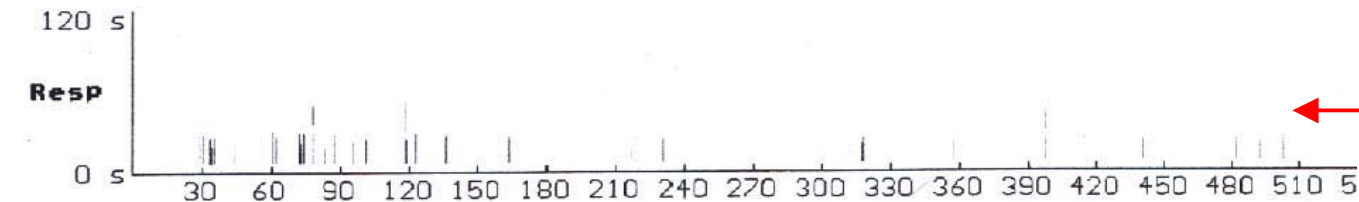
← Position changes



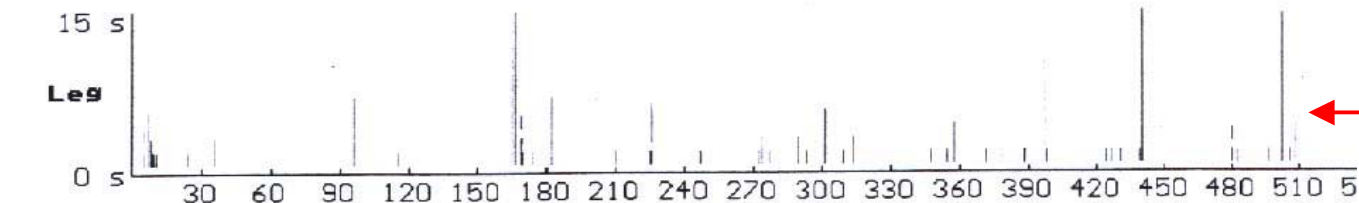
← More REM at end



← Mean oxygen level -97%



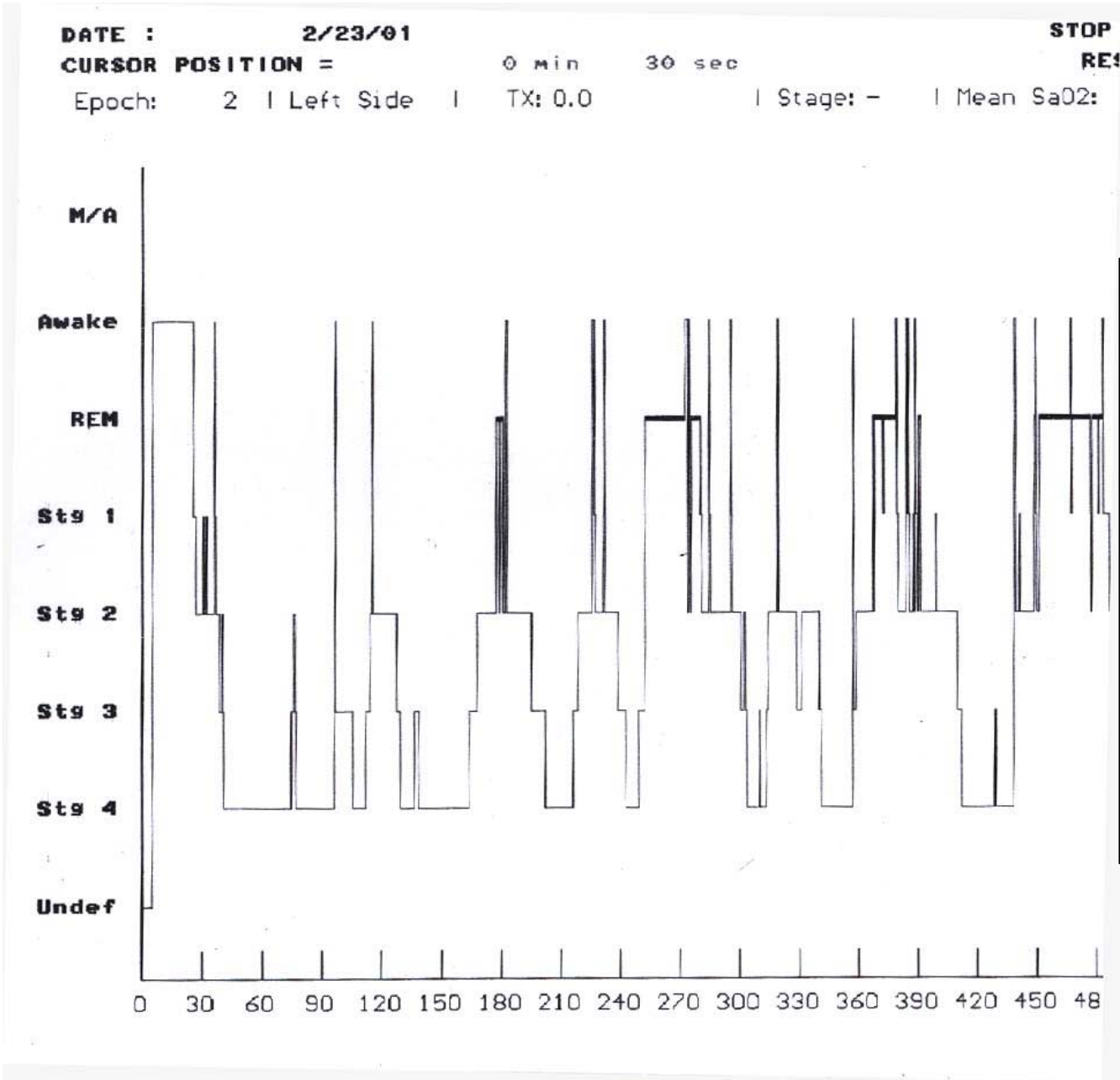
← Some hypopnea events



← Leg movements

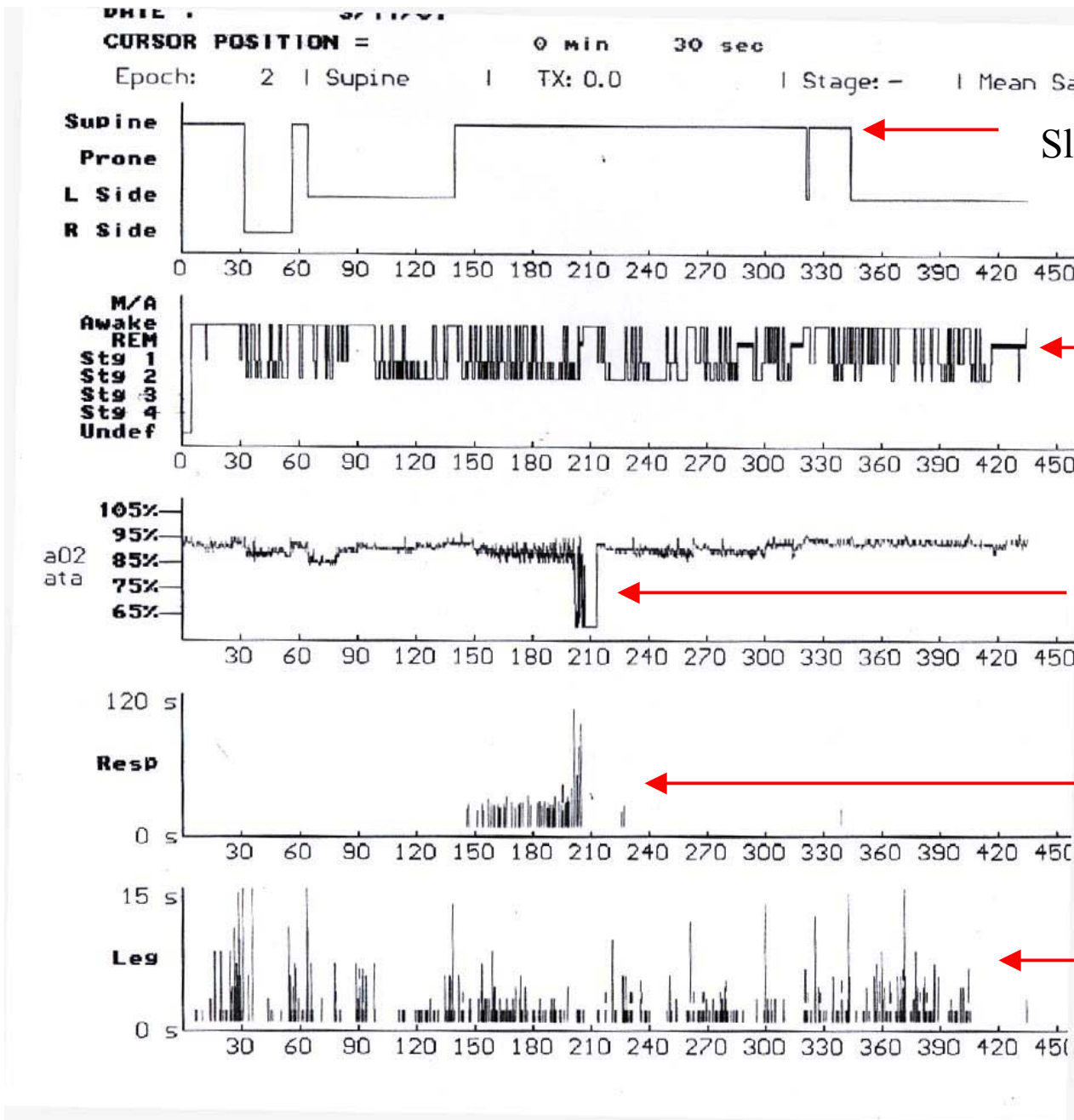
A13

Sleep data demonstrating another normal sleep cycle



← Awake
 ← REM
 ← Stage 1
 ← Stage 2
 ← Stage 3
 ← Stage 4

A14 Close up of previous slide demonstrating good cycles



