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).

A3

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.

Challenge – Can the research be duplicated?

A4

Stanford Morphometric Model

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

P = palatal height

Mx = maxillary intermolar distance

Mn = mandibular intermolar distance

OJ = overjet

NC = neck circumference

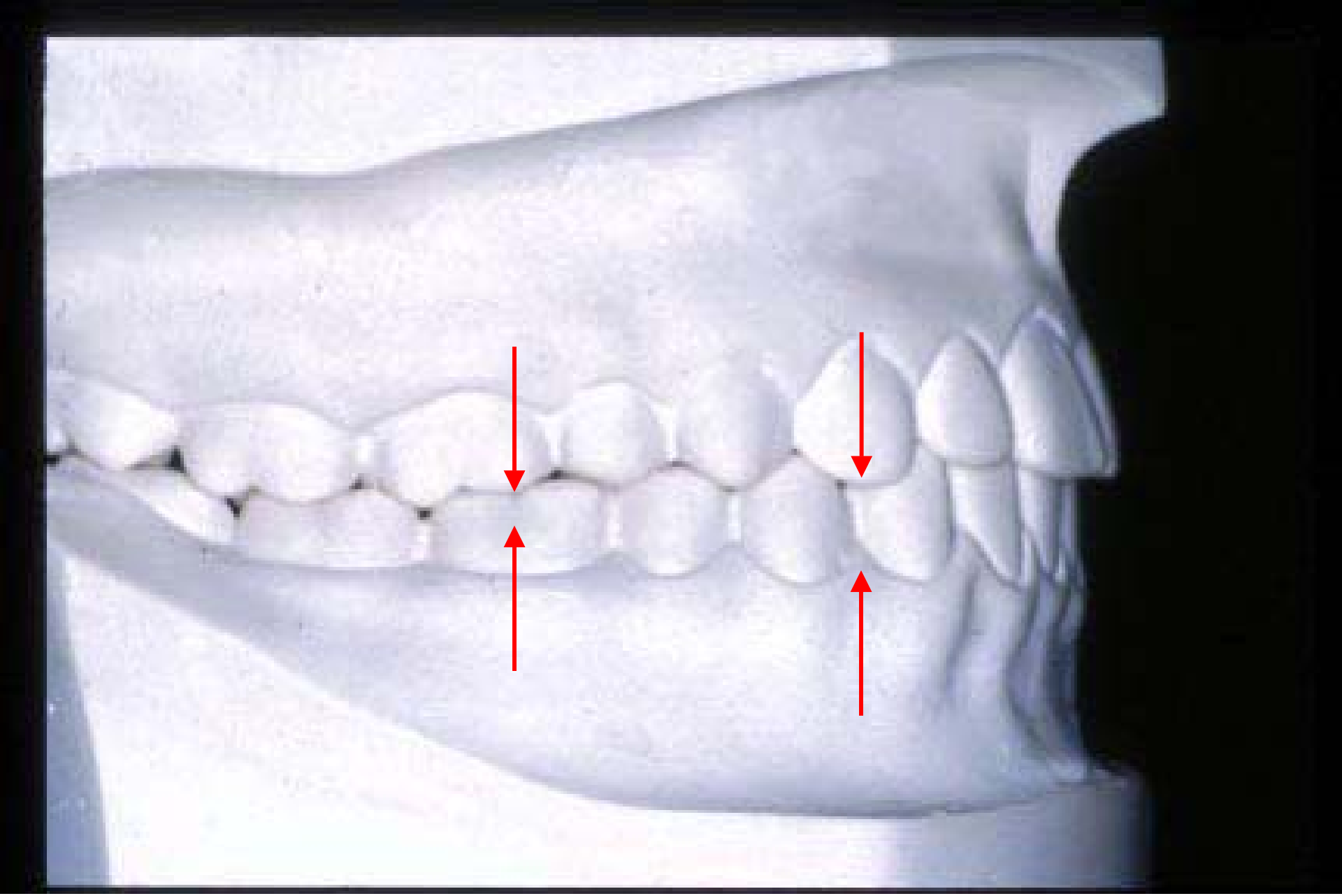
BMI = body mass index

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

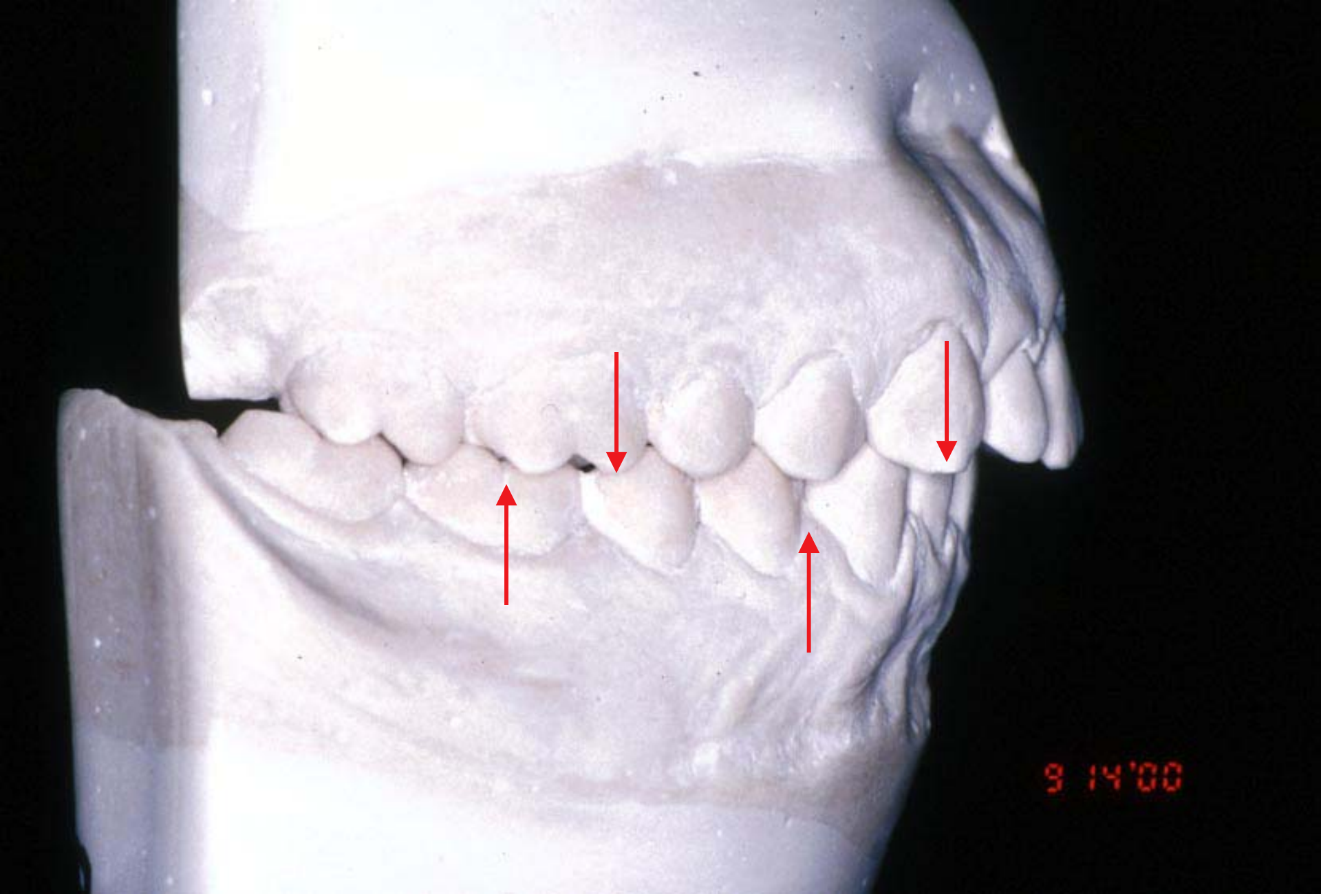
A5

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.



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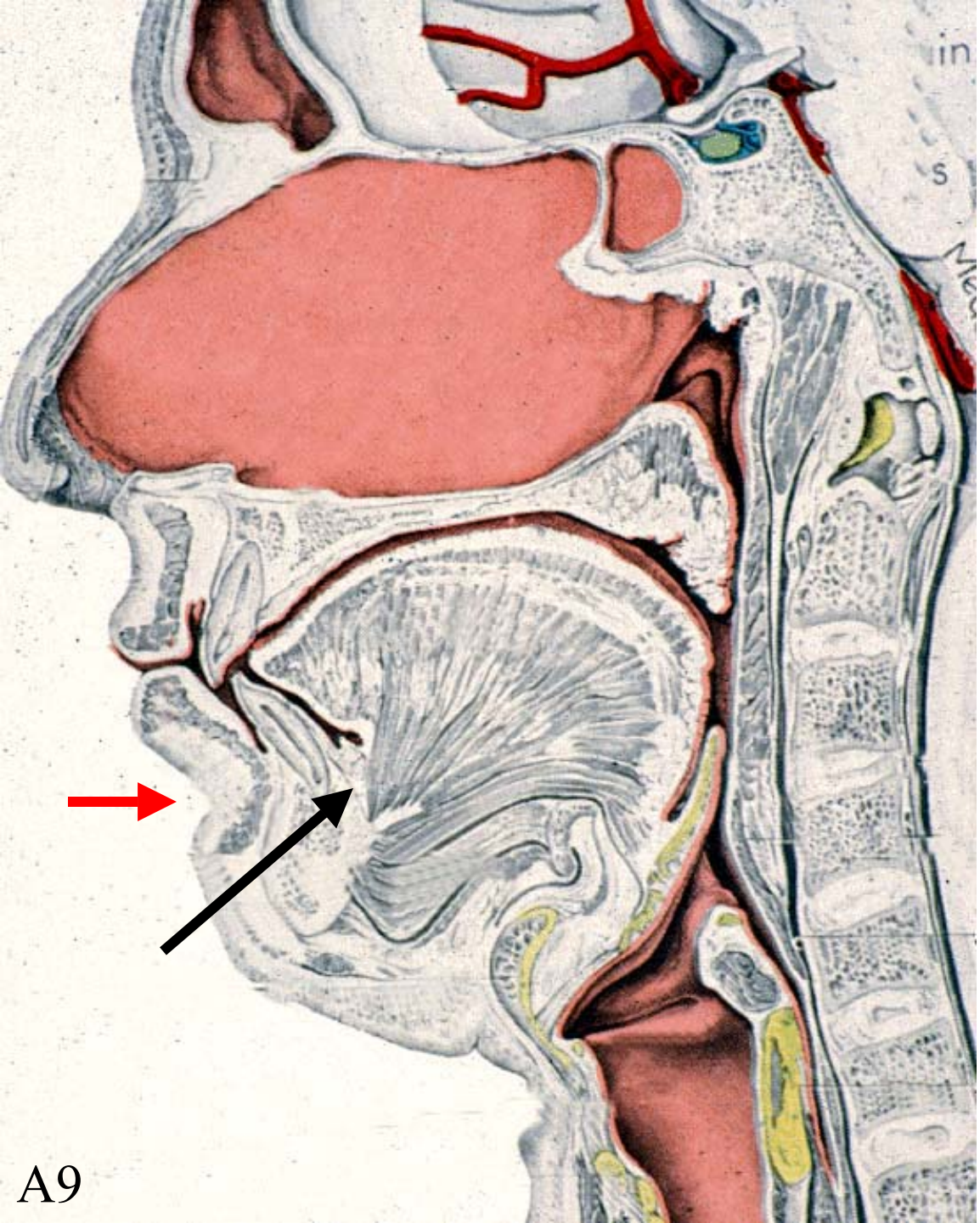
Class II - retrognathic malocclusion.

