Aligning tongues and palates with Palatron

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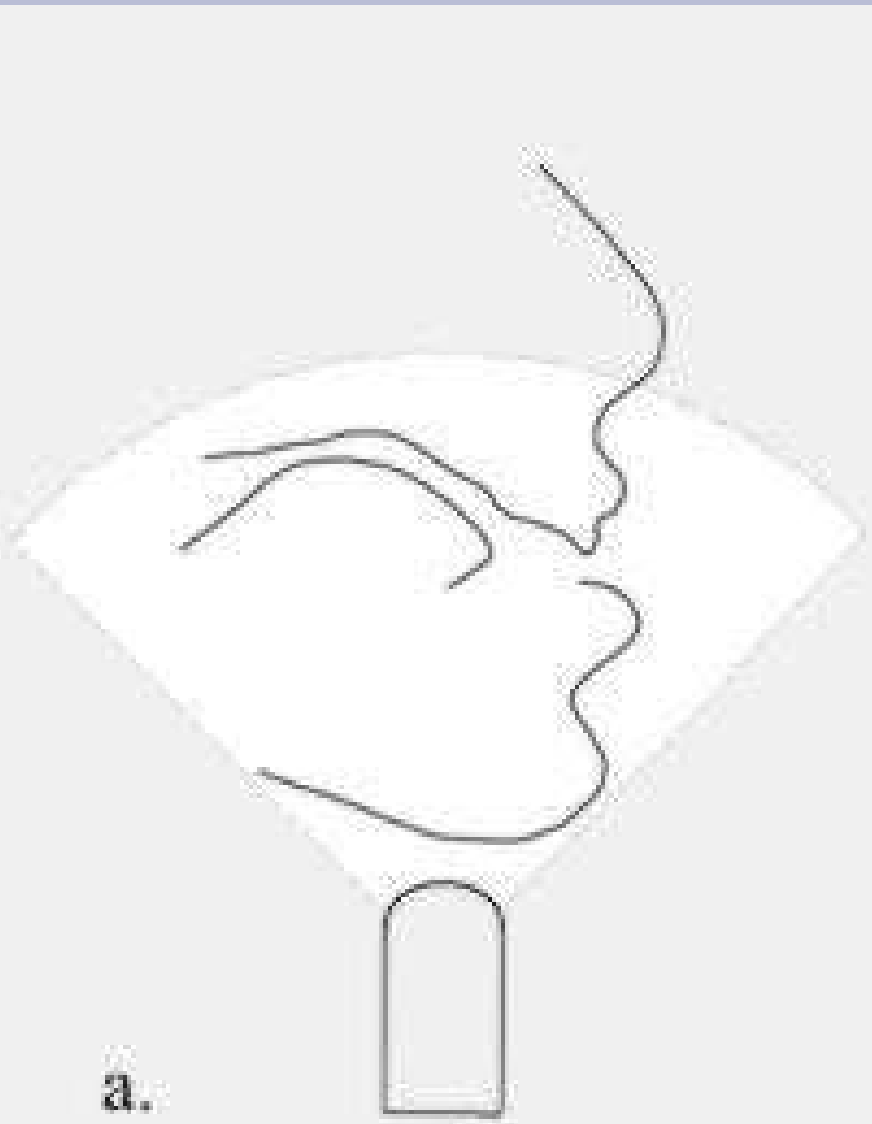
Goals

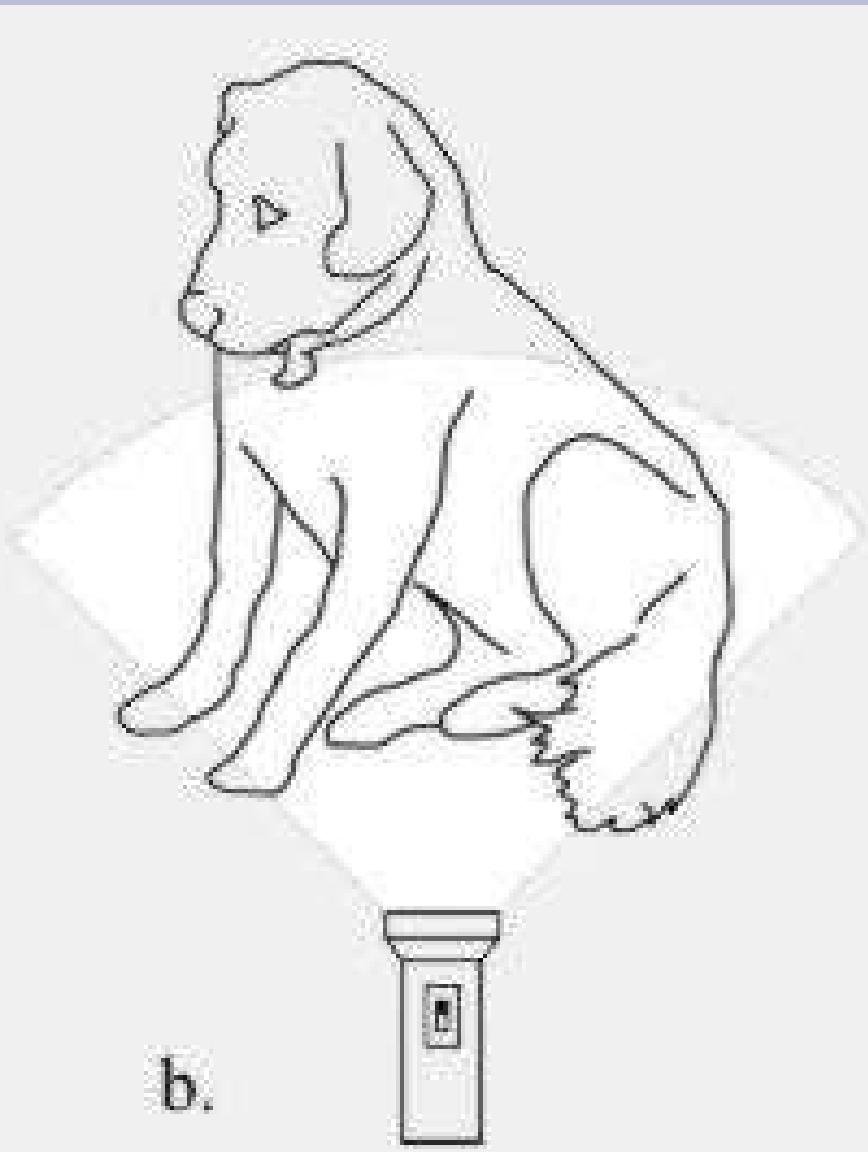
- Add fixed point of reference to ultrasound images.
- Add palate image to ultrasound images of the tongue.
- Avoid compromising portability and relative affordability of ultrasound.