Sleeps on back most of the time

Disrupted sleep

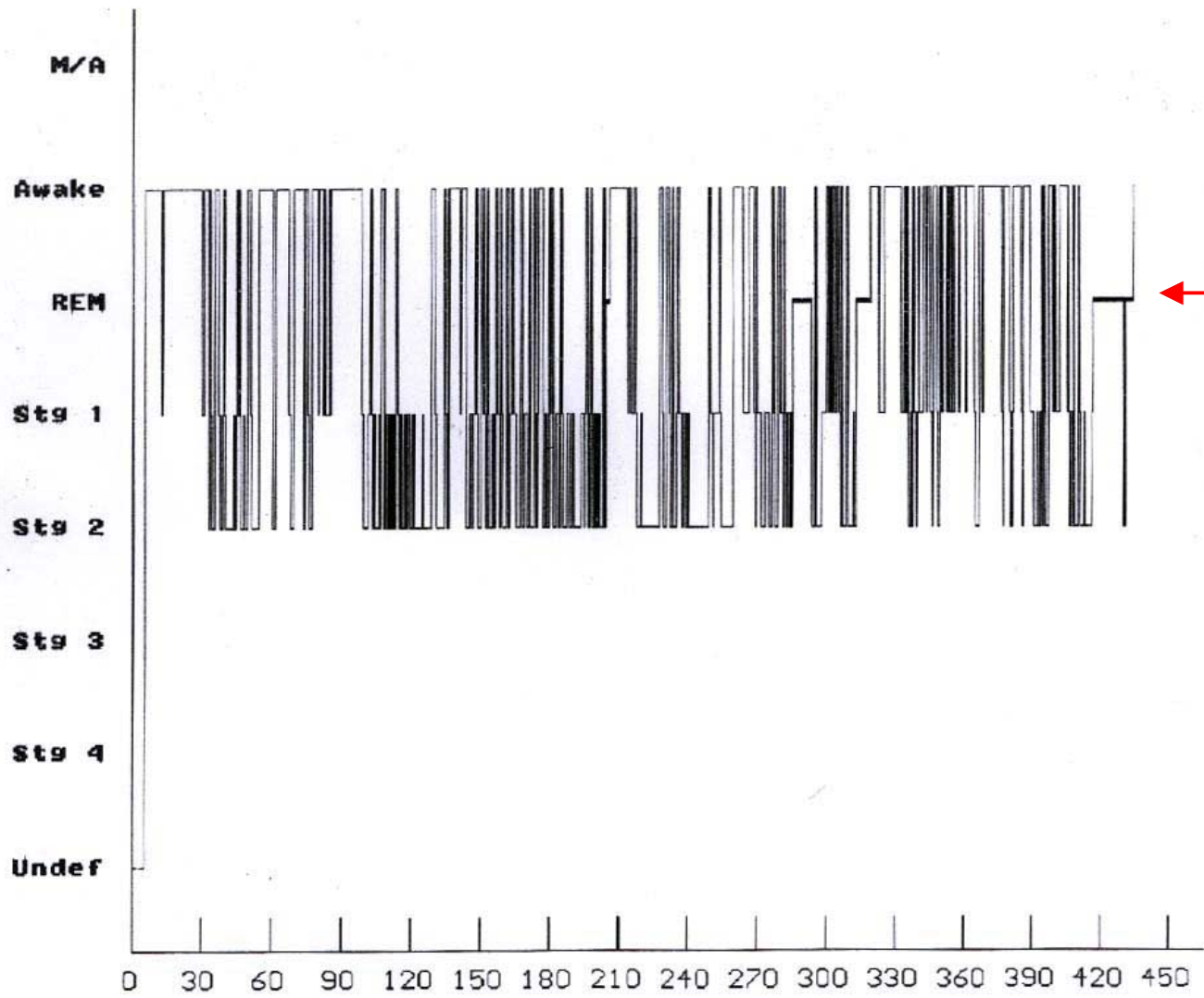
Oxygen dropped to 65% - then started on CPAP

Had a lot of respiratory events until started on CPAP

Lot of leg jerks

A15 Data demonstrates fragmented sleep pattern

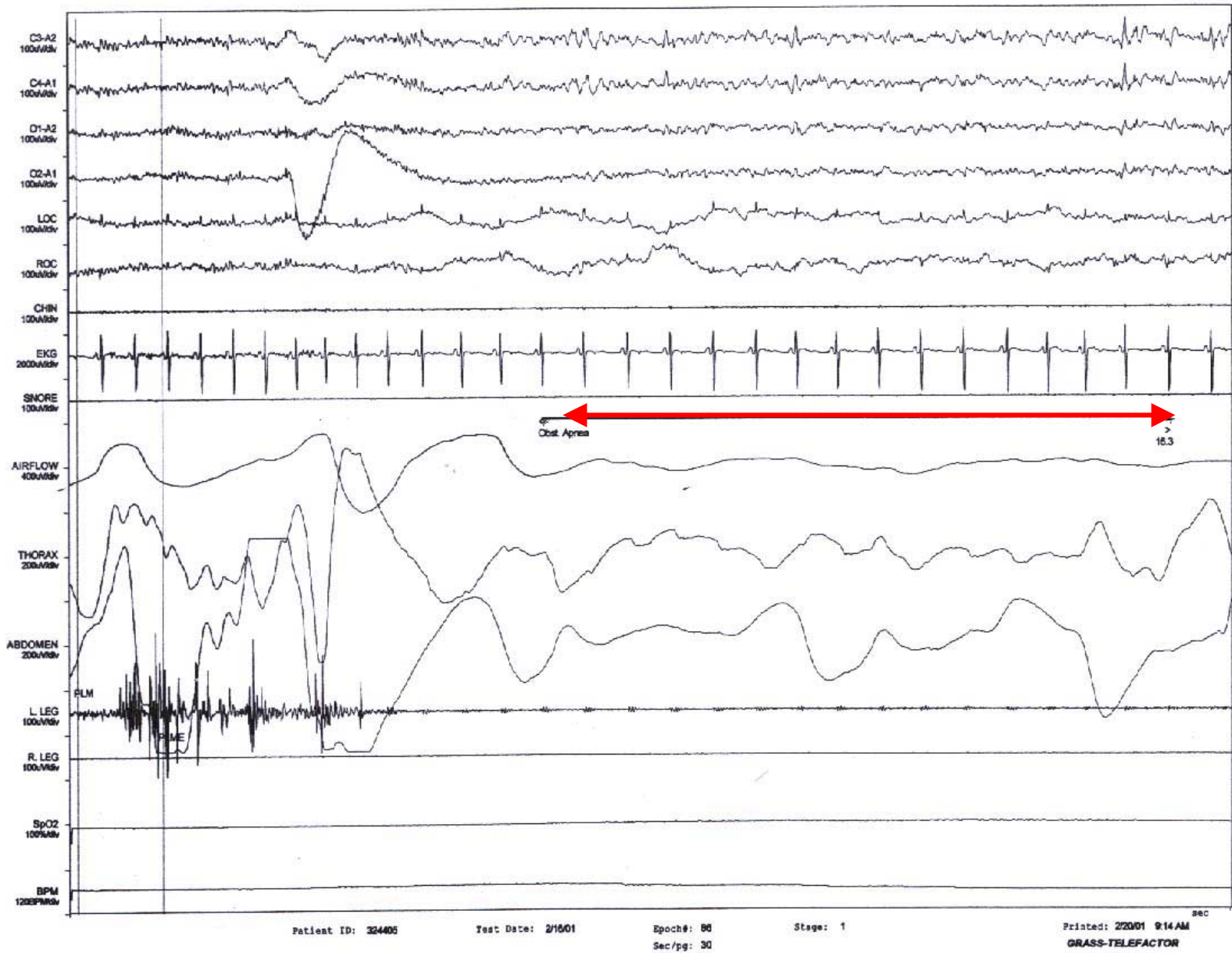
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CURSOR POSITION =
Epoch: 2 | Supine | TX: 0.0 | Stage: - | Mean SaO₂