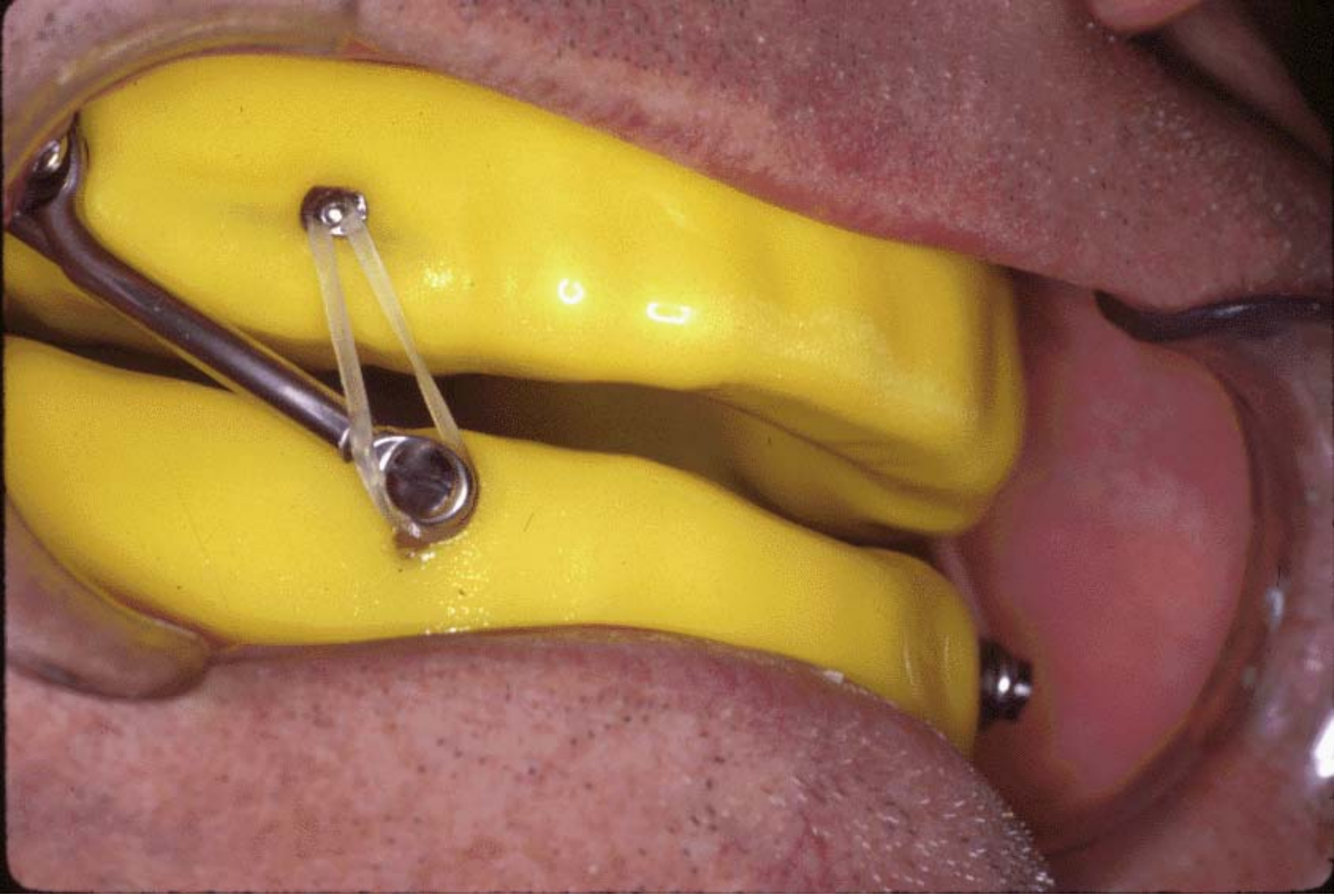


A retruded mandible can drive tongue back into throat and can block off airway. A retruded tongue can also elevate the soft palate which in turn can block off the airway and eustachian tubes.

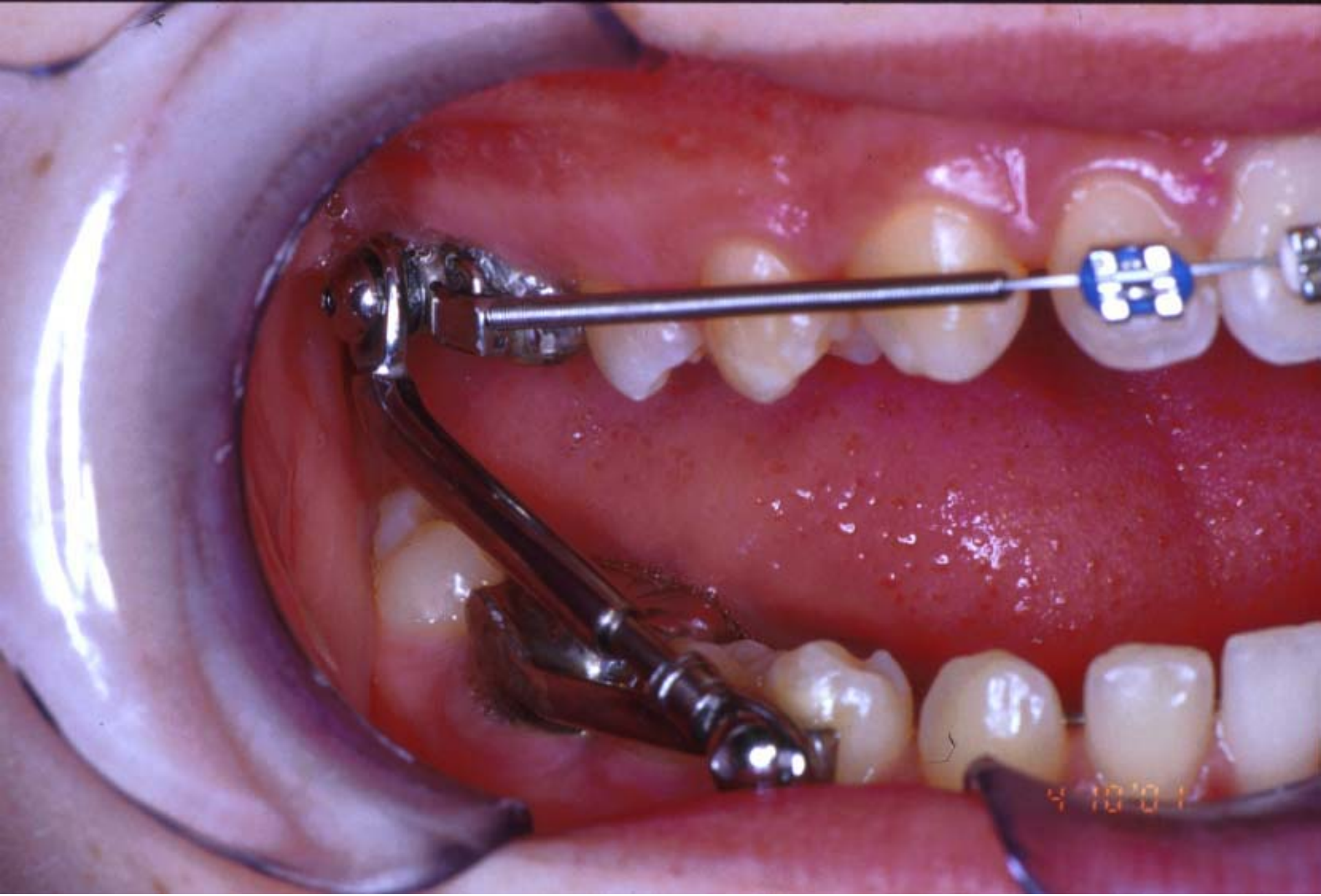
Black arrow shows insertion point of tongue into lingual(tongue) side of mandible (lower jaw).

(Grant's Atlas)

A9



A10 Herbst appliance in the mouth for treatment for OSA.



A11 Permanent Herbst appliance - age 11 1/2 years

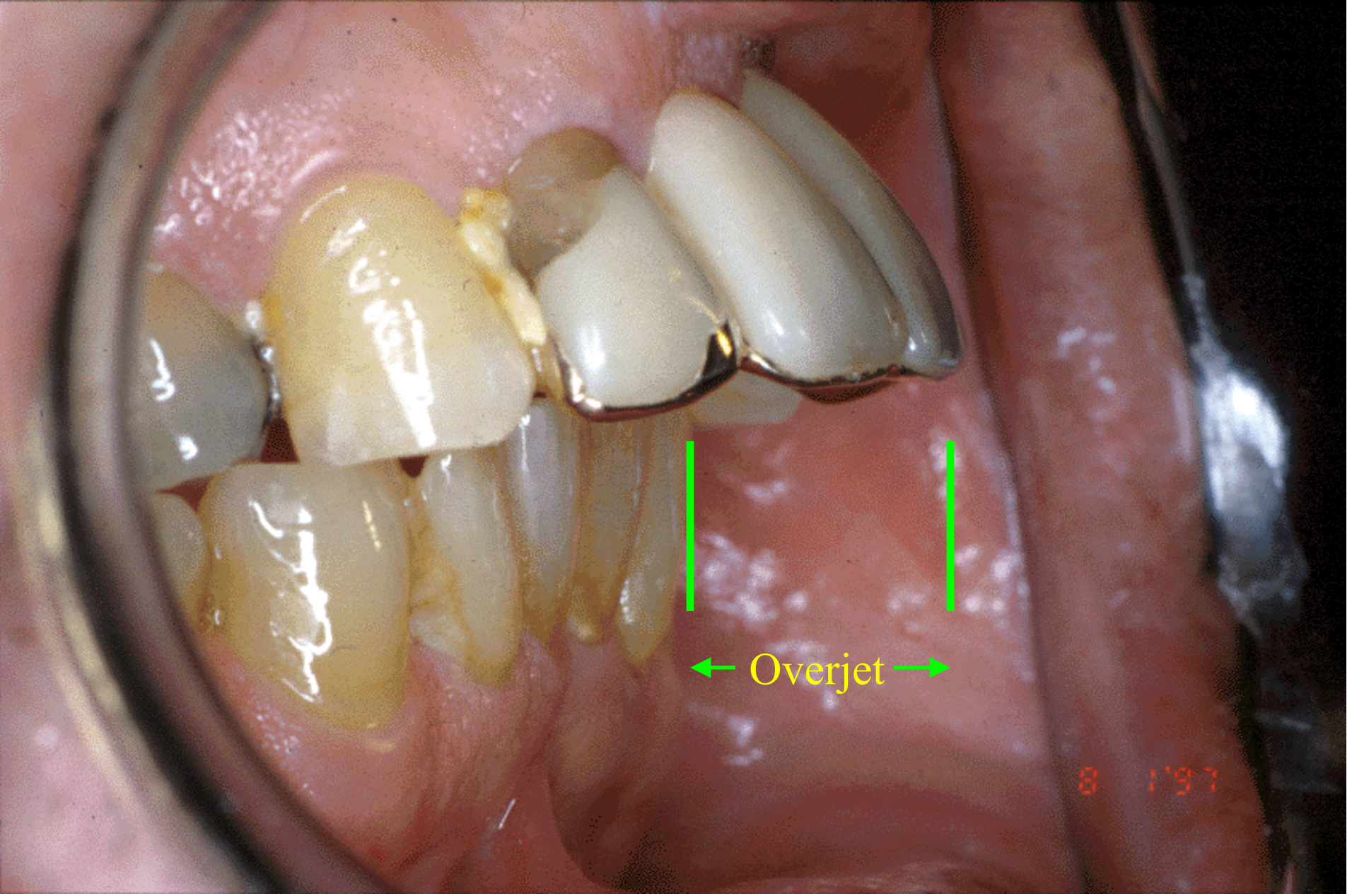
Patient with OSA who exhibits features of the formula.

Note large 20 inch neck size.

A12

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

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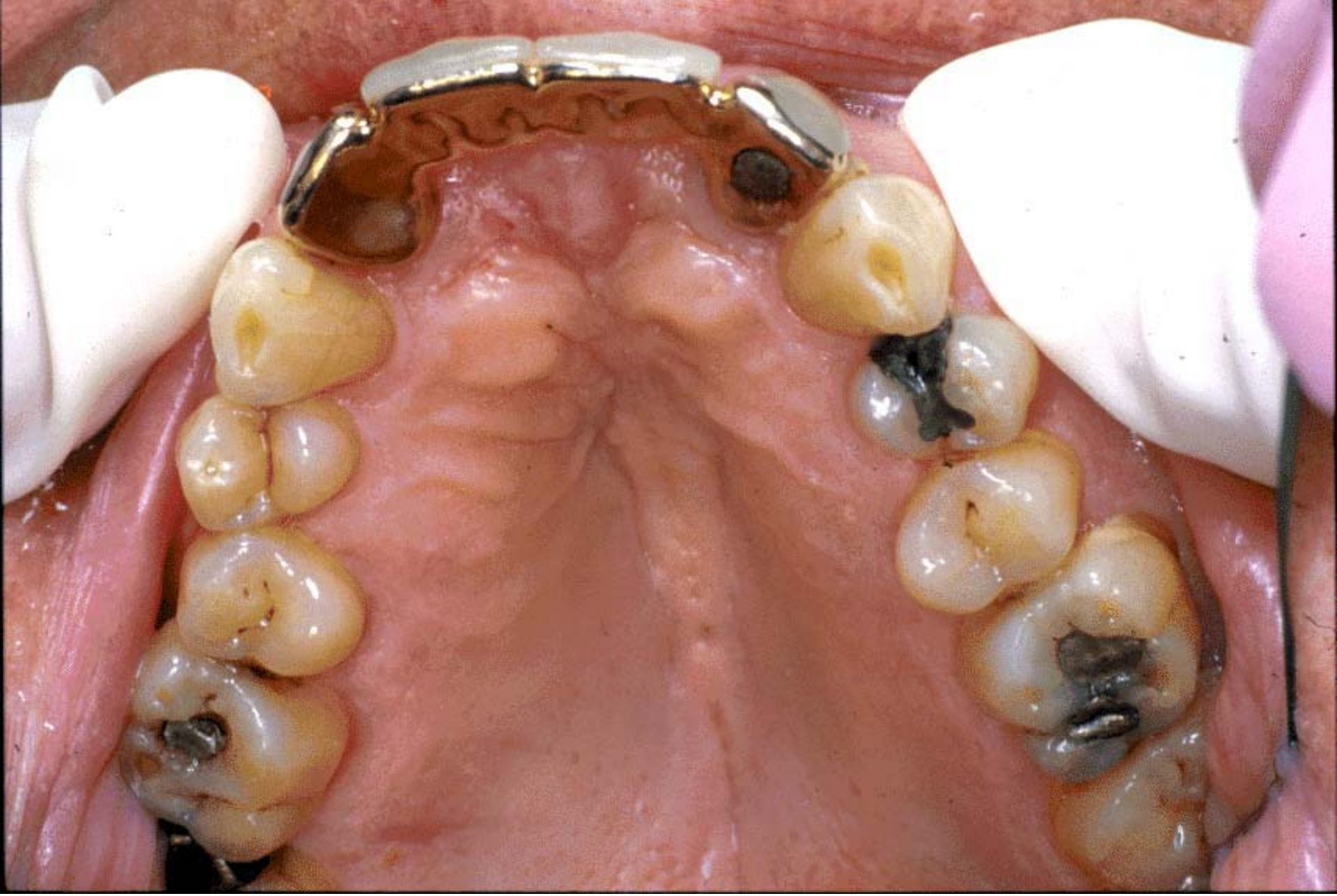
Overjet as seen from inferior view.