Overview

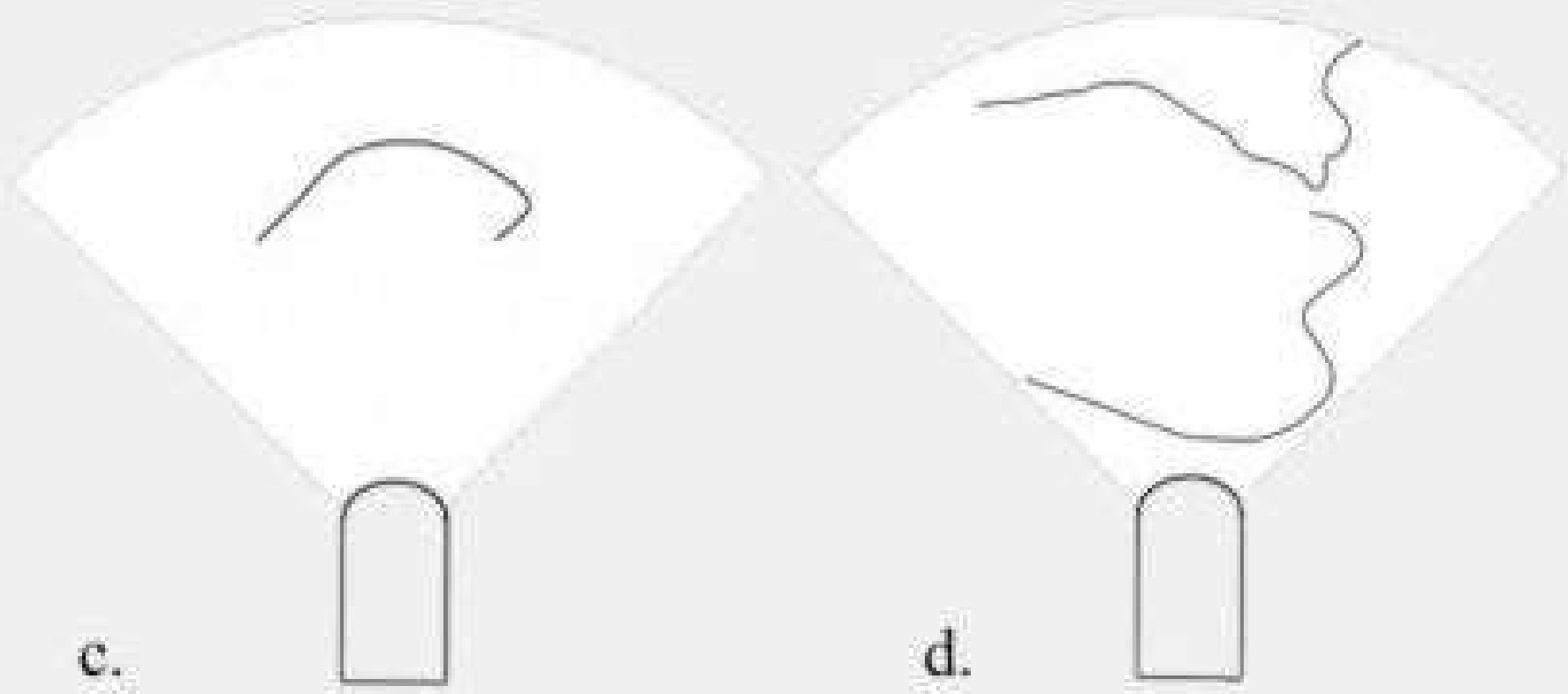
- Use video camera to track head and transducer movements.
- Use yogurt to create palate images.
- Implement an algorithm to correct for movements.
- Align images
  - tongues and palates
  - sequences