Only small amount of REM acquired

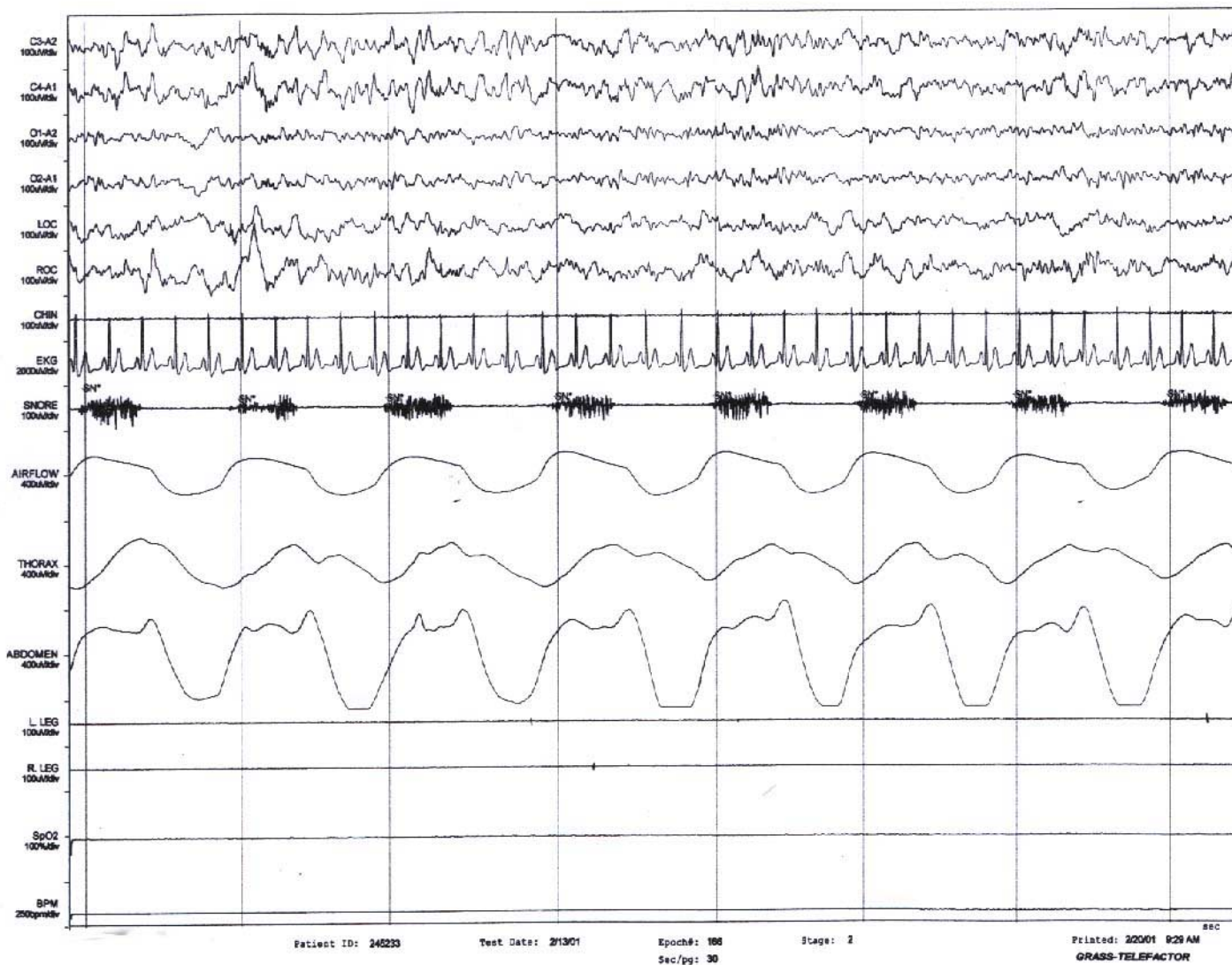
Does not get into Stage 3 or 4.

A16 Close up of fragmented sleep pattern



Obstructive
apnea

A17 Obstructive apnea - No airflow even with chest and abdominal effort



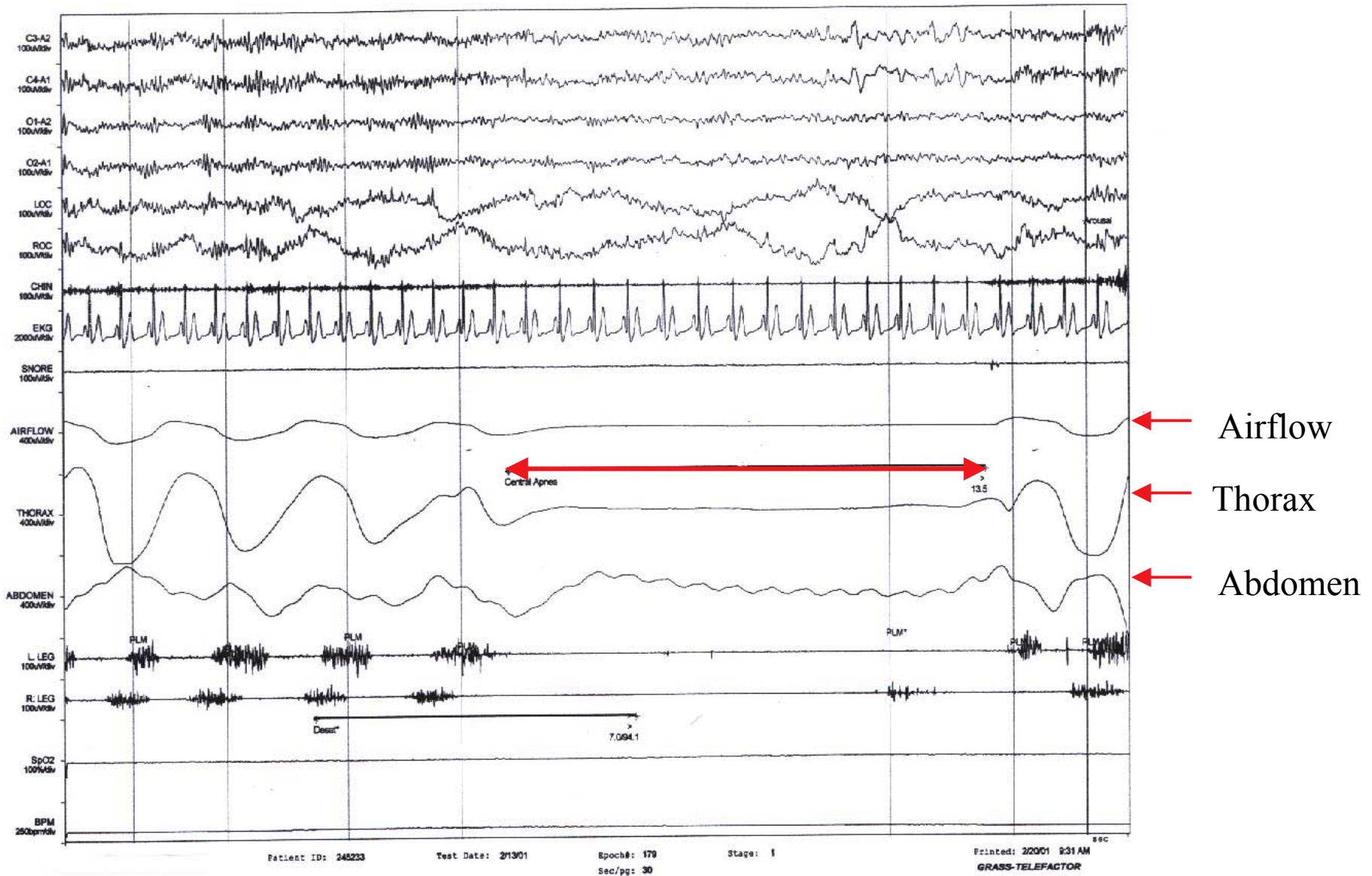
Snoring



No change
in airflow

A18

Primary snoring



← Airflow
 ← Thorax
 ← Abdomen

Central apnea pattern - no airflow and no chest or abdominal effort.

A19

Basic Introduction to Obstructive Sleep Apnea (OSA)

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April, 2001

Obstructive Sleep Apnea

Cessation of airflow
for greater than 10 seconds
with continued chest and
abdominal effort

Symptoms of OSA in Adults

- Heavy snoring
- Stop breathing while sleeping - then “snort”
- Excessive daytime sleepiness
- High blood pressure
- Morning headaches
- Restless sleeps
- Depression
- Severe anxiety

Adult symptoms continued

- Short term memory loss
- Intellectual deterioration
- Temperamental behavior
- Poor job performance
- Impotence
- Dry mouth upon awakening
- Mouth breathing

Symptoms of OSA in Children

- Snoring
- Hyperactivity
- Developmental delay
- Poor concentration
- Bed wetting
- Nightmares
- Night terrors

Children's Symptoms continued

- Headaches
- Restless sleeps
- Obesity
- Large tonsils
- Noisy breathers
- Chronic runny noses
- Frequent upper airway infections / earaches

Attention Deficit/Hyperactivity Disorder (ADHD)

- Snoring associated with higher levels of inattention and hyperactivity
- 81% of snoring children with ADHD (25%) could have their ADHD eliminated if their habitual snoring were effectively treated

Chervin, RD et al. Symptoms of Sleep Disorders, Inattention, and Hyperactivity in Children, 1997, *Sleep*, 20(12):1185-1192.