Patient has high palate and narrow arch.

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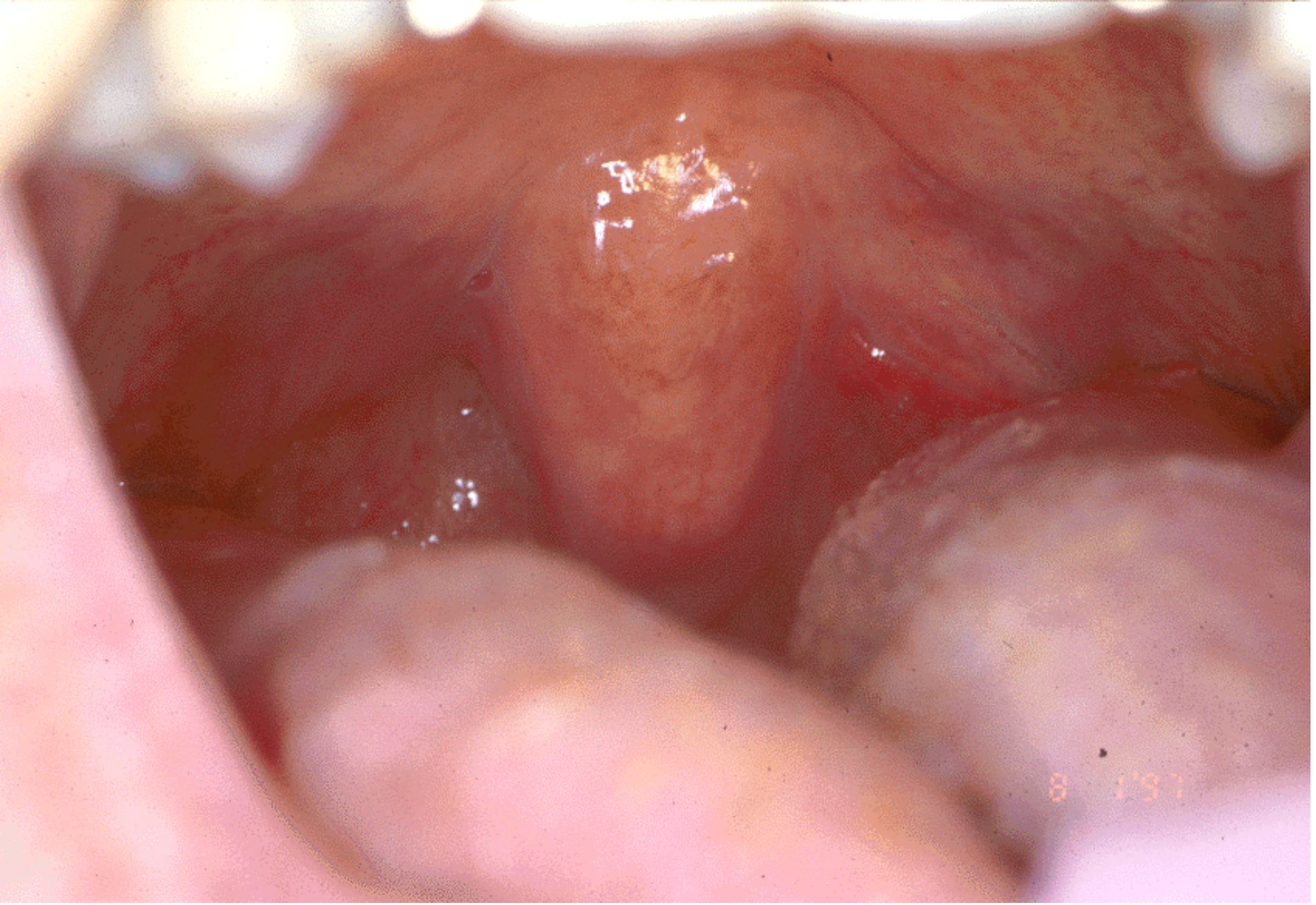


A17 Compromised oropharynx - too high of a risk for surgery.

A18 Added problem is that he has a large tongue.

A19 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.

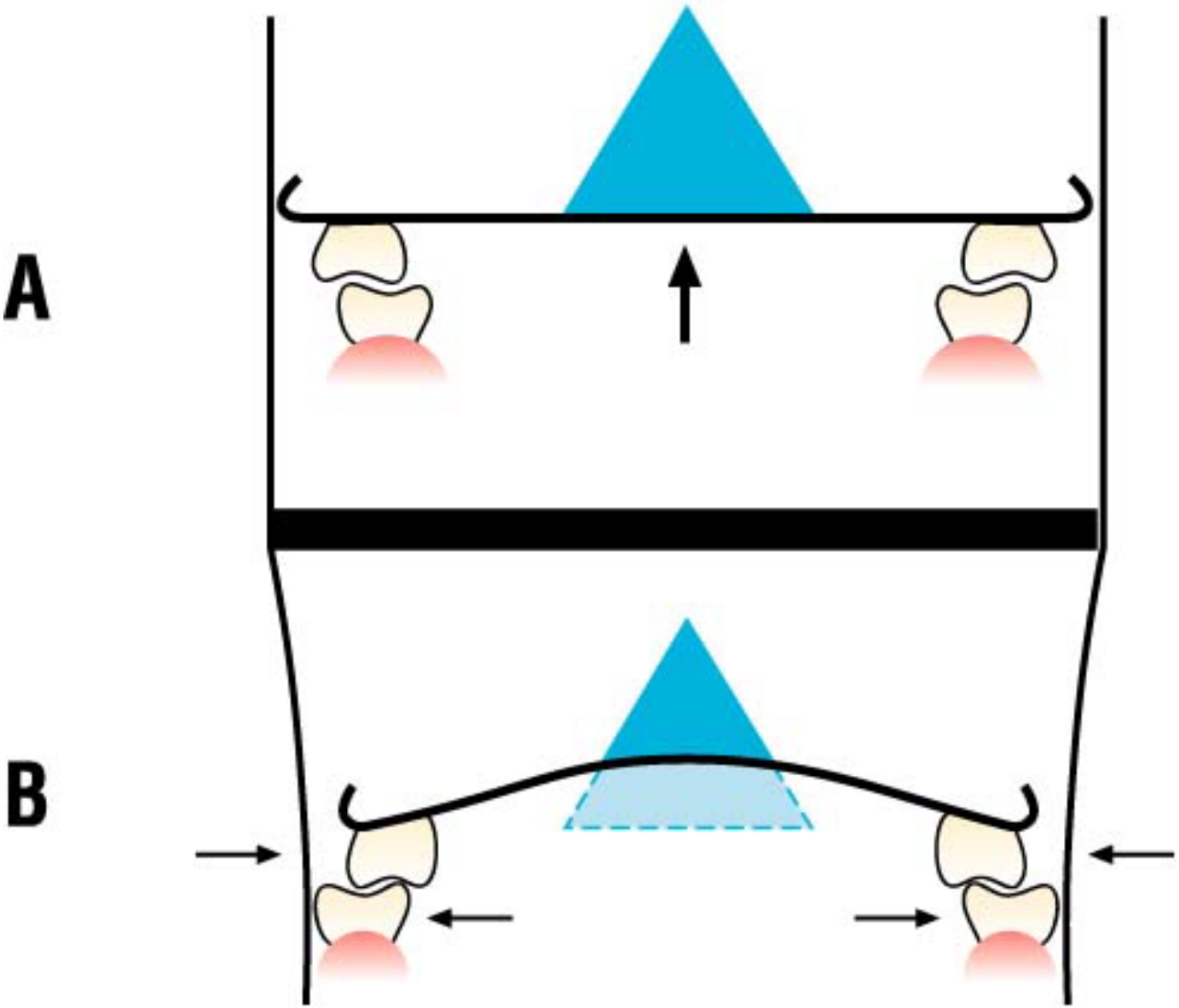
Calculating Body Mass Index (BMI)

BMI = Weight in lbs. x 704 / height in inches / height in inches.

Ranges for BMI

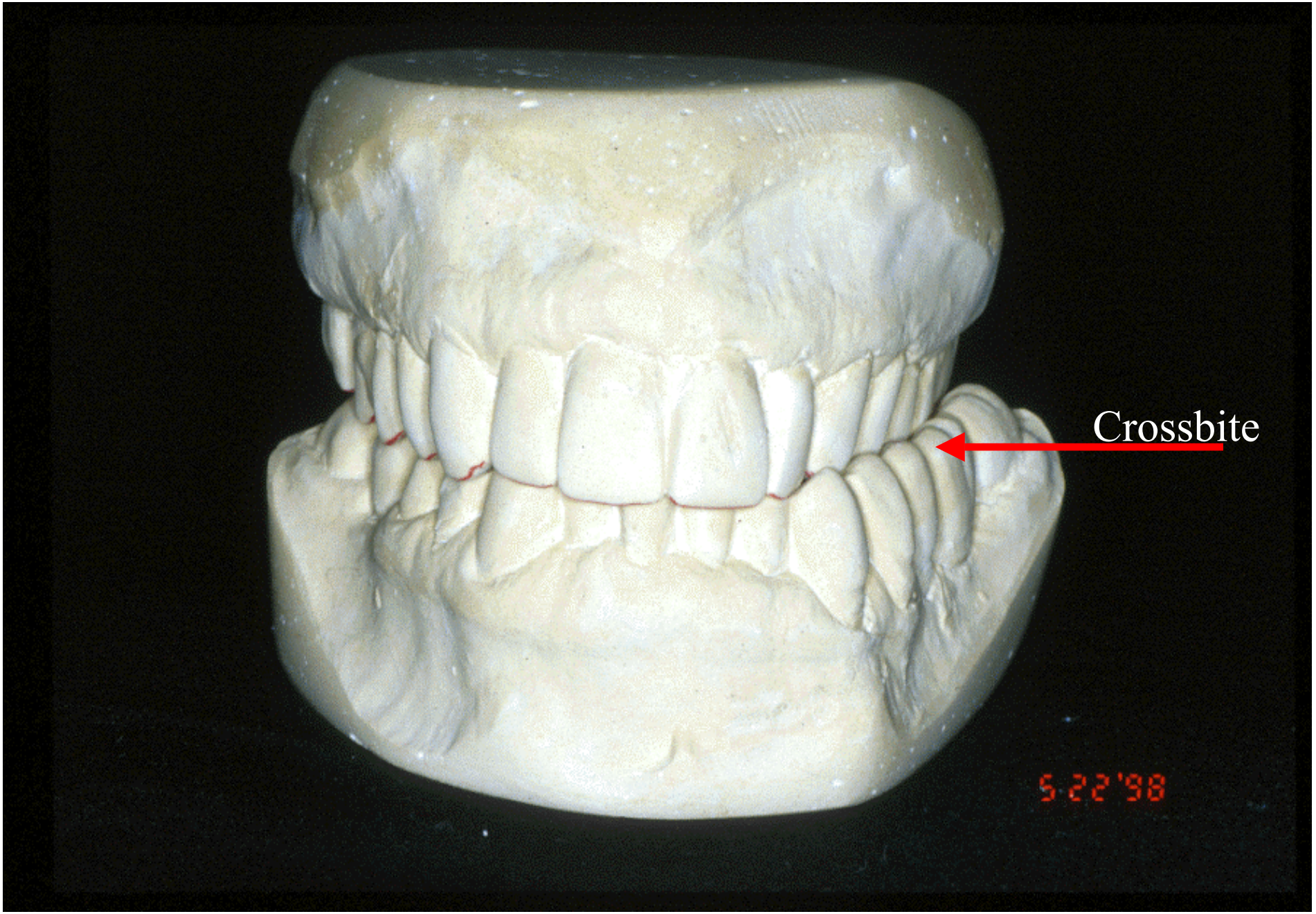
- Normal - 18.5 - 24.9
- Overweight - 25.0 - 29.9
- Obese - 30.0 - 39.9
- Extremely obese - > 40