Two images

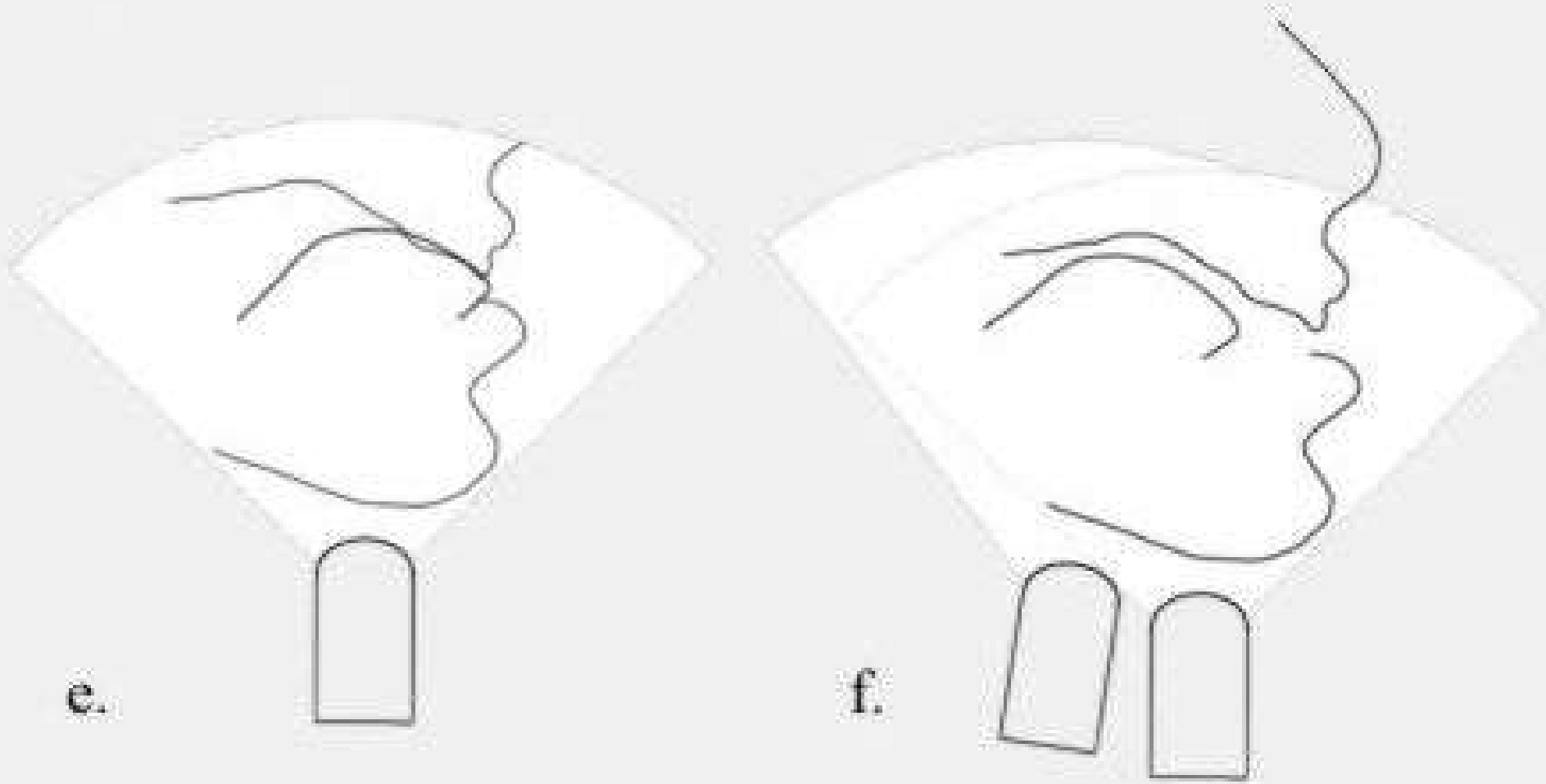




Two ultrasound images

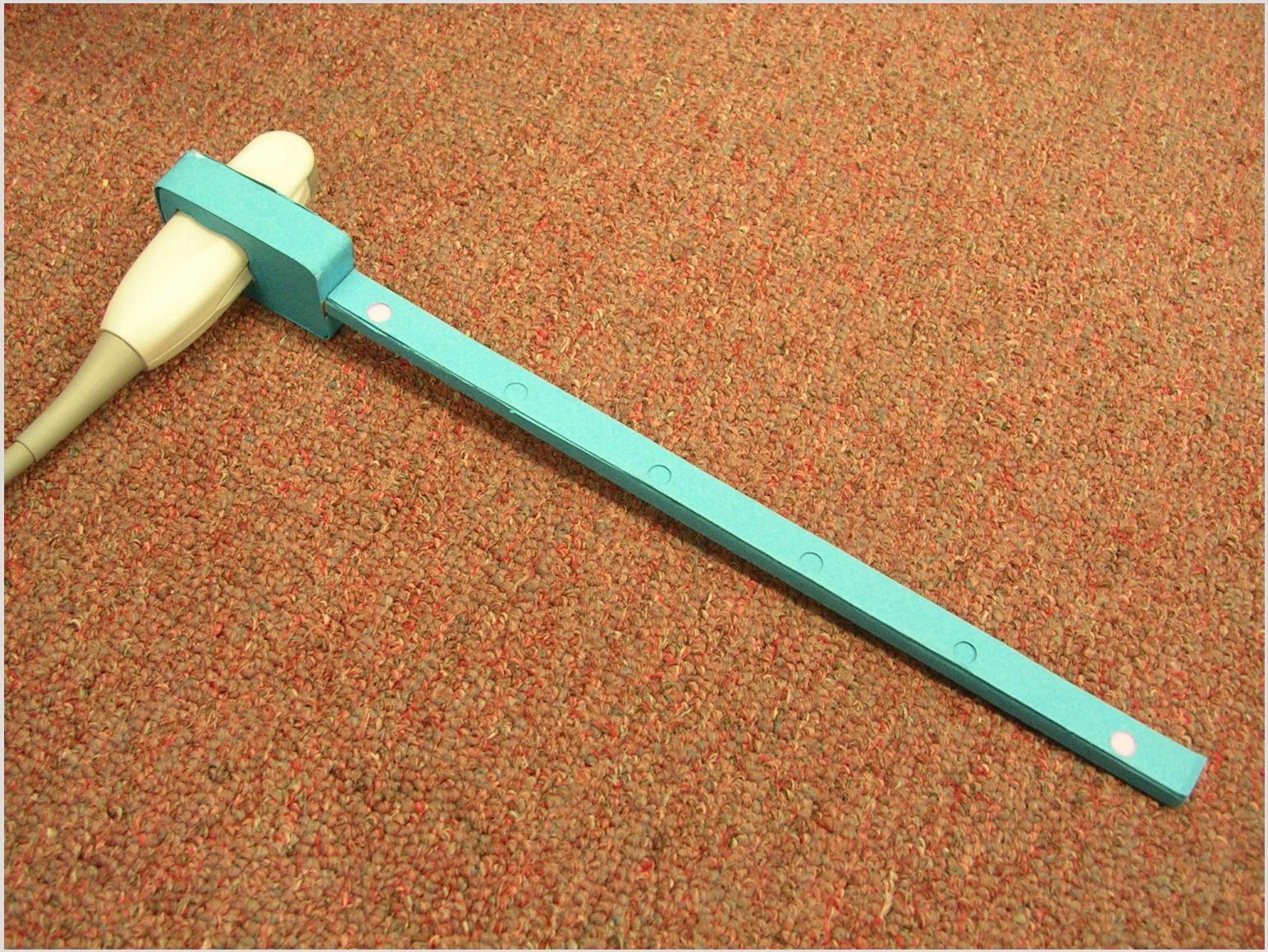


Combining two ultrasound images