Enuresis (Bed wetting)

“Surgical removal of upper airway obstruction led to a significant decrease in or complete cure of nocturnal enuresis in 76% of children studied.”

Weider, DJ, Nocturnal enuresis in children with upper airway obstruction, *Otolaryngol Head Neck Surg* 1991;105:417-32

“Nocturnal enuresis ceased within a few months in the 10 cases studied by using rapid maxillary expansion to reduce nasal constriction.”

Timms D, Rapid maxillary expansion in the treatment of nocturnal enuresis, *The Angle Orthodontist* 1990, 60(3):229-33

Physical Characteristics of OSA

Morphometric formula

Kushida C. et al., A predictive morphometric model for the obstructive sleep apnea syndrome, *Annals of Internal Medicine*, Oct 15, 1997; 127(8):581-87.

This is one of the most important formulas in the medical field today. You can link to this article from within this website.

Stanford Morphometric Model

$$P + (Mx - Mn) = 3 \times OJ + 3 \times (BMI - 25) \times (NC/BMI)$$

P = palatal height

Mx = maxillary intermolar distance

Mn = mandibular intermolar distance

OJ = overjet

NC = neck circumference

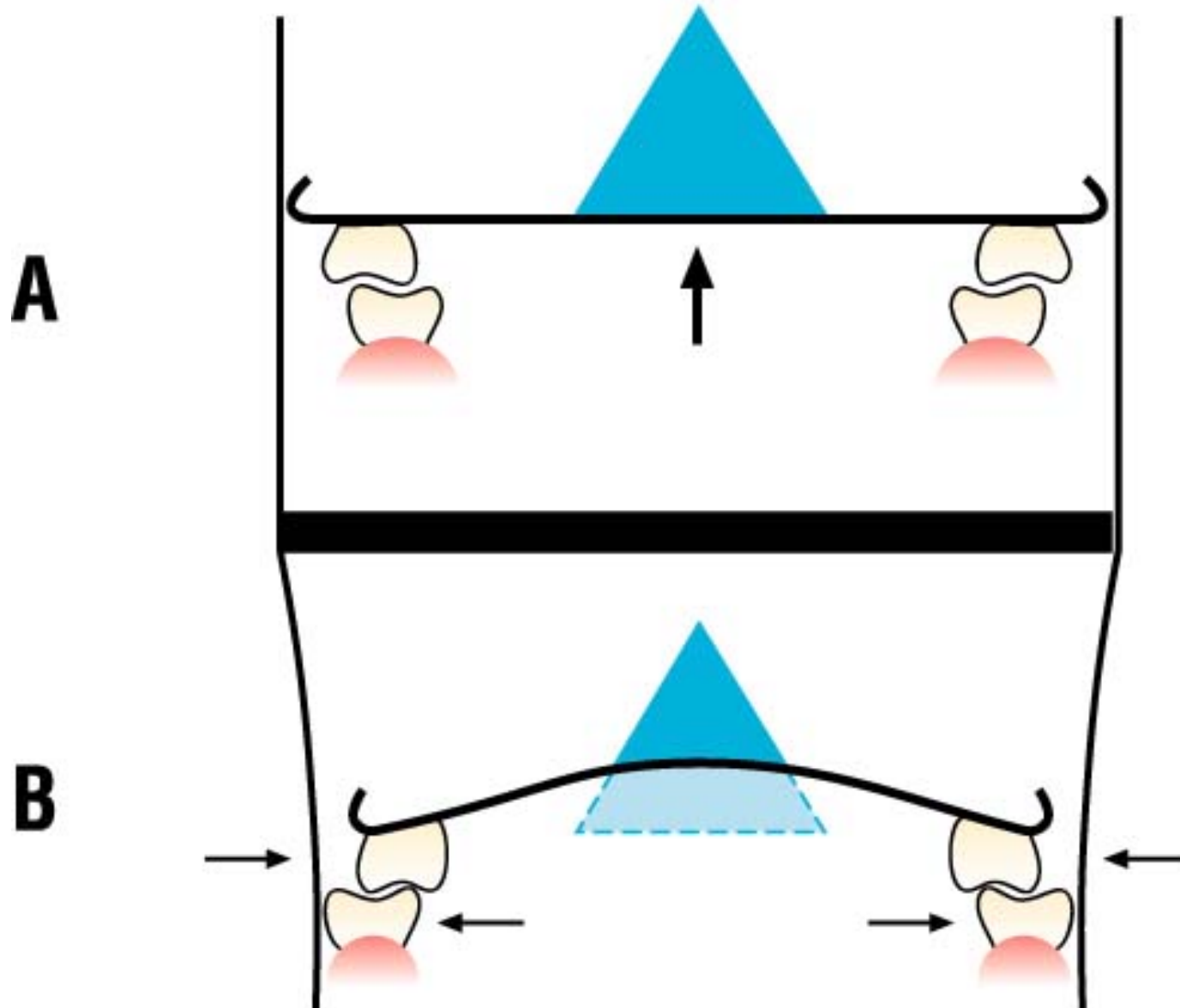
BMI = body mass index

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

Summarizing formula

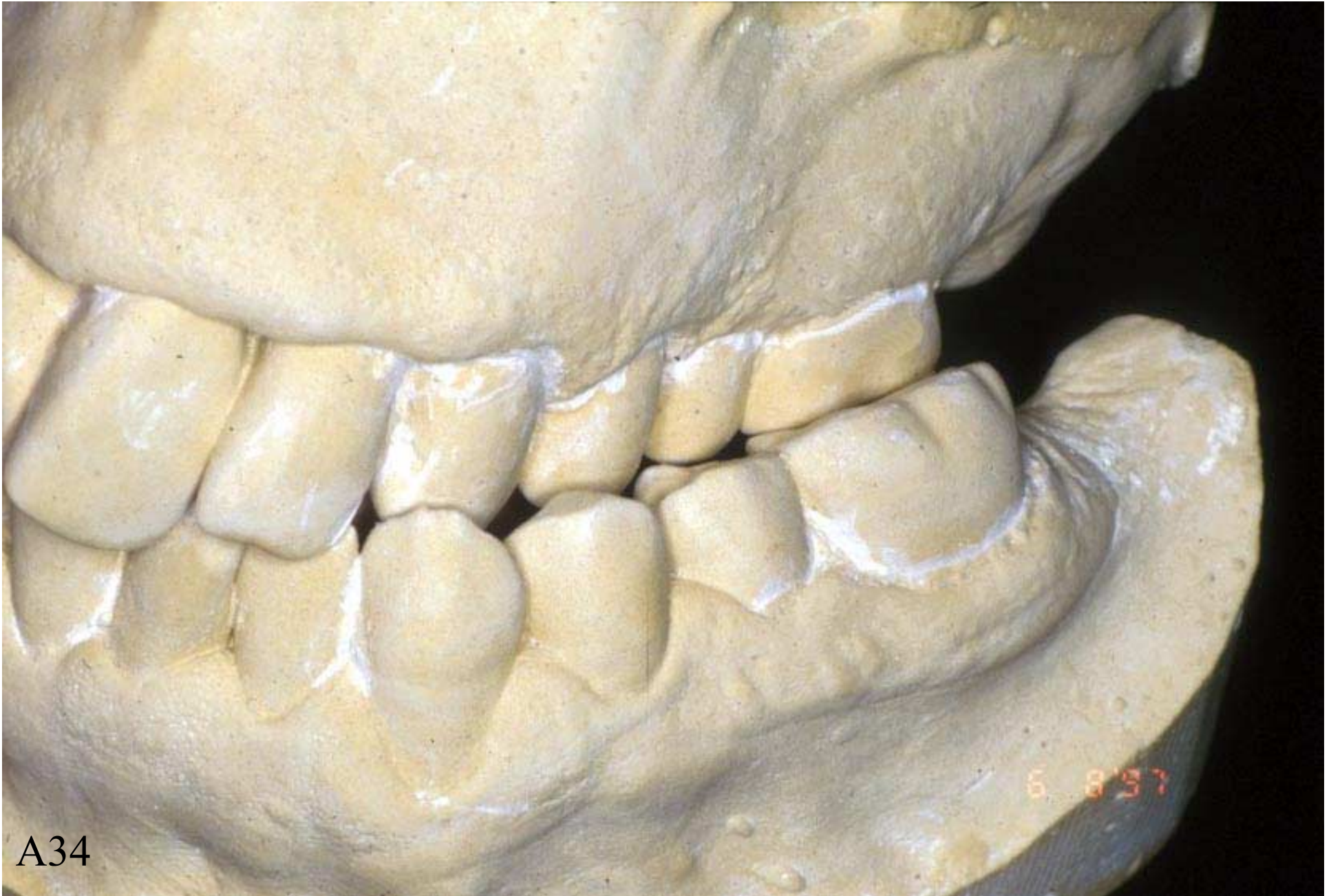
Anyone with a high palate, narrow dental arches, overjet, large neck and/or large body mass, is at risk for sleep apnea. If the individual does not have a large neck size or body mass, the predictive value of the formula is based on the height of the palate, arch wide and overjet.