Palate Formation

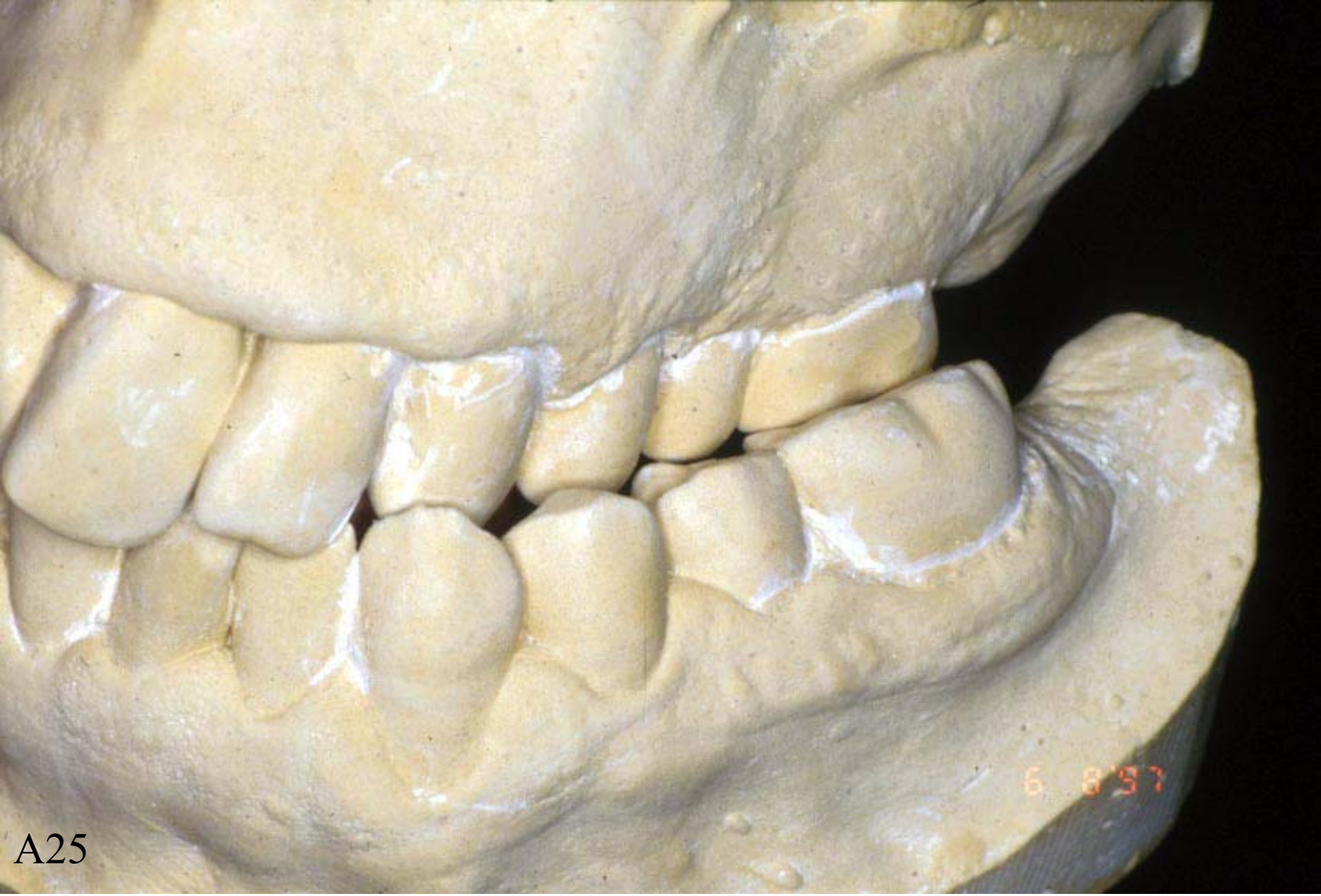


Upper and lower models of an adult demonstrating a high palate and narrow upper dental arch. Tongue force has created wide lower arch. See next slide.

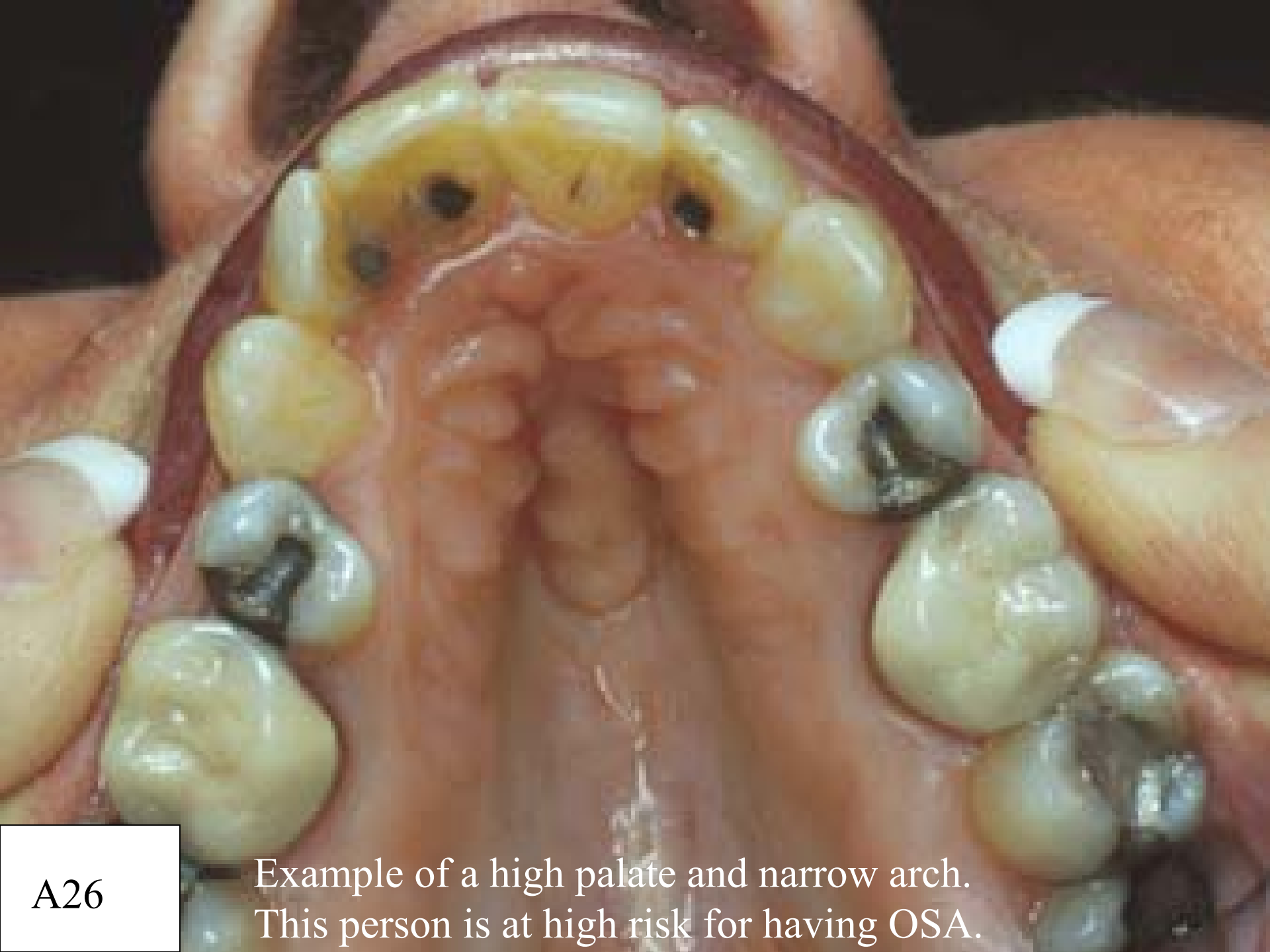
A23



A24 Patient's left side is in crossbite.

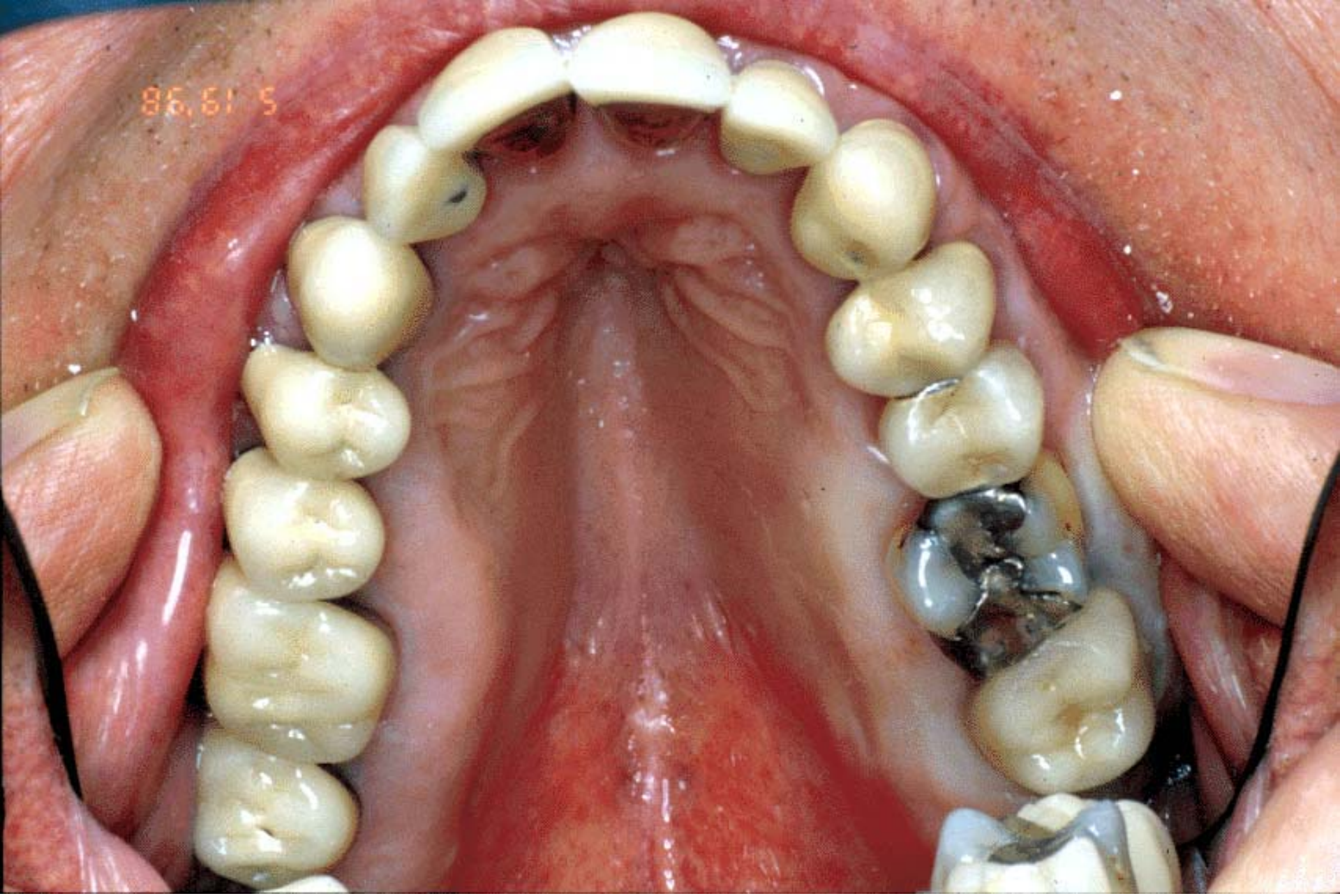


Models in crossbite - indicates a high palate and narrow arch.

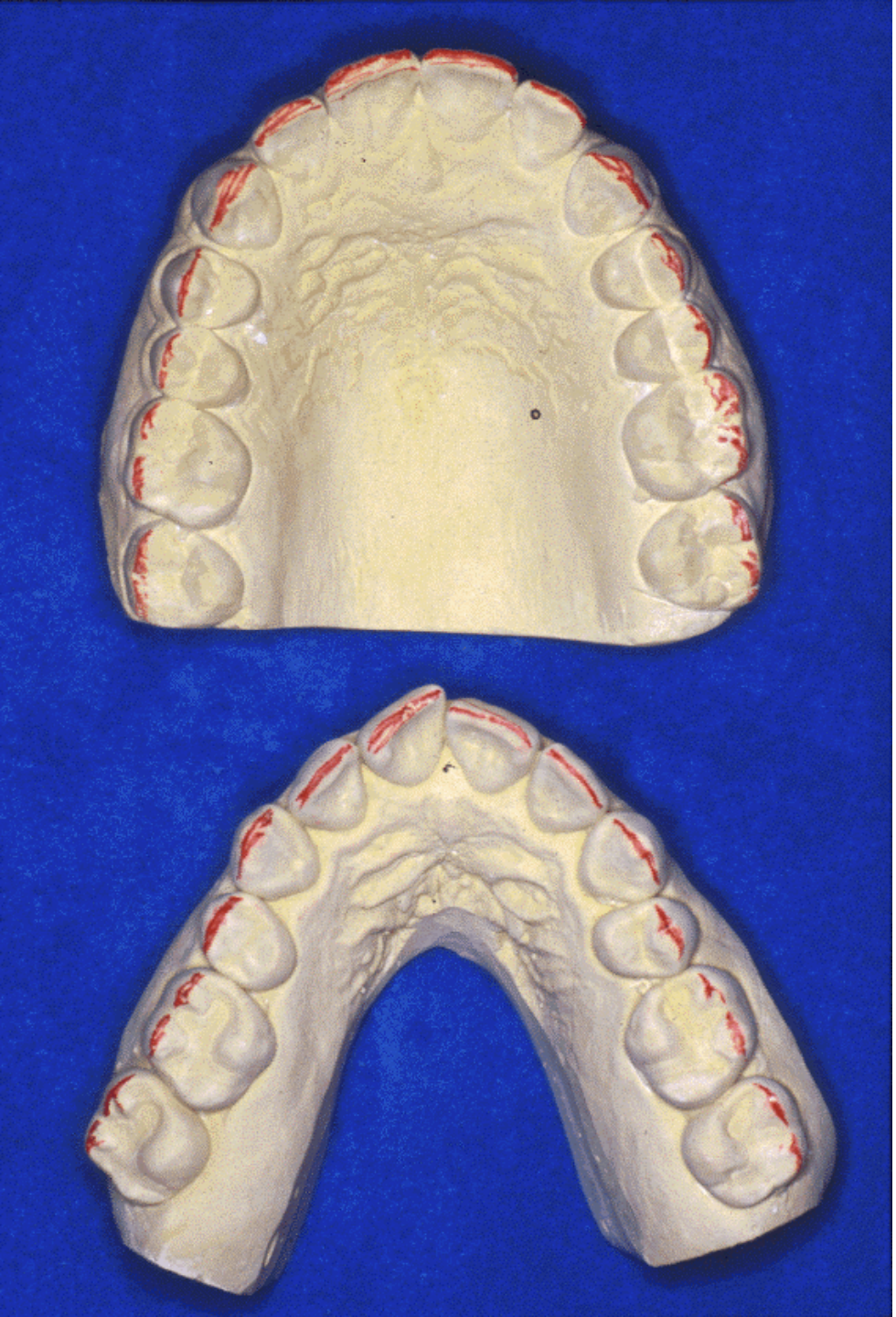


A26

Example of a high palate and narrow arch.
This person is at high risk for having OSA.