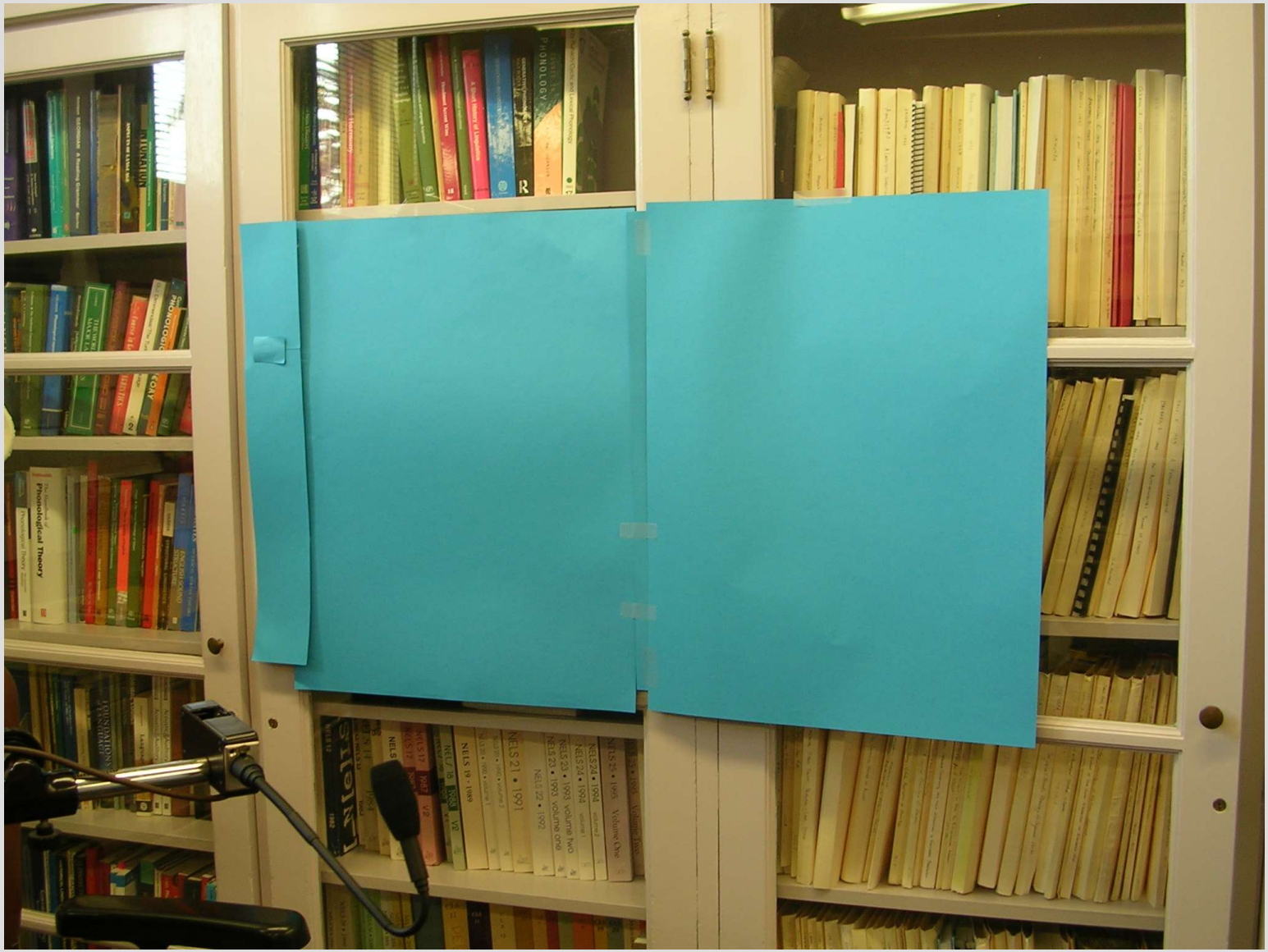


Track head movement

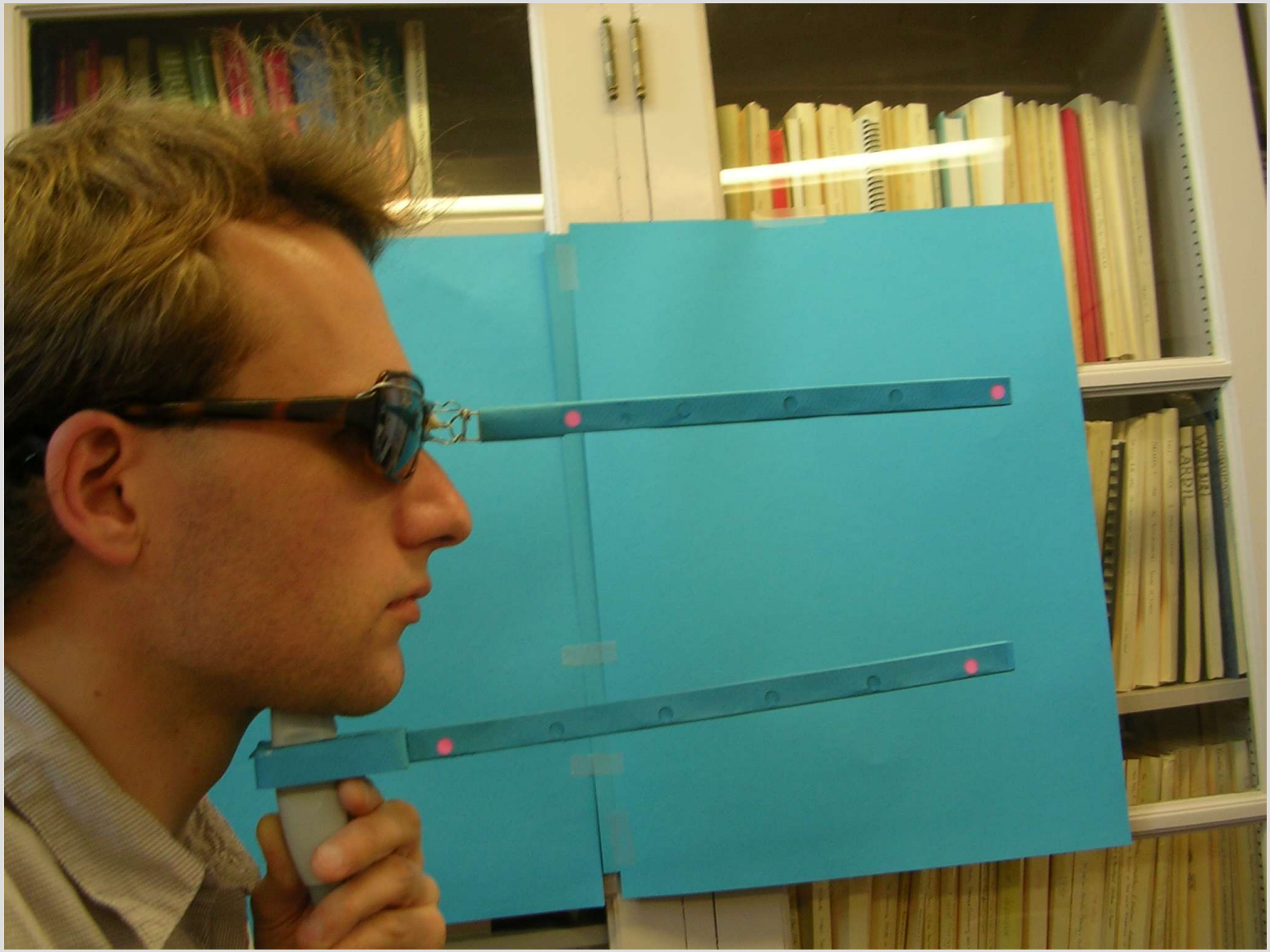
Track transducer movement