Palate Formation



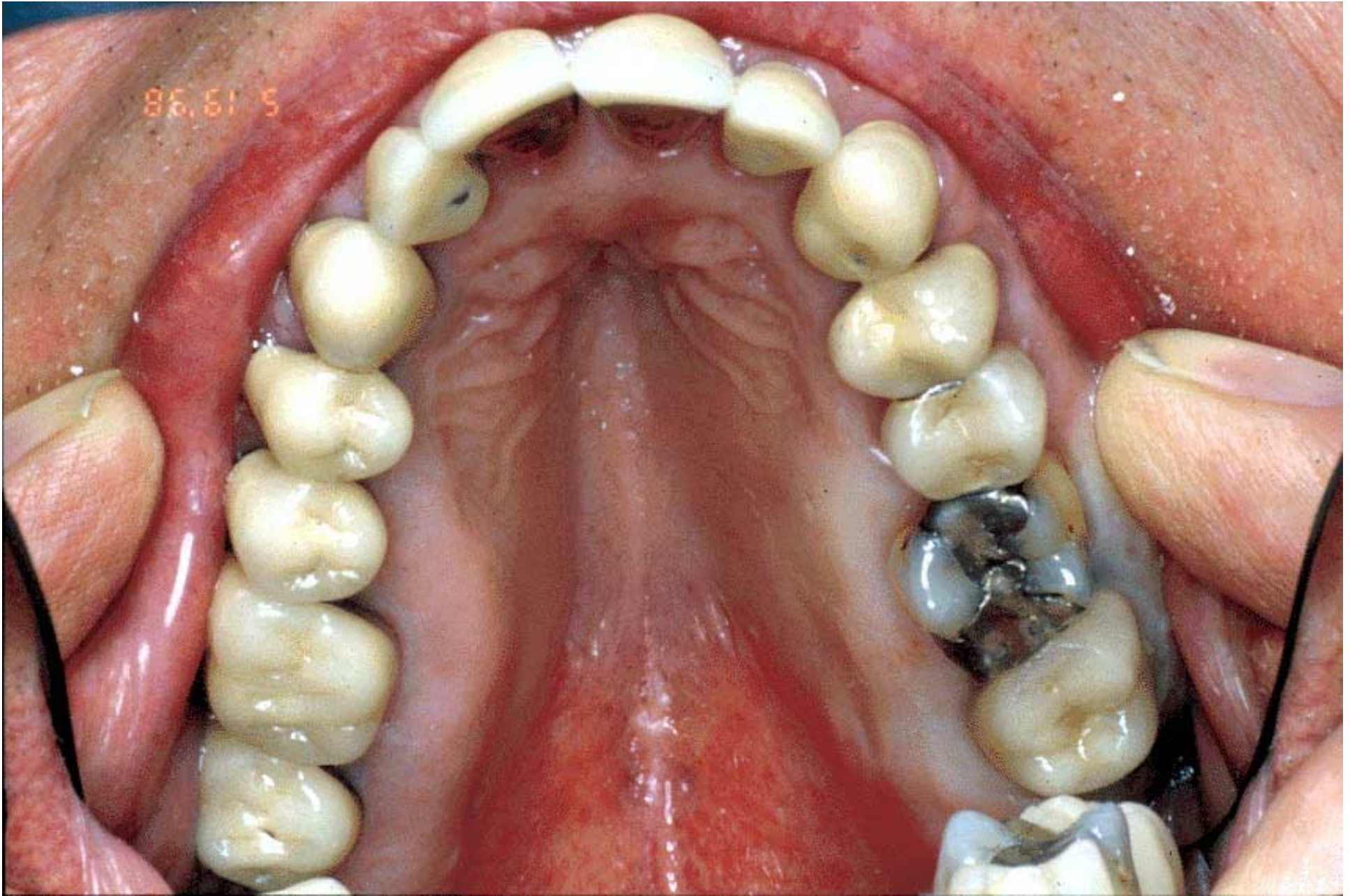


Upper and lower models of an adult demonstrating a high palate and narrow upper dental arch. Tongue force has created wide lower arch. See next slide.



A34

Models in crossbite - indicates a high palate and narrow arch



A35 Example of a high palate and narrow arch



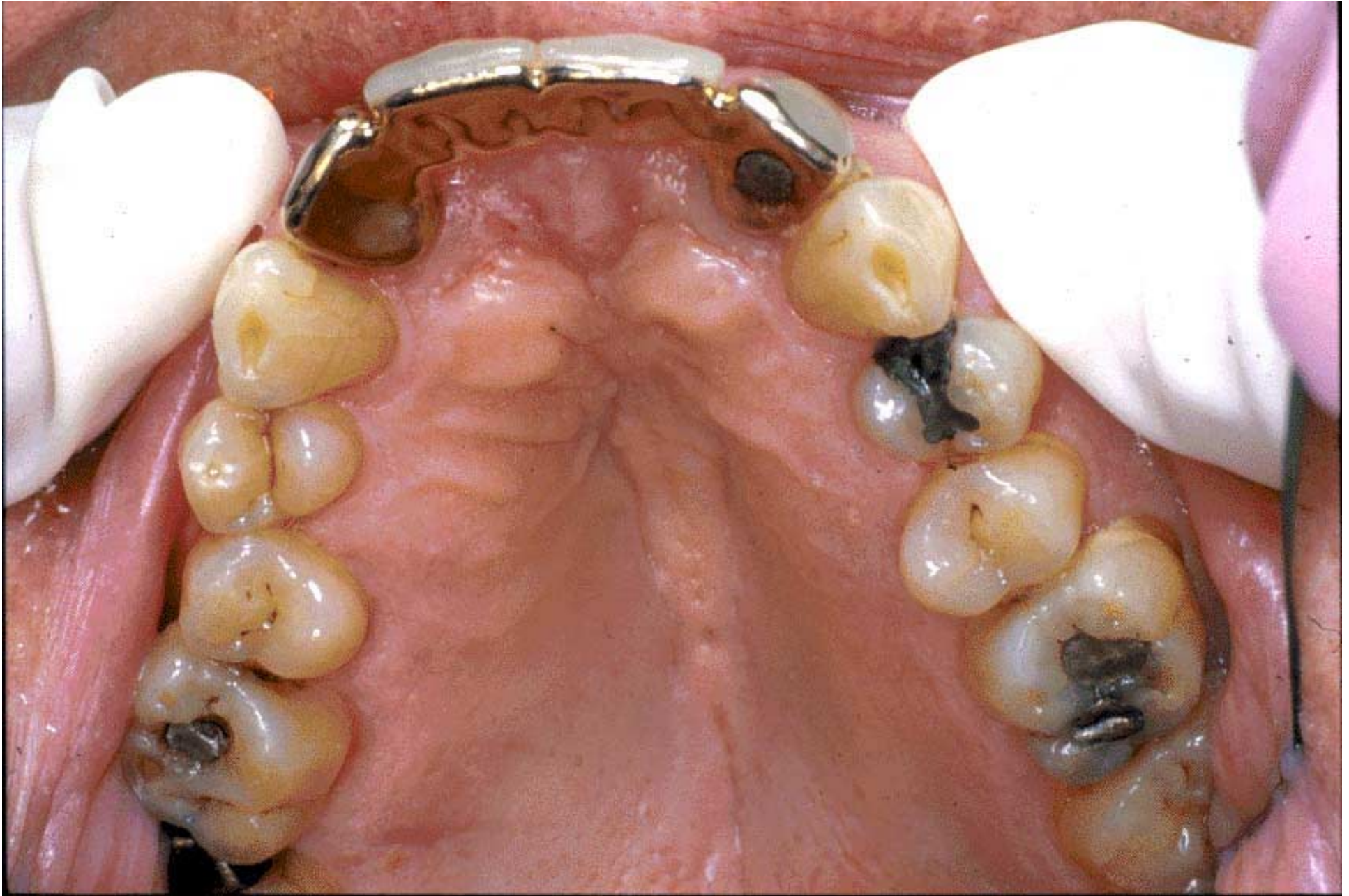
Patient with OSA
who exhibits
features of the
formula.

Note large 20 inch
neck size.



Note large body mass index and head gear to help keep mouth closed while sleeping.

A37



A38

Patient has high palate and narrow arch



A39

Overjet as seen from inferior view



A40

Overjet from side view



A41 Added problem is that patient has large tongue

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)

$$\text{BMI} = \text{Weight in lbs.} \times 704 / \text{height in inches} / \text{height in inches.}$$

Ranges for BMI

- Normal - 18.5 - 24.9
- Overweight - 25.0 - 29.9
- Obese - 30.0 - 39.9
- Extremely obese - > 40

Other factors

Other factors that may contribute to OSA other than large body mass, large neck size, and factors 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.”

Mezzanotte et al., Influence of sleep onset on upper airway muscle activity in apnea patients versus normal controls.

Am J Respir Crit Care Med, 1996 Vol 153:1880-87.