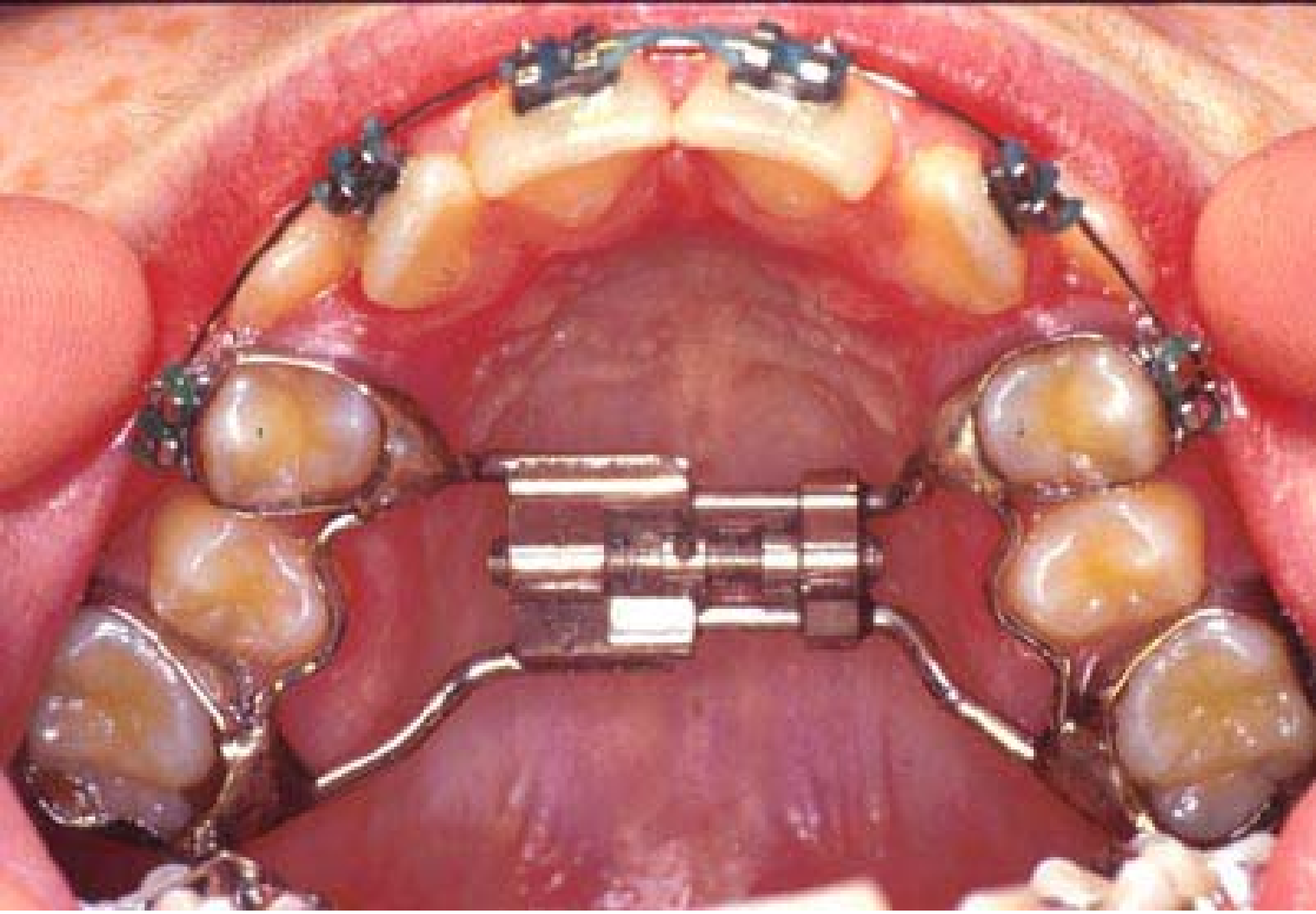


A27 Example of a high palate and narrow arch.



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.



A29 Rapid palatal expansion – one method of expanding arch.

Peter A. Cistulli et al. Treatment of Obstructive Sleep Apnea Syndrome by Rapid Maxillary Expansion. Sleep 1998, 21(8):831-35.

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

Age range: 14 - 37

Expansion: 12.1±1.5 mm over 24±2days

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.

Results showed a reduction in nasal airway resistance of 37% in patients treated with RME.

Timms, Donald J., **Rapid Maxillary Expansion** in the Treatment of Nasal Obstruction and Respiratory Disease, Ear, Nose and Throat June 1987;66(6):242-46.

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.

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

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.

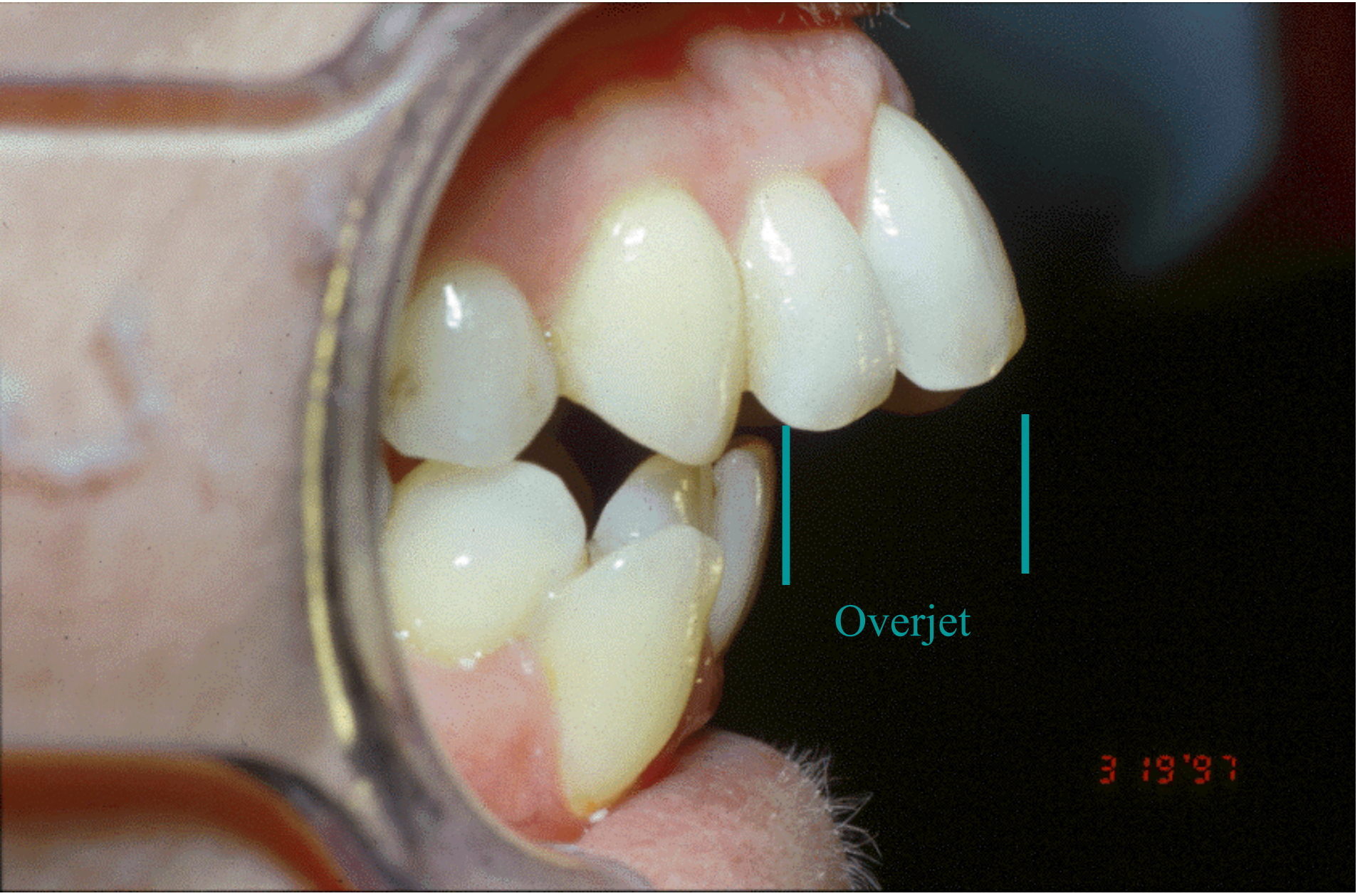
Tongue activity and OSA

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

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.

Another patient with high palate and narrow arch.

A36



Significant overjet.

A37

A38

Patient has overjet - inferior view.

This ‘abnormal tongue activity’ is what I generically refer to as a ‘ tongue thrust’.

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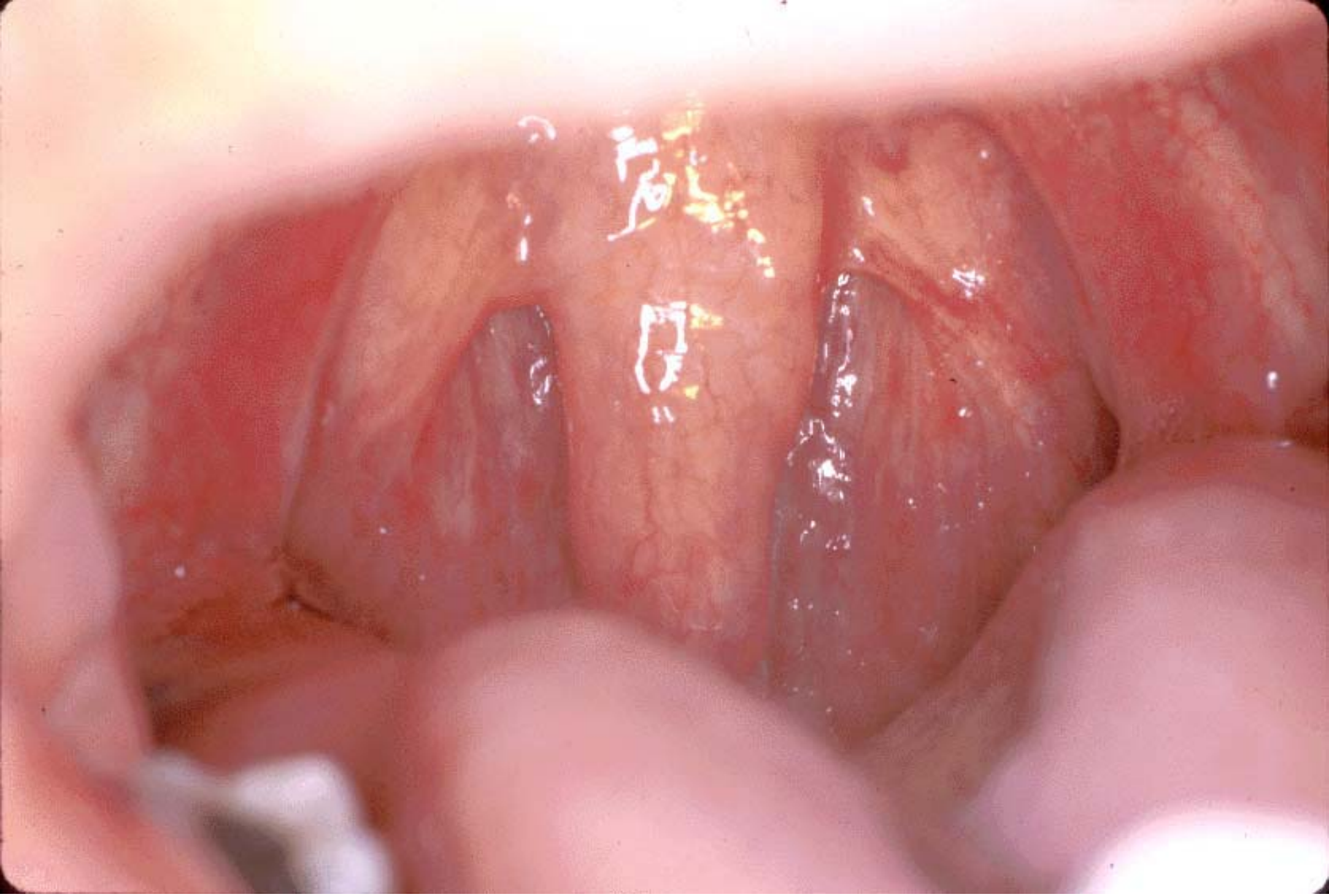
A40