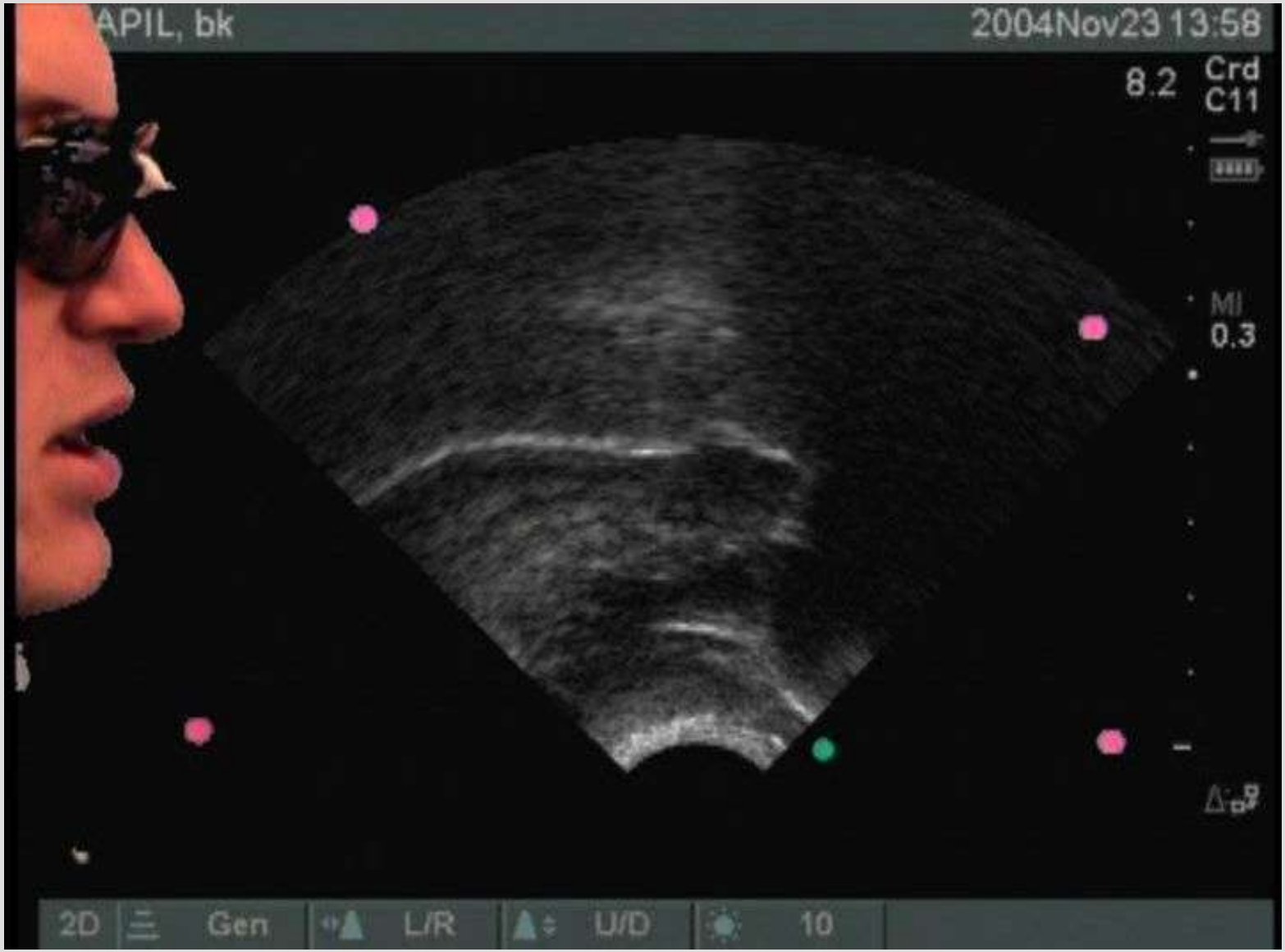
Blue screen


PHONOLOGY
Phonological Theory
NELS 21 • 1991
NELS 23 • 1993 volume two
NELS 24 • 1994
NELS 25 • 1995 Volume One