A47 Another patient with high palate and narrow arch



A48

Patient has overjet - inferior view

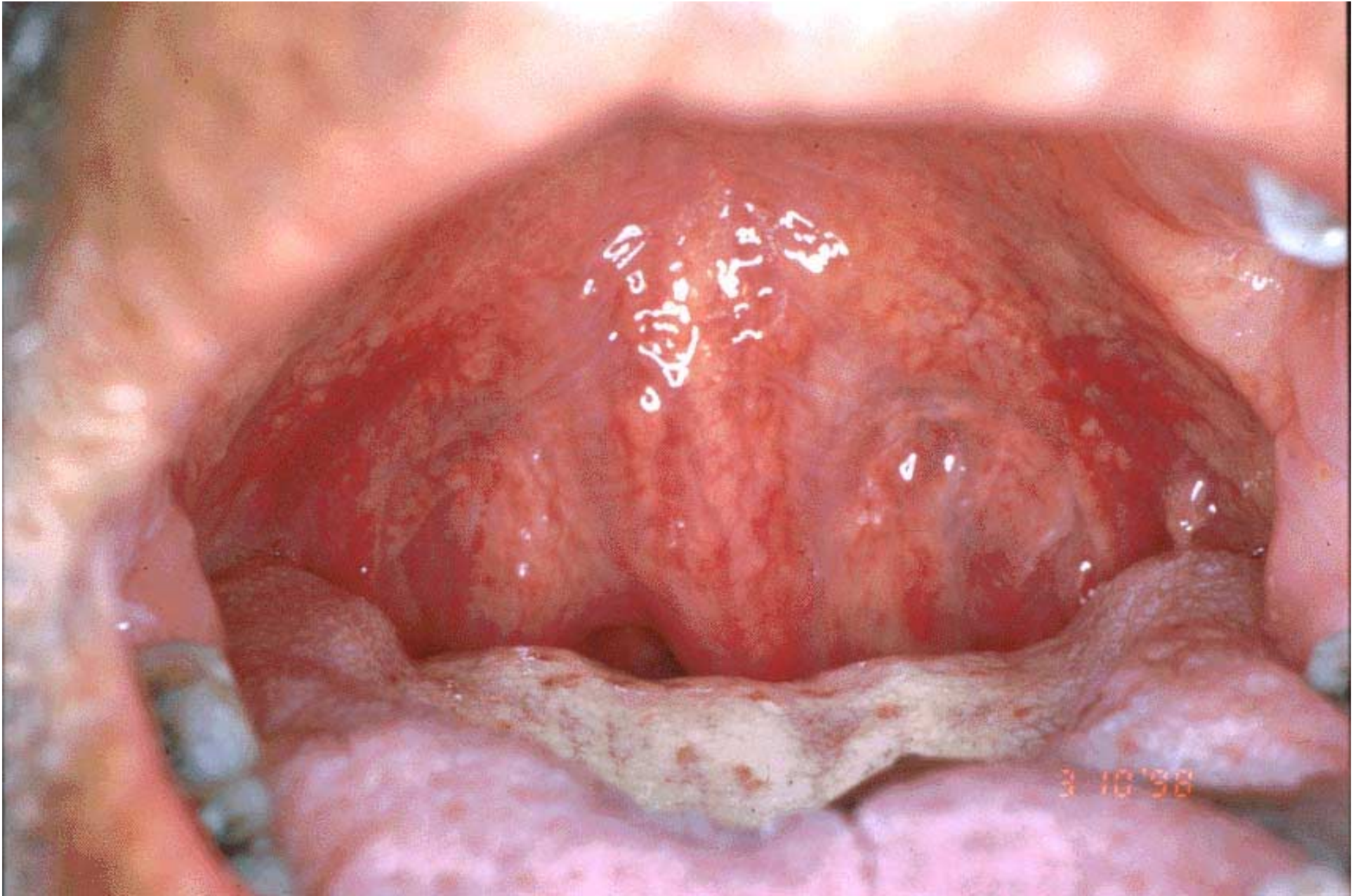


A49

View of overjet from side view

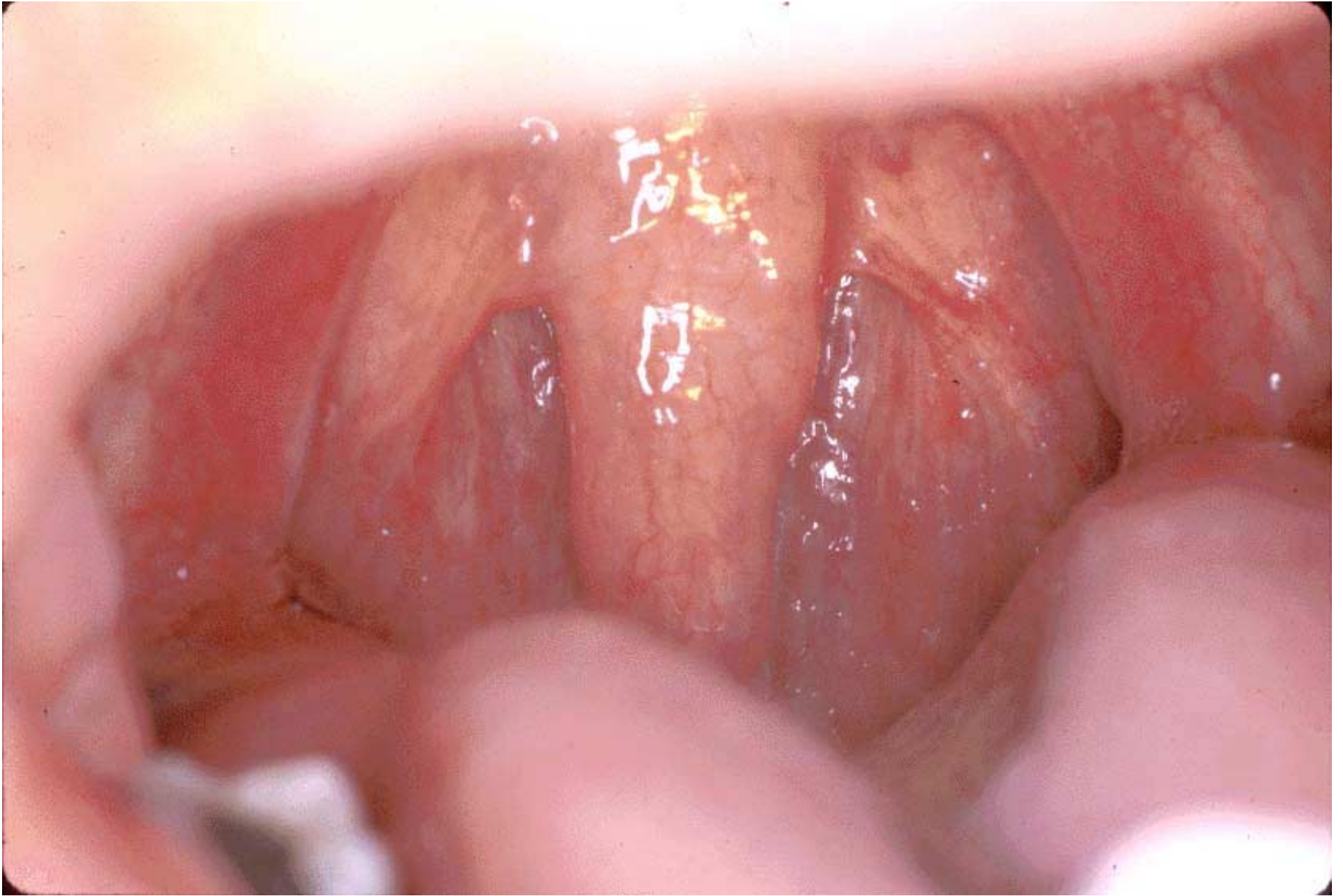


A50 This abnormal tongue activity is called a “tongue thrust”