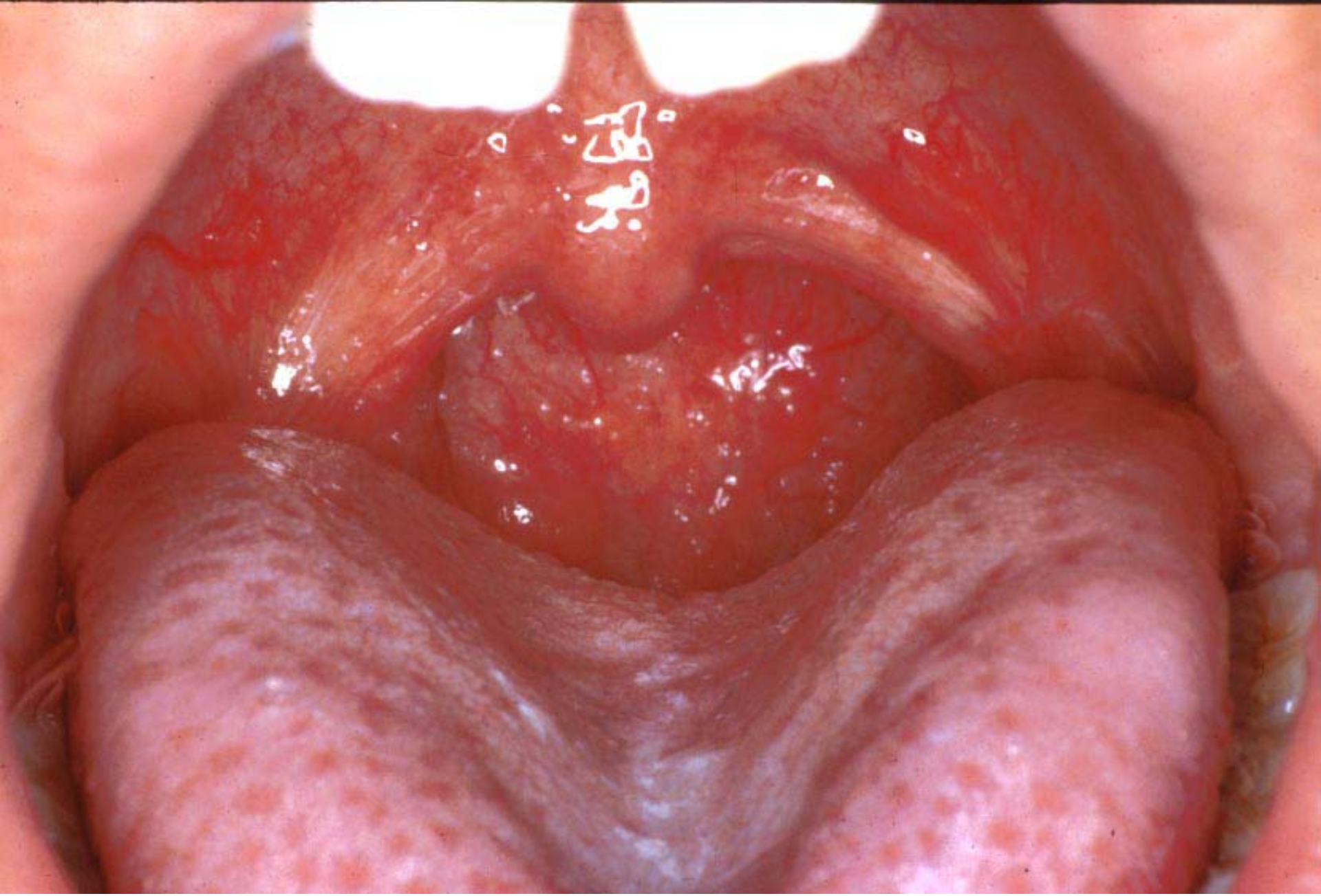
Note very elongated soft palate.



A41

Massive uvula could obstruct airway.

A42 Massive tonsils could obstruct airway – 12-year-old.



A43

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 comon cause of OSAS in otherwise healthy children. Behavior problems and quality of life tend to improve after adenotonsilectomy and resolution of the sleep-disordered breathing.

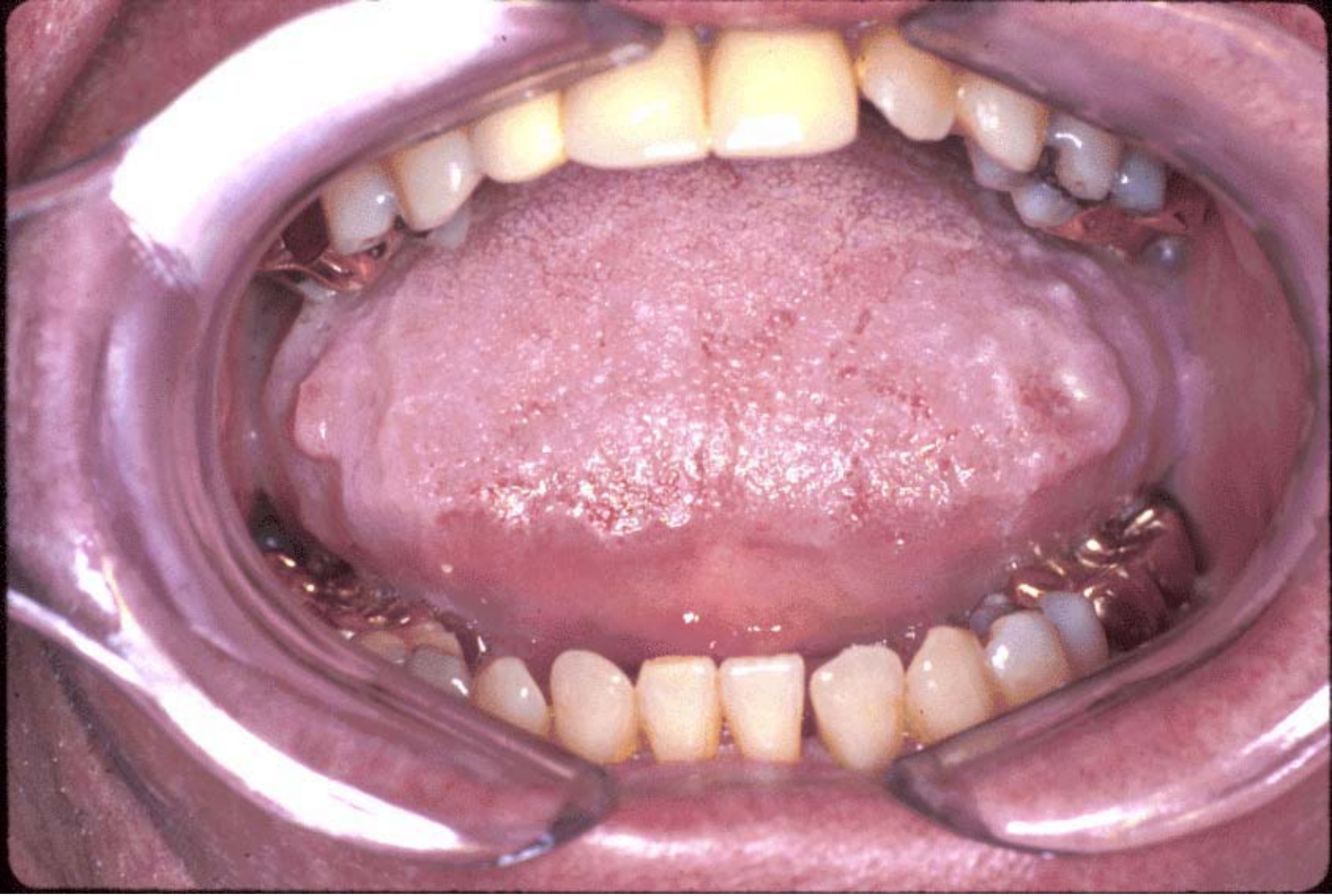
Study showed an improvement of 11 points in IQ in the Mental Processing Composite following adentonsillectomy.

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

Bat-Chen Friedman et al. Adenotonsillectomy Improves Neurocognitive Function in Children with OSAS. Sleep 2003;26(8):999-1005.

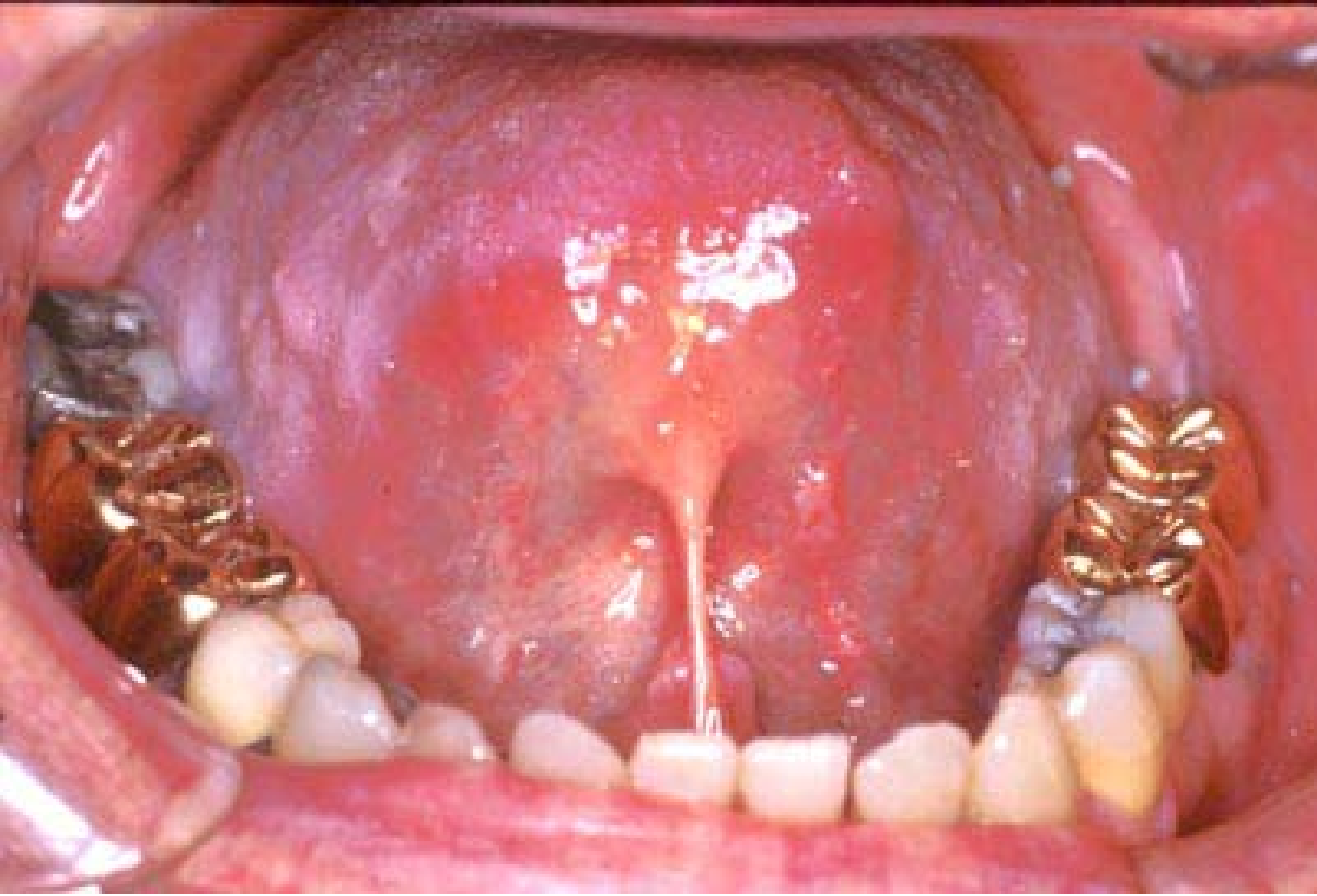
A45 Patient MUST sleep with CPAP every night for his sleep apnea.

A46 Person has had UPPP as one form of treatment.



A47 Massive tongue in patient with severe OSA.

A48 Close-up of lateral indentation on tongue.