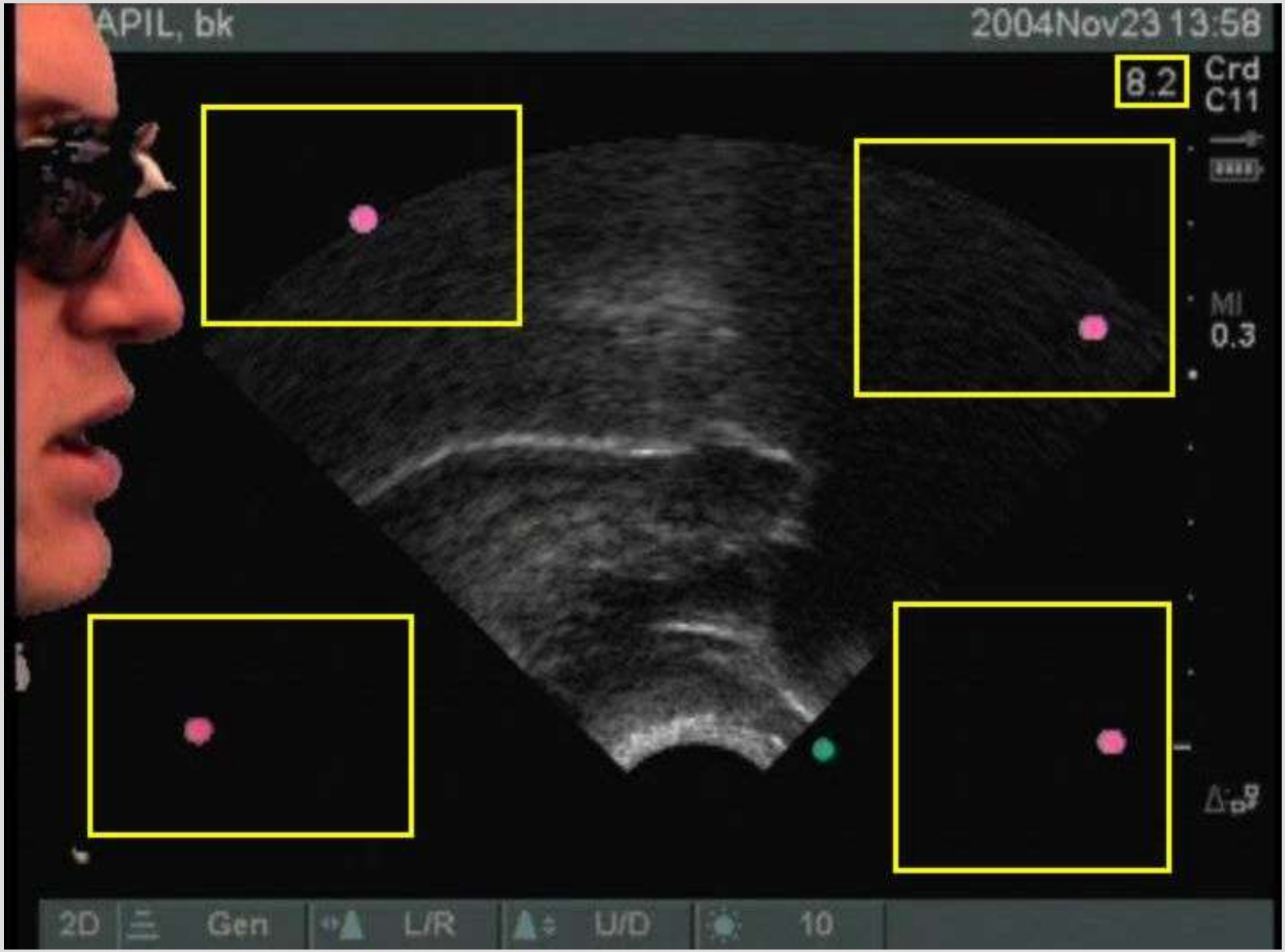
Subject



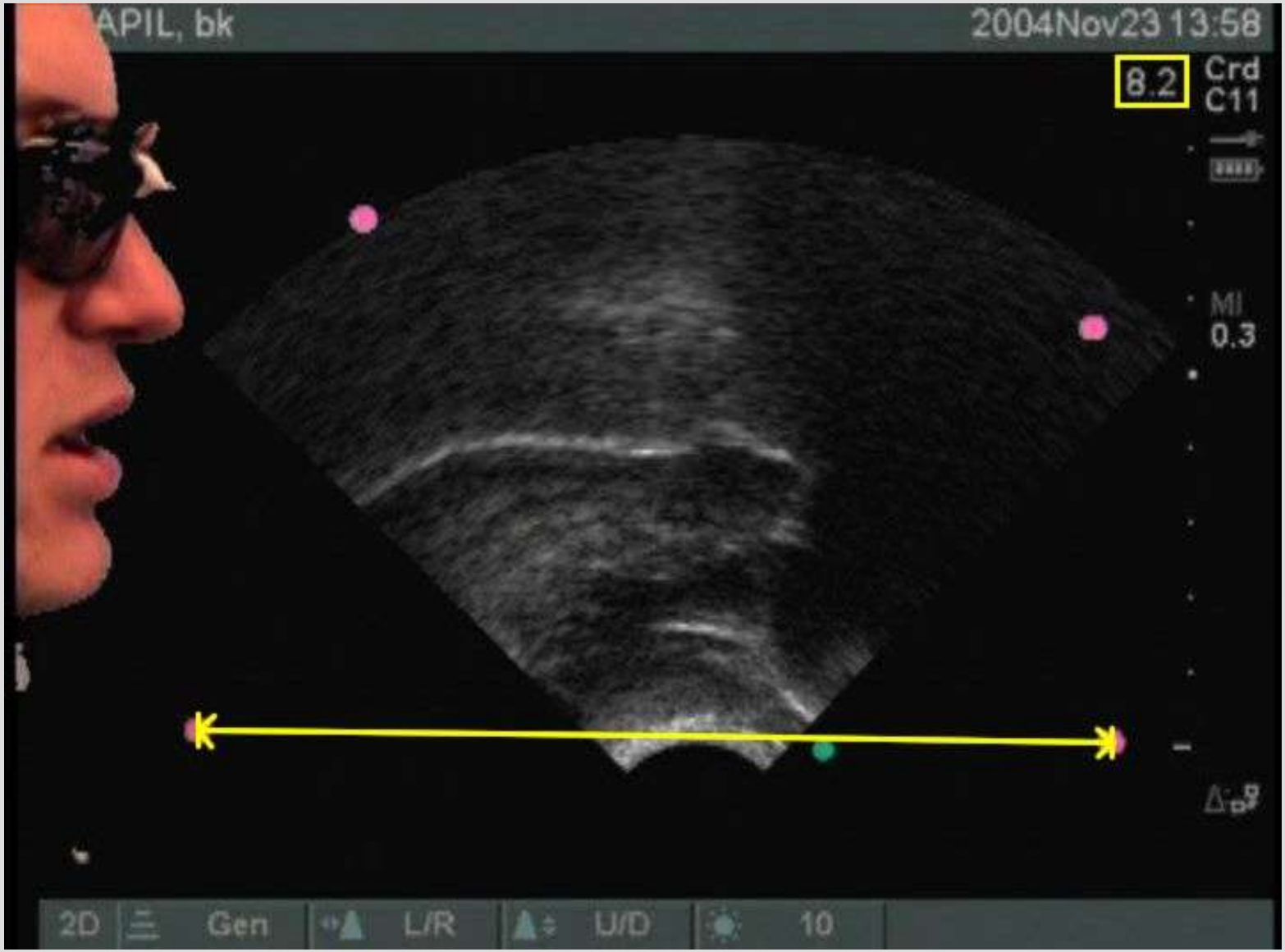