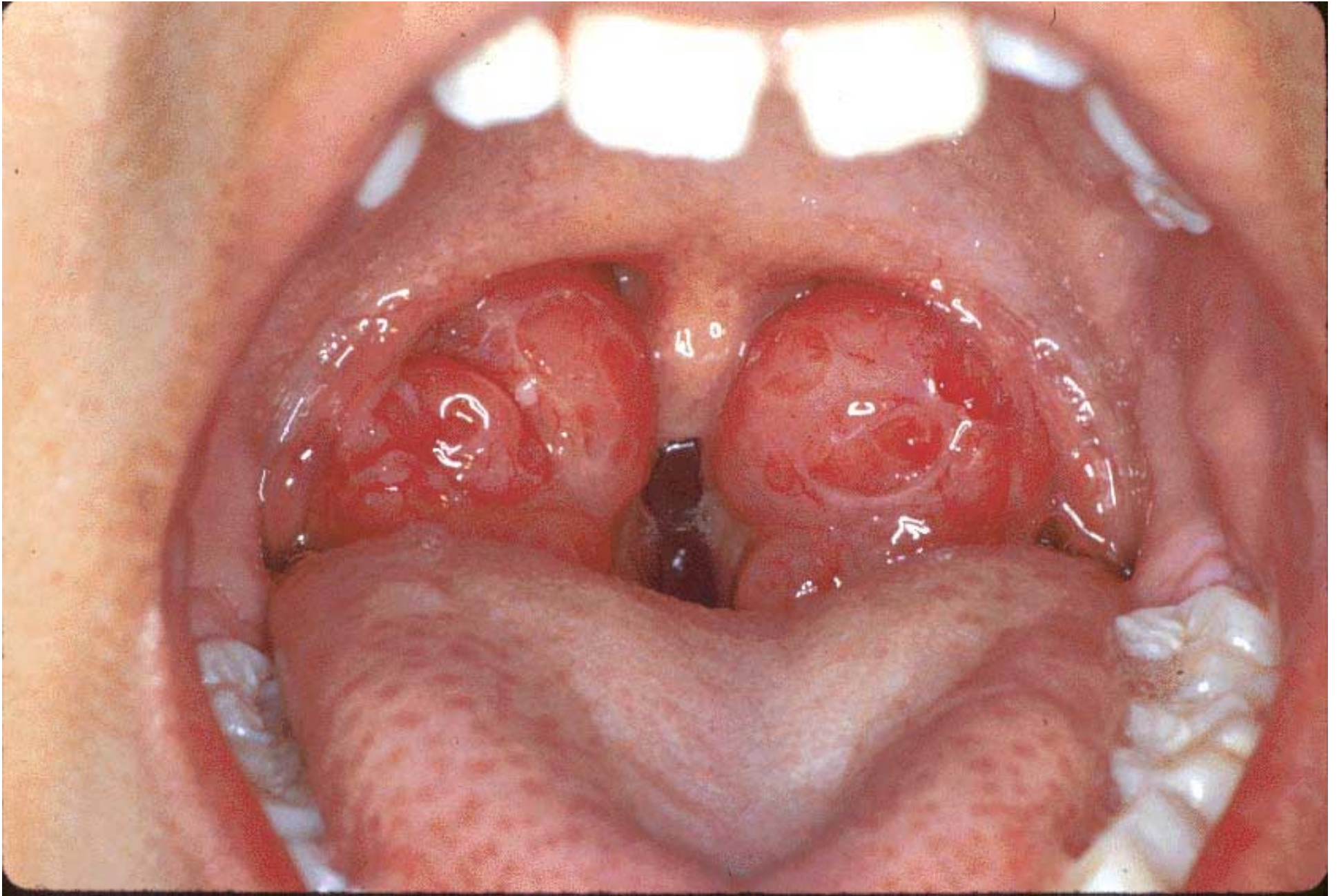
A51

Note very elongated soft palate



A52

Massive uvula could obstruct airway



A53

Massive tonsils could obstruct airway



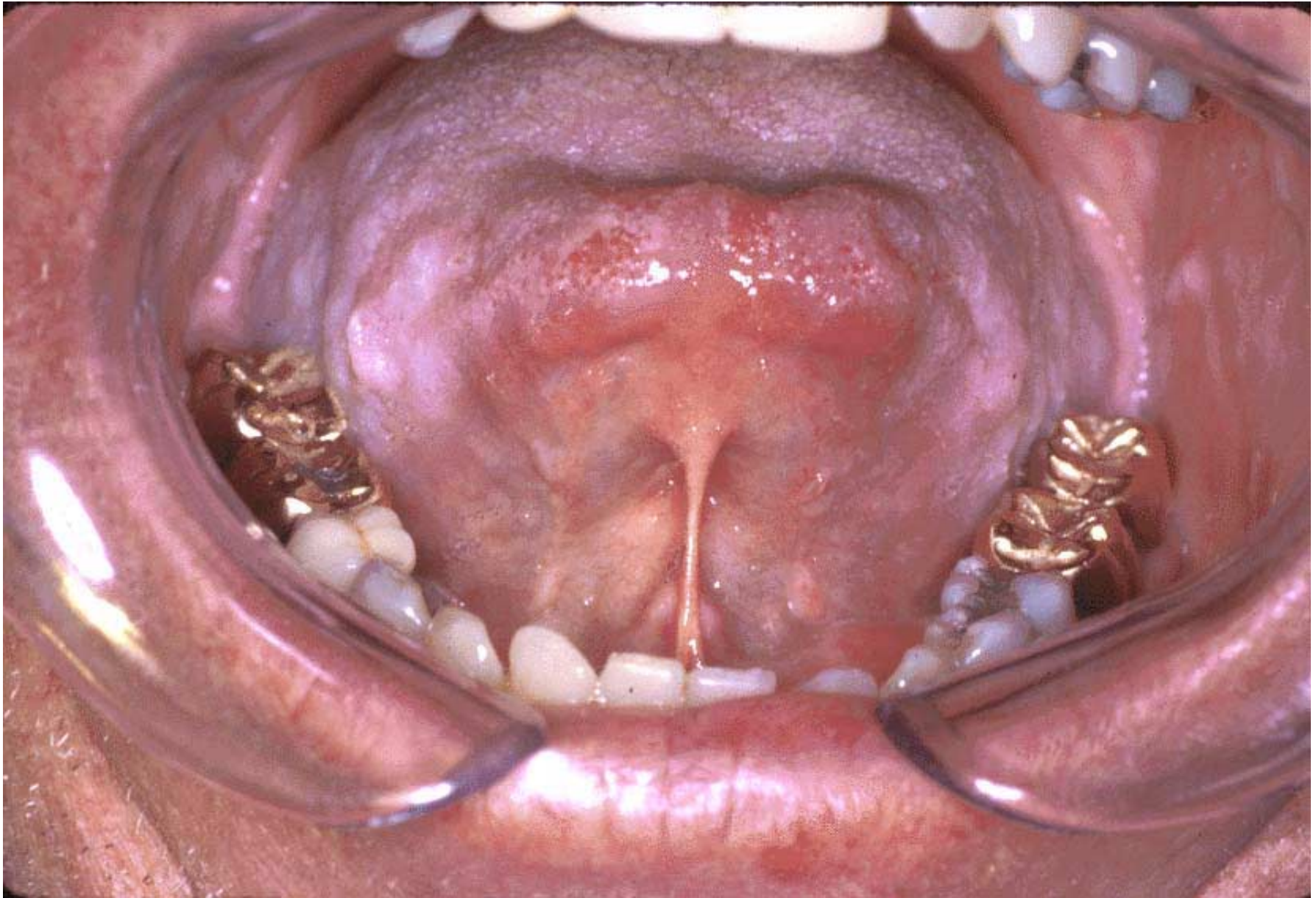
A54

Massive tongue in patient with severe OSA



A55

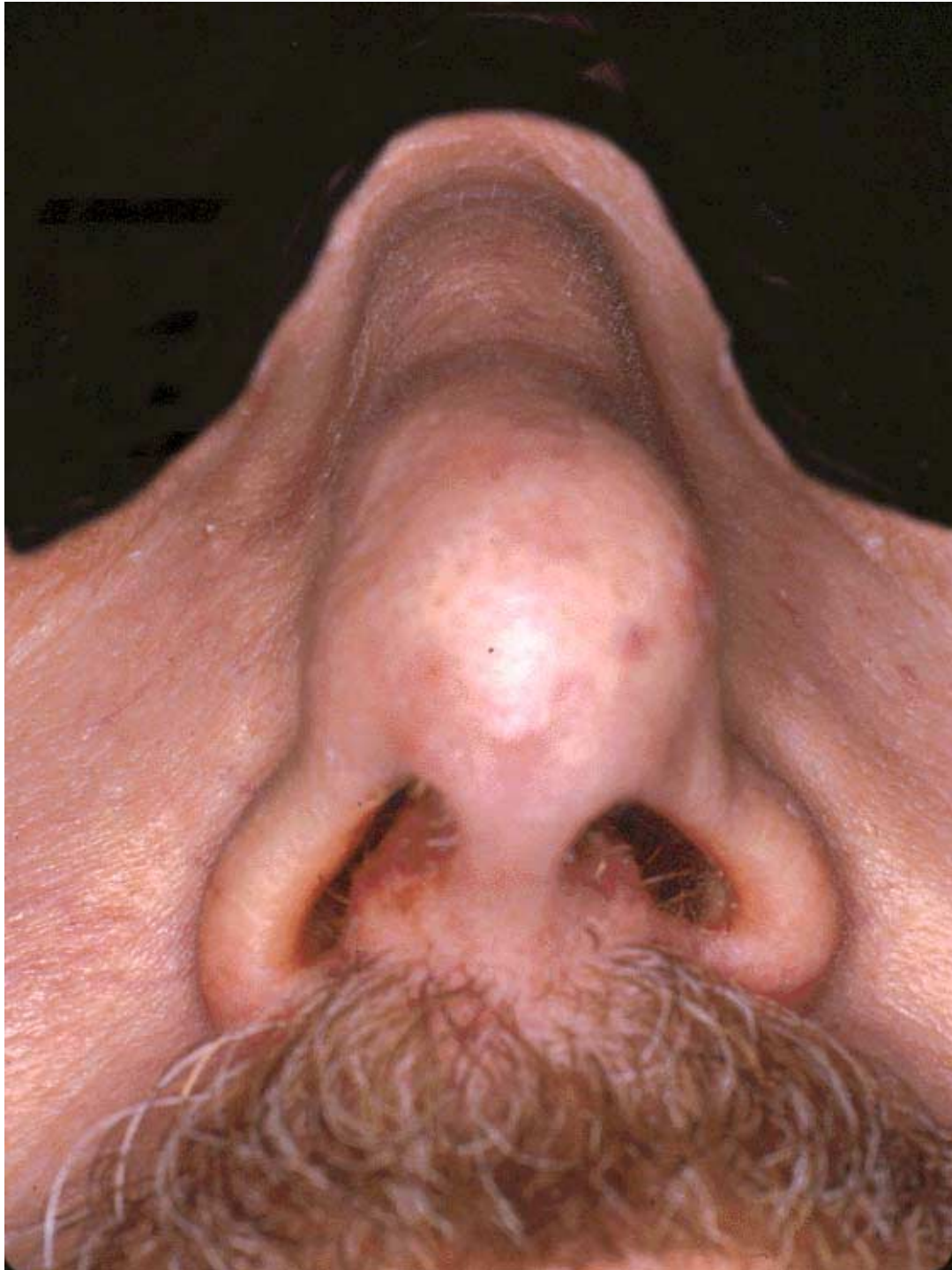
Indentations on side of tongue indicate tongue is large