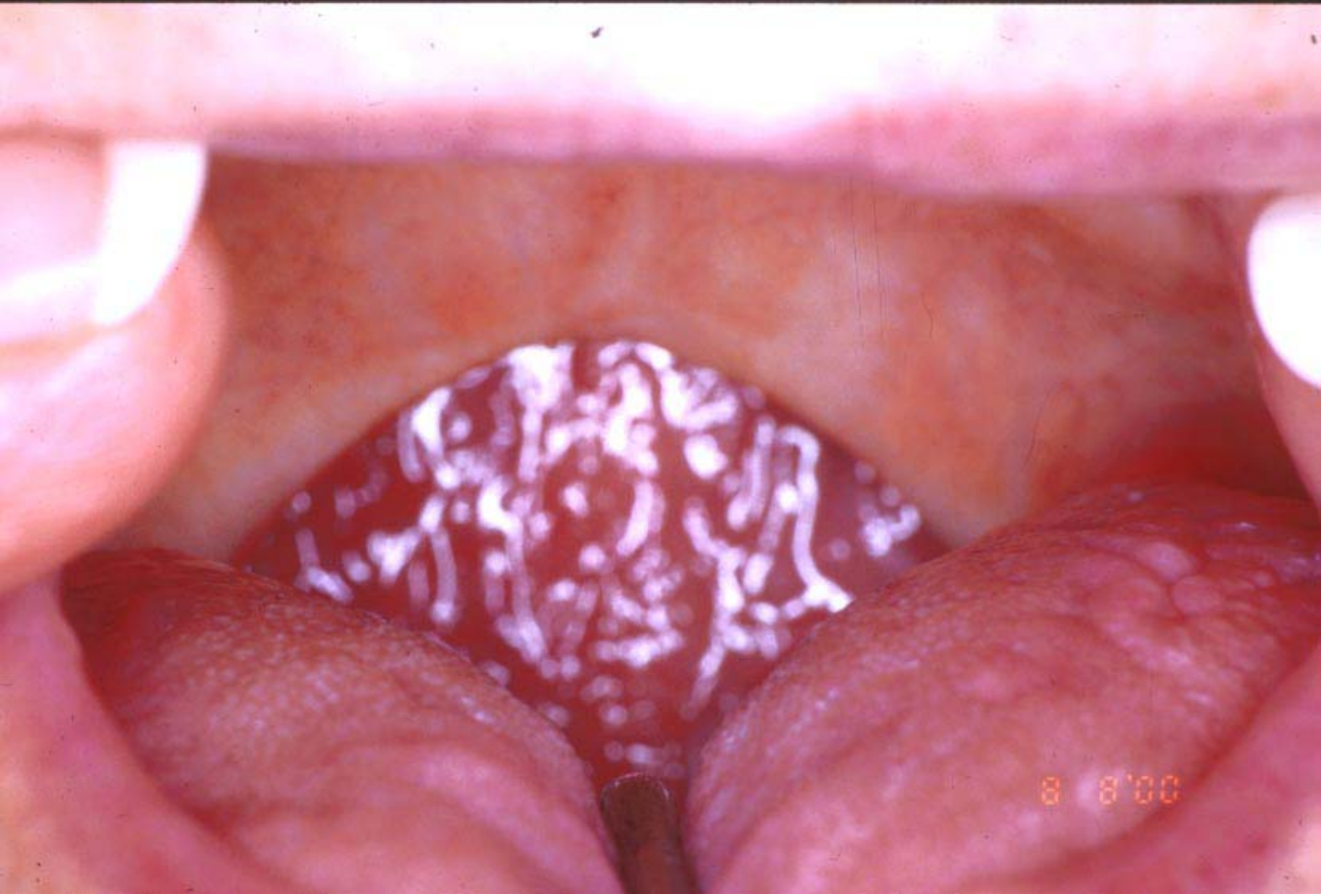


A49

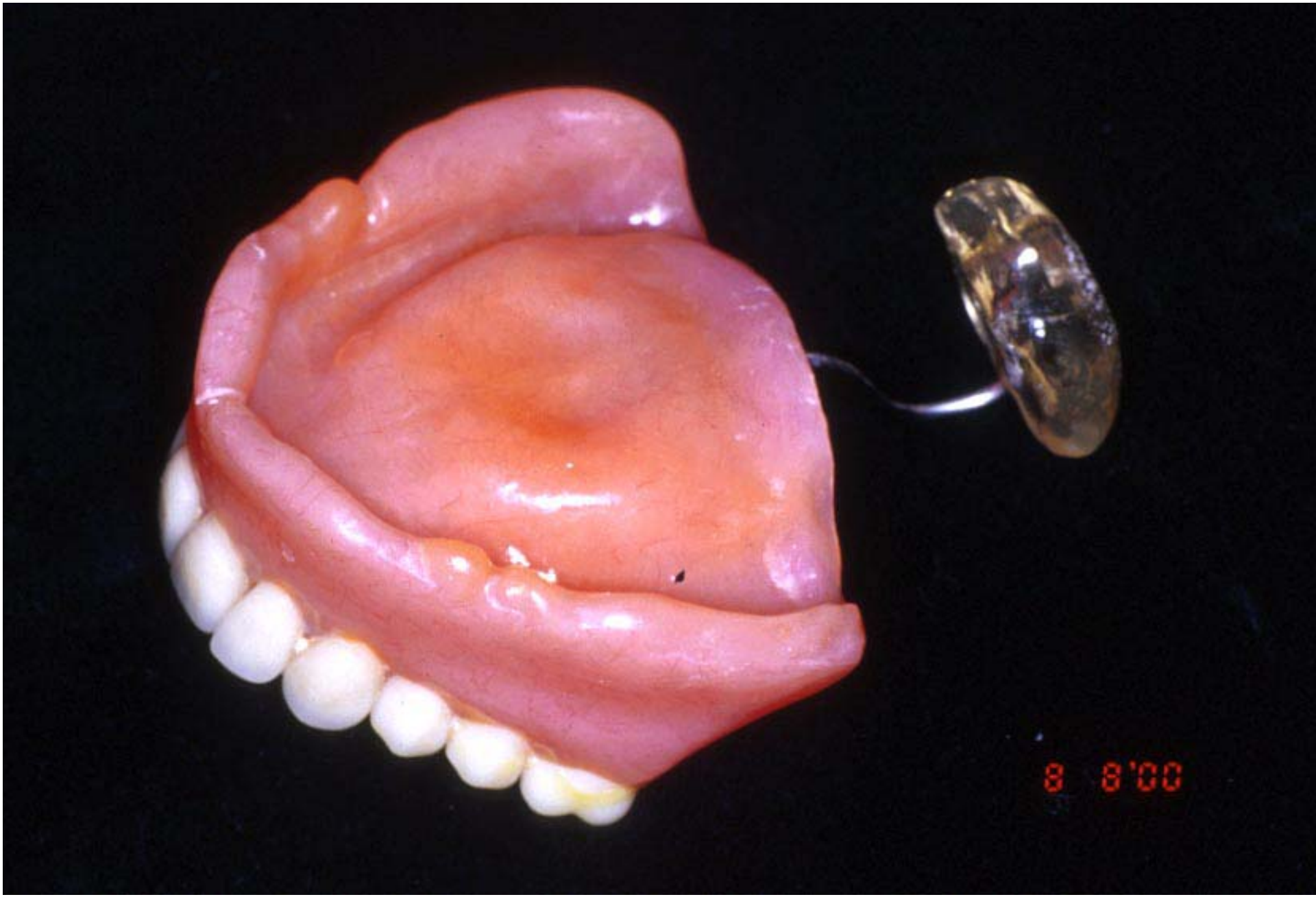
Demonstrates tight frenulum and large tongue (macroglossia).
Similar to Down's Syndrome case.

A50 Tongue thrusting between teeth during swallow.

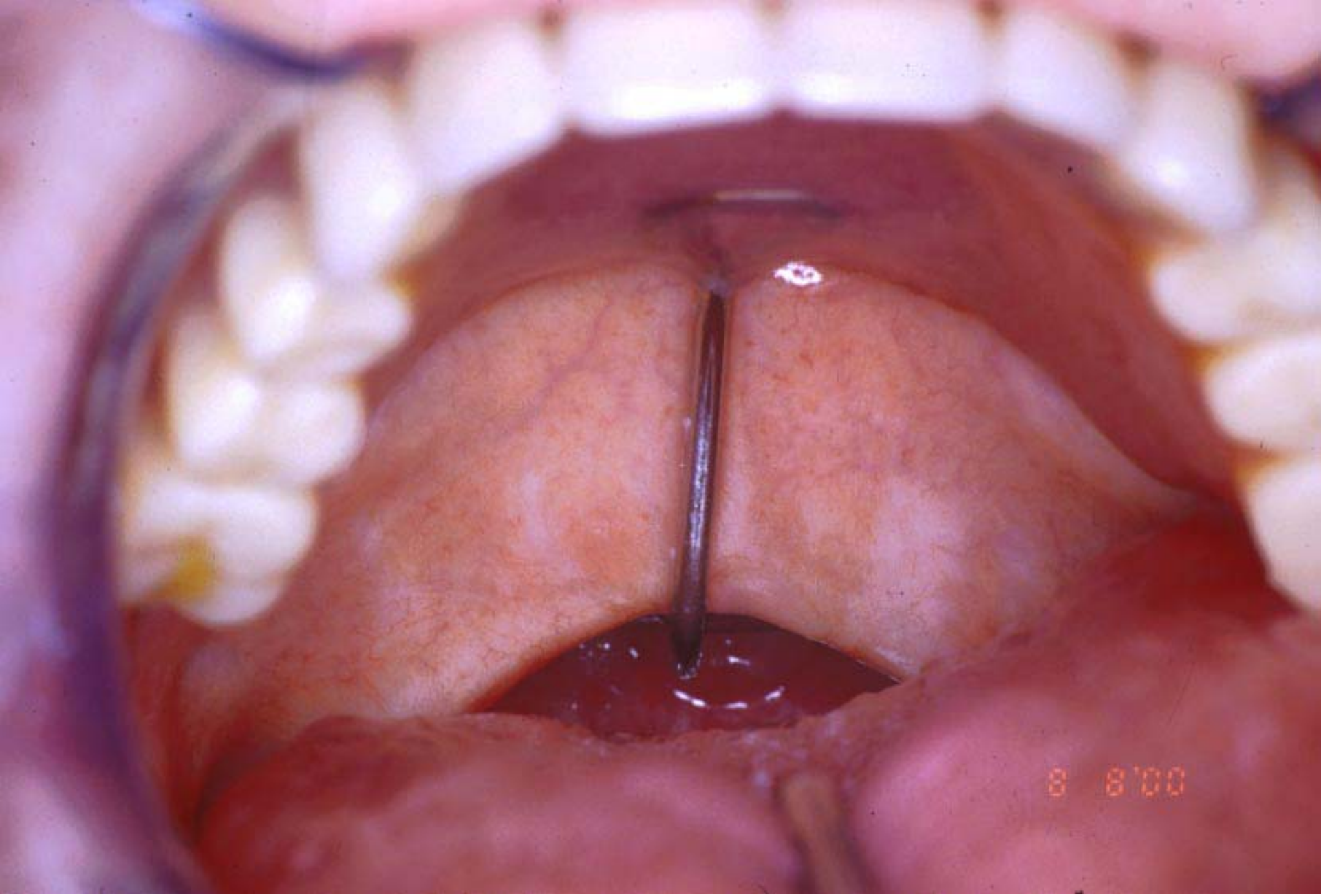
A51 Subtle open bite due to tongue thrust.



A52 Too much tissue removed during this UPPP.

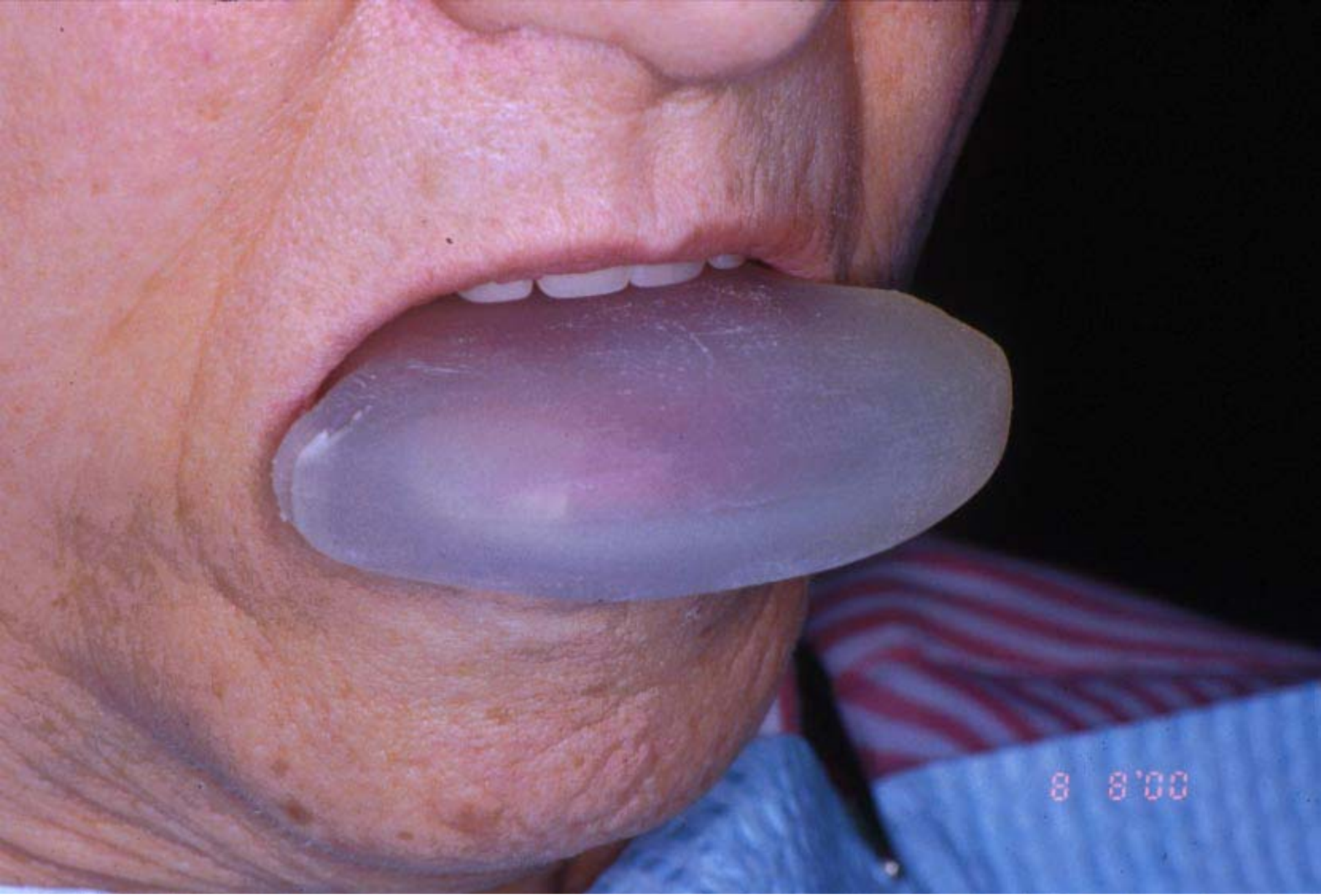


A53 Obturator attached to upper denture.