Camera view



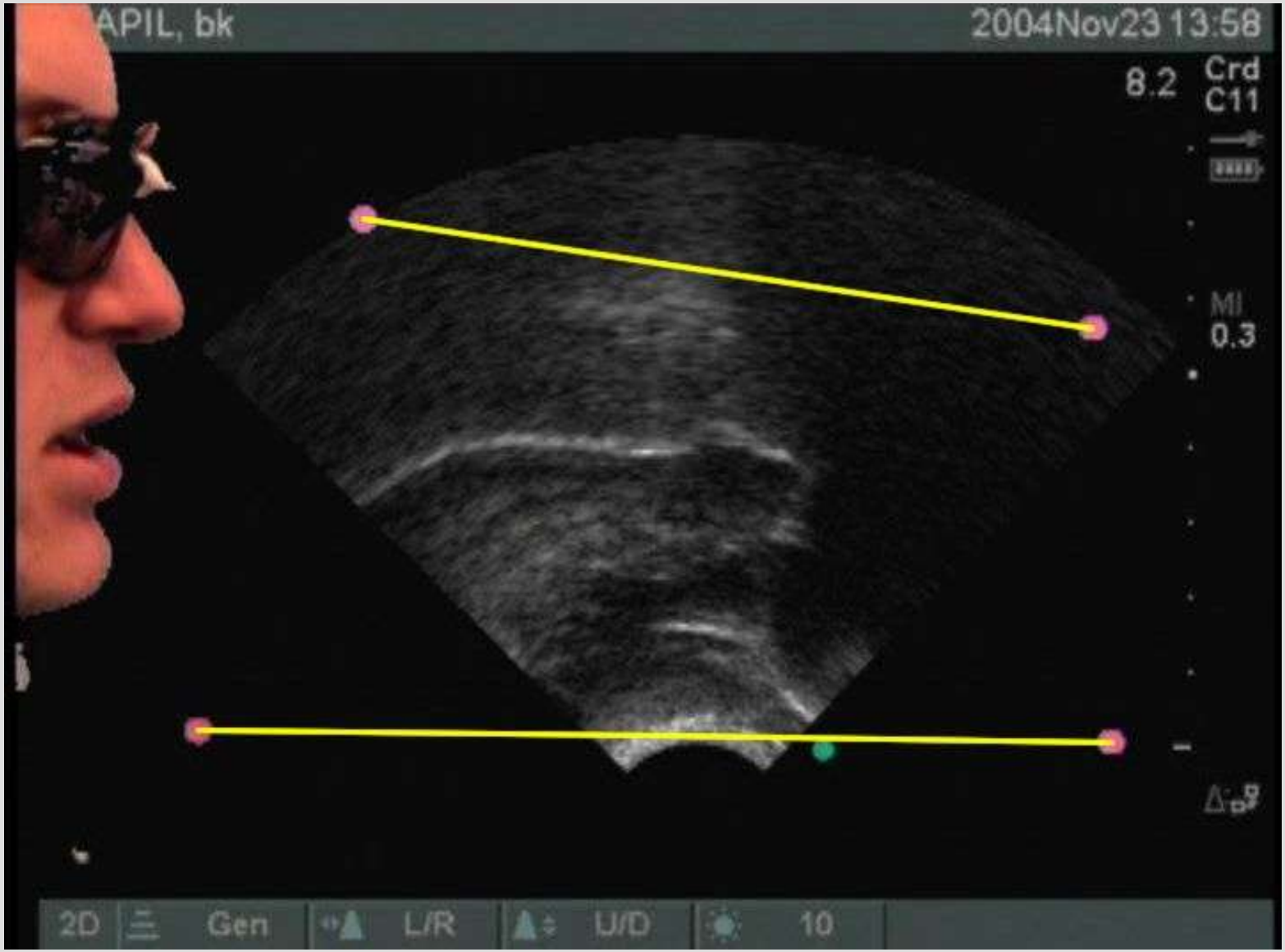
Input



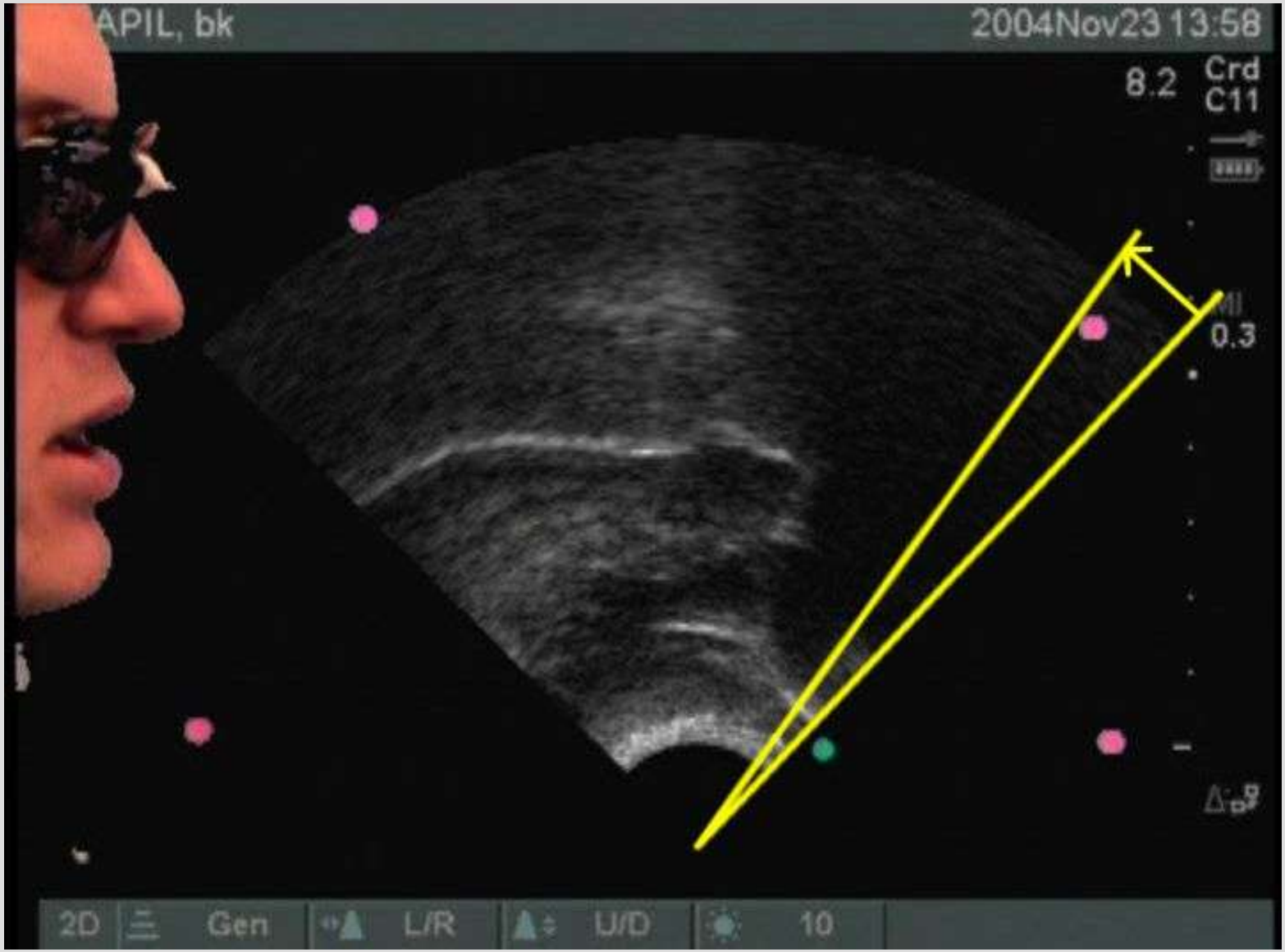
Get video and ultrasound scales