A56 Same patient is also tongue tied (ankyloglossia)



A57 Tongue size diminished success of throat surgery



A high narrow
nose can collapse
easily and block
air flow

A58

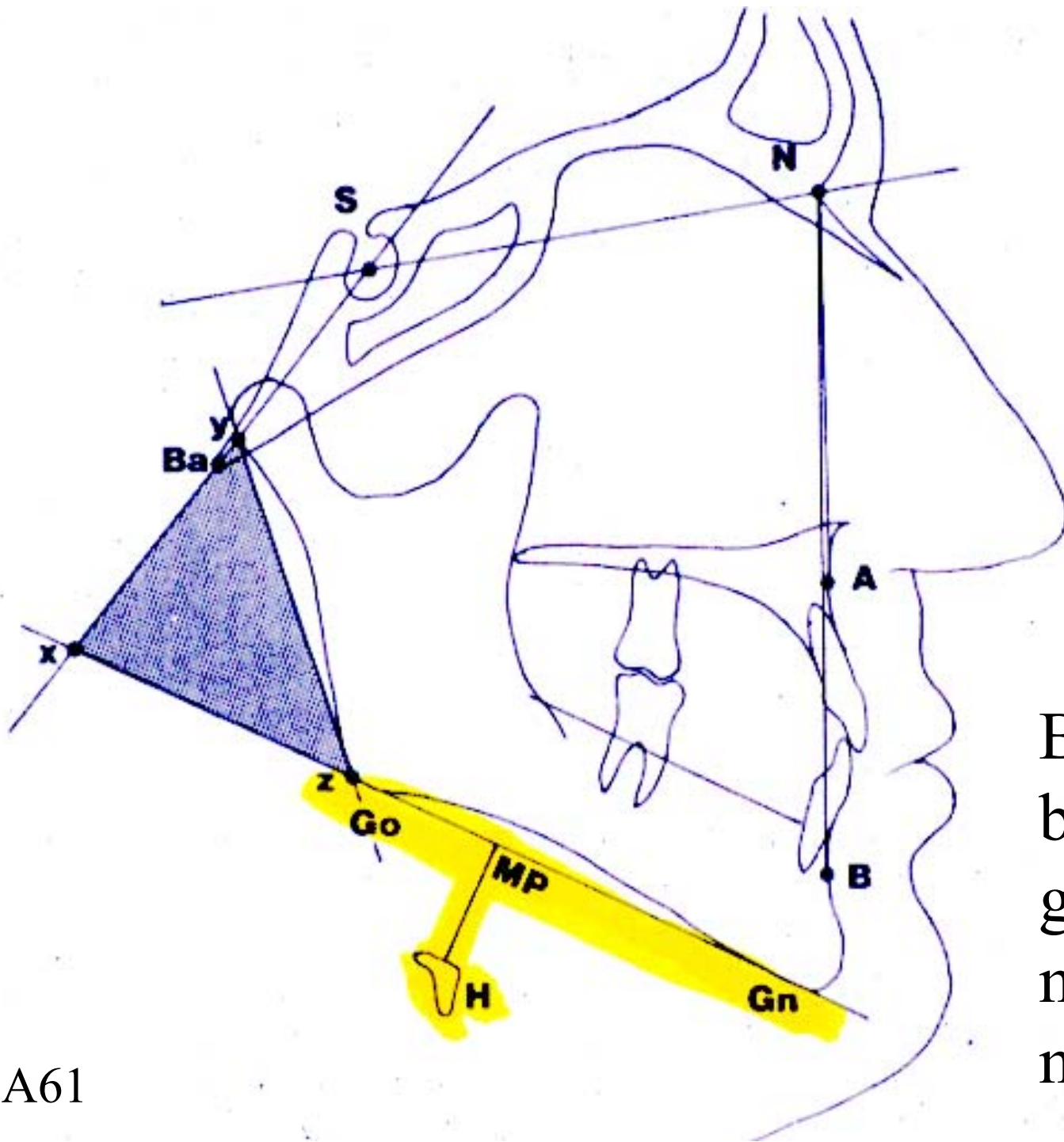


A59

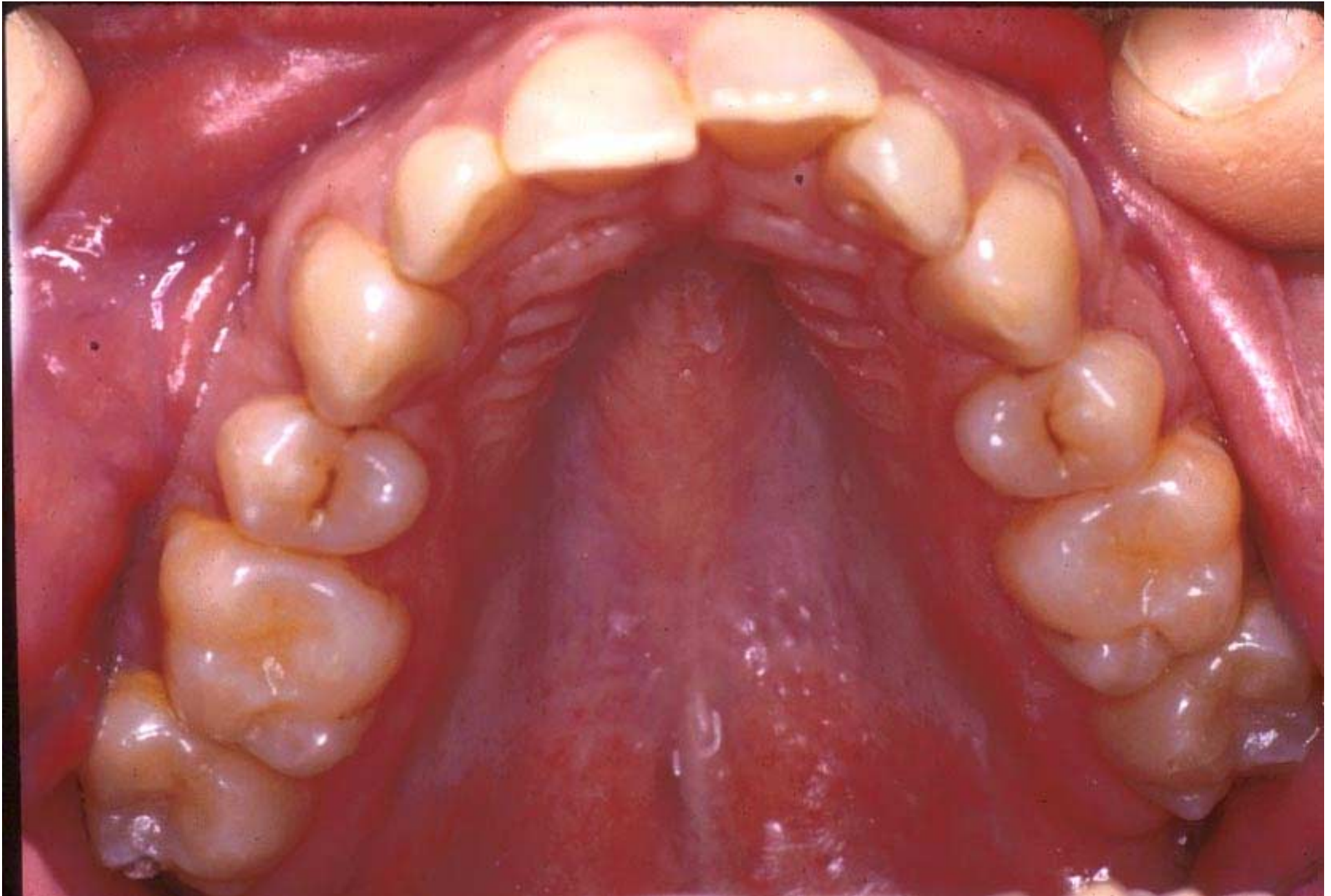
Massive tori take up tongue space

Hyoid bone

A hyoid bone with a distance greater than 20 mm below the border of the mandible is considered a risk factor for OSA.



Best if hyoid bone is not greater than 20 mm from mandible



A62 Removing 4 bicuspids for ortho reasons can be deadly!

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