A54 Obturator and denture in mouth.

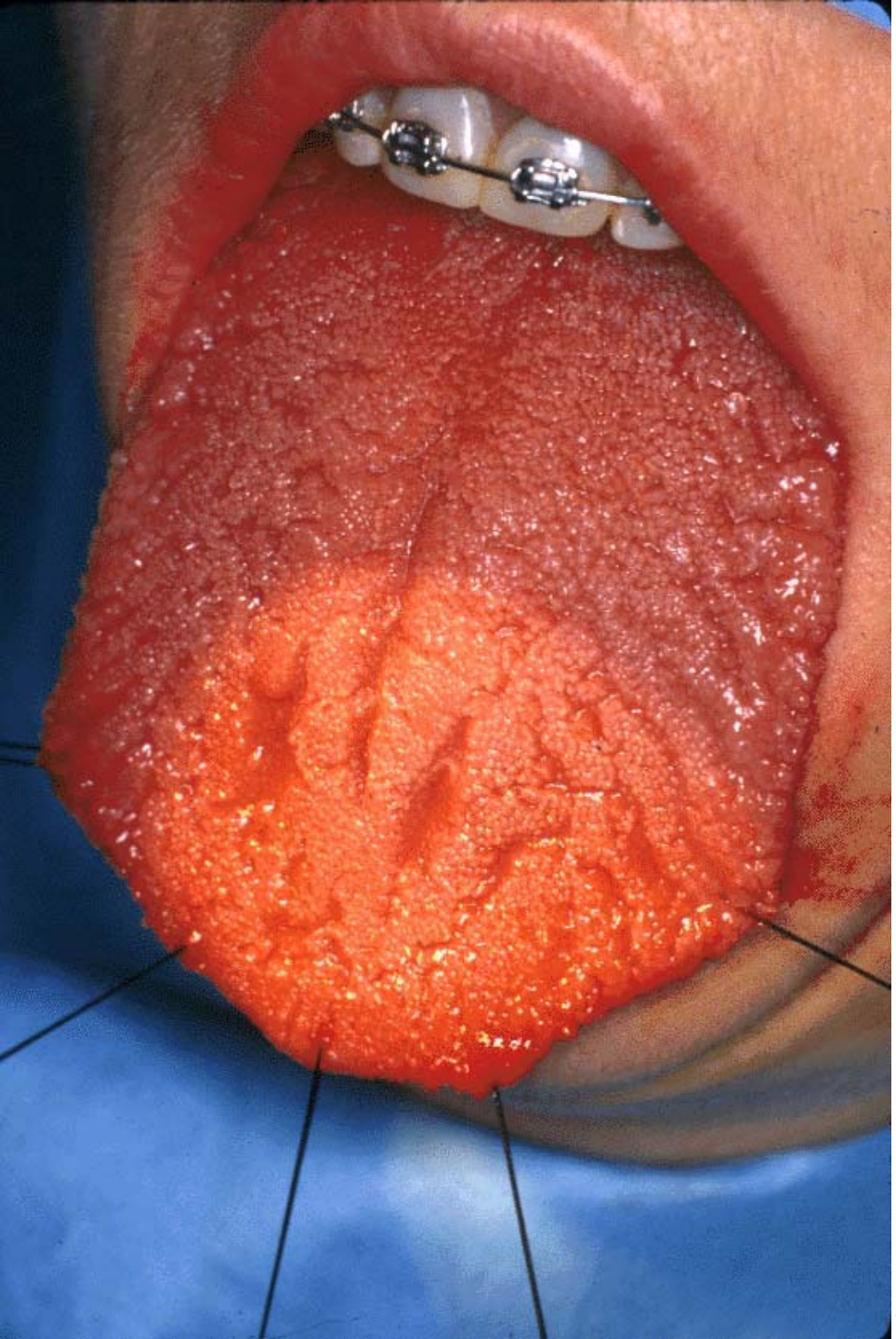
A55 Large tongue was contributing factor to OSA.



A56

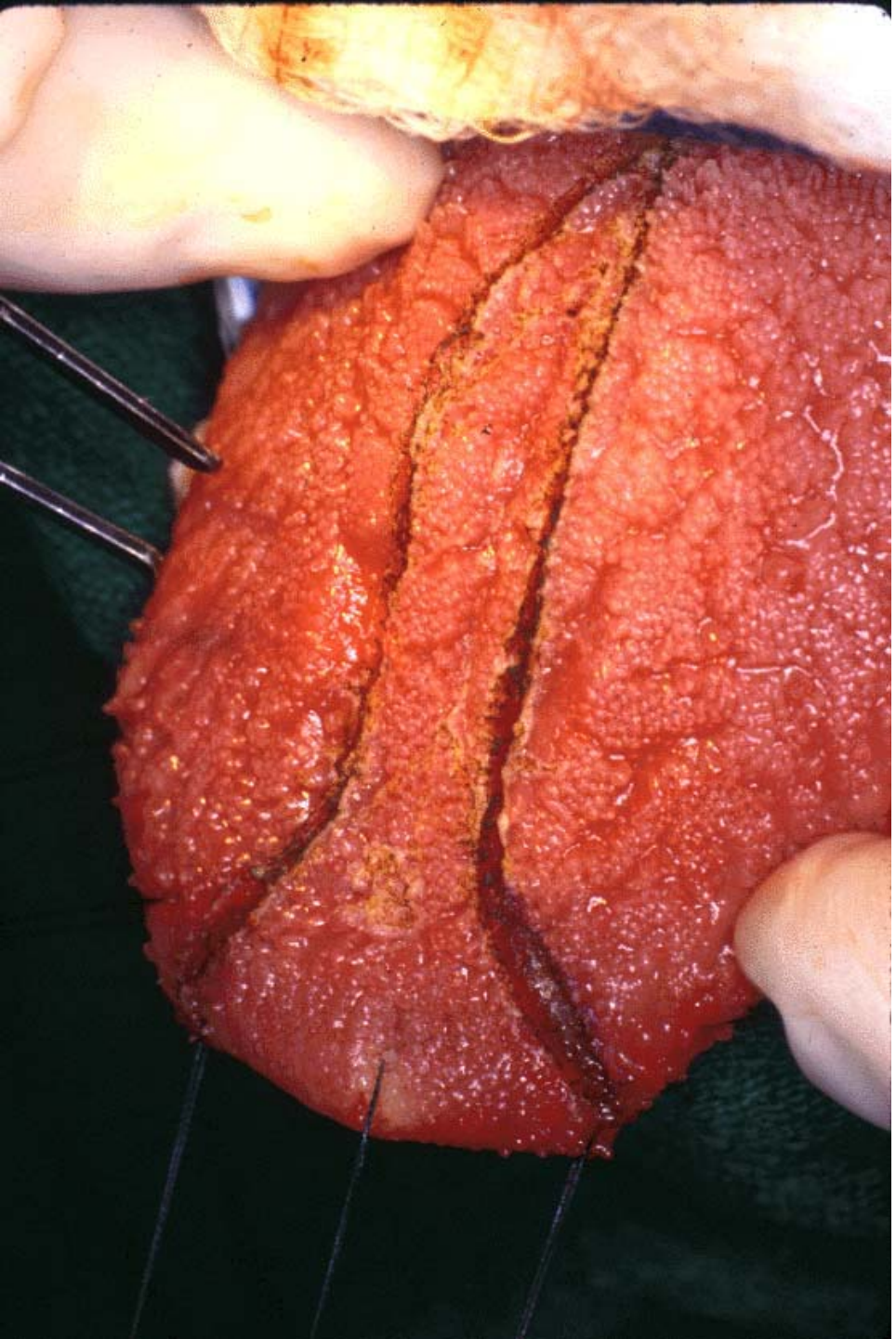
Snor-X in mouth.

Warning - Surgery-5



Preparing for tongue reduction surgery.

A57



Laser being used to outline area of tongue to be removed.

Front-middle-section of tongue being removed.

A59

Mid-section of tongue removed.

A60

Tongue being sutured.

A61

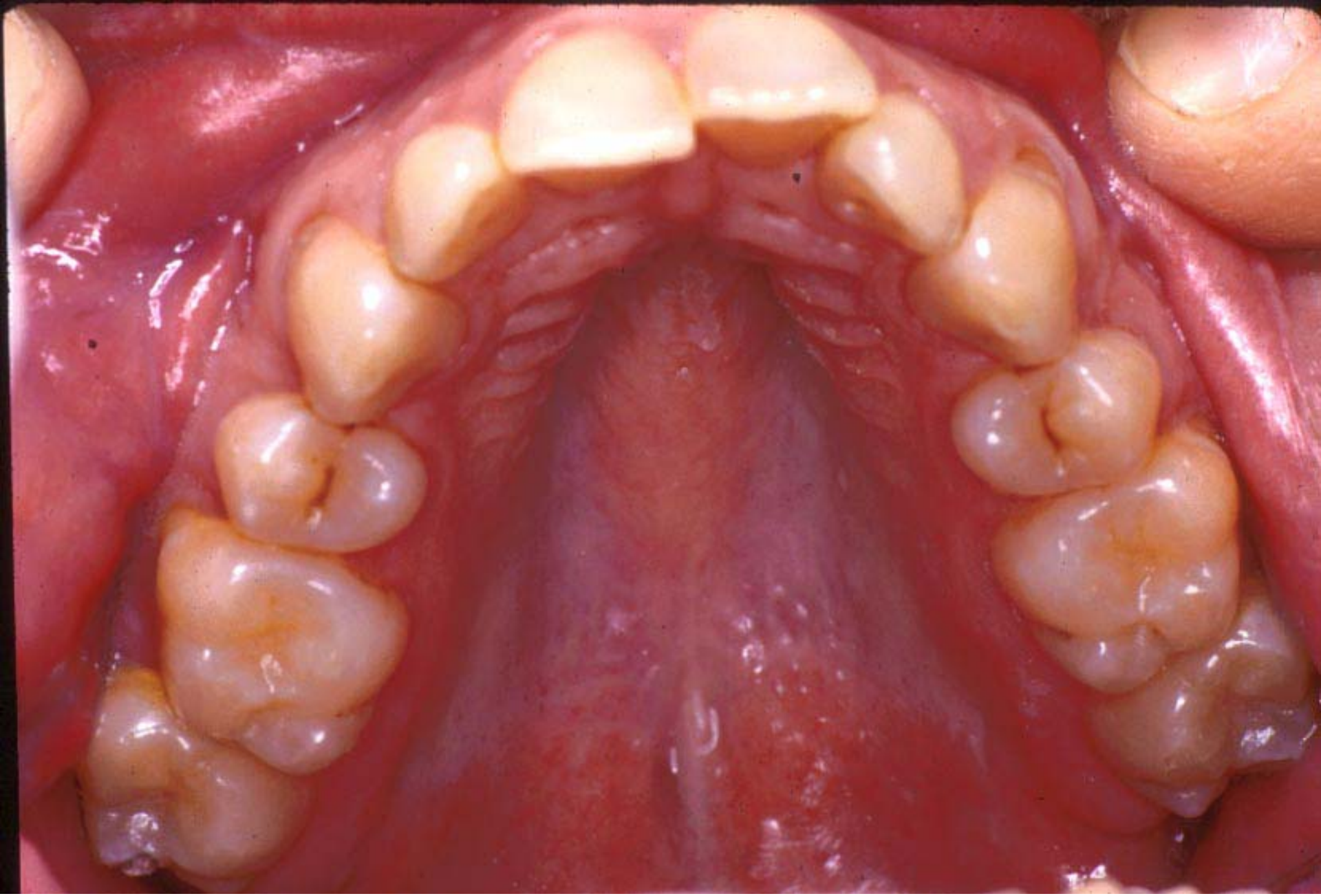
A62

Massive tori take up tongue space.

A high narrow nose can easily collapse and obstruct air flow.

A63

A64 Crossbite on both sides indicates a narrow dental arch.



A65 Removing 4 bicuspids for ortho reasons can be deadly!

A66 PM Positioner on models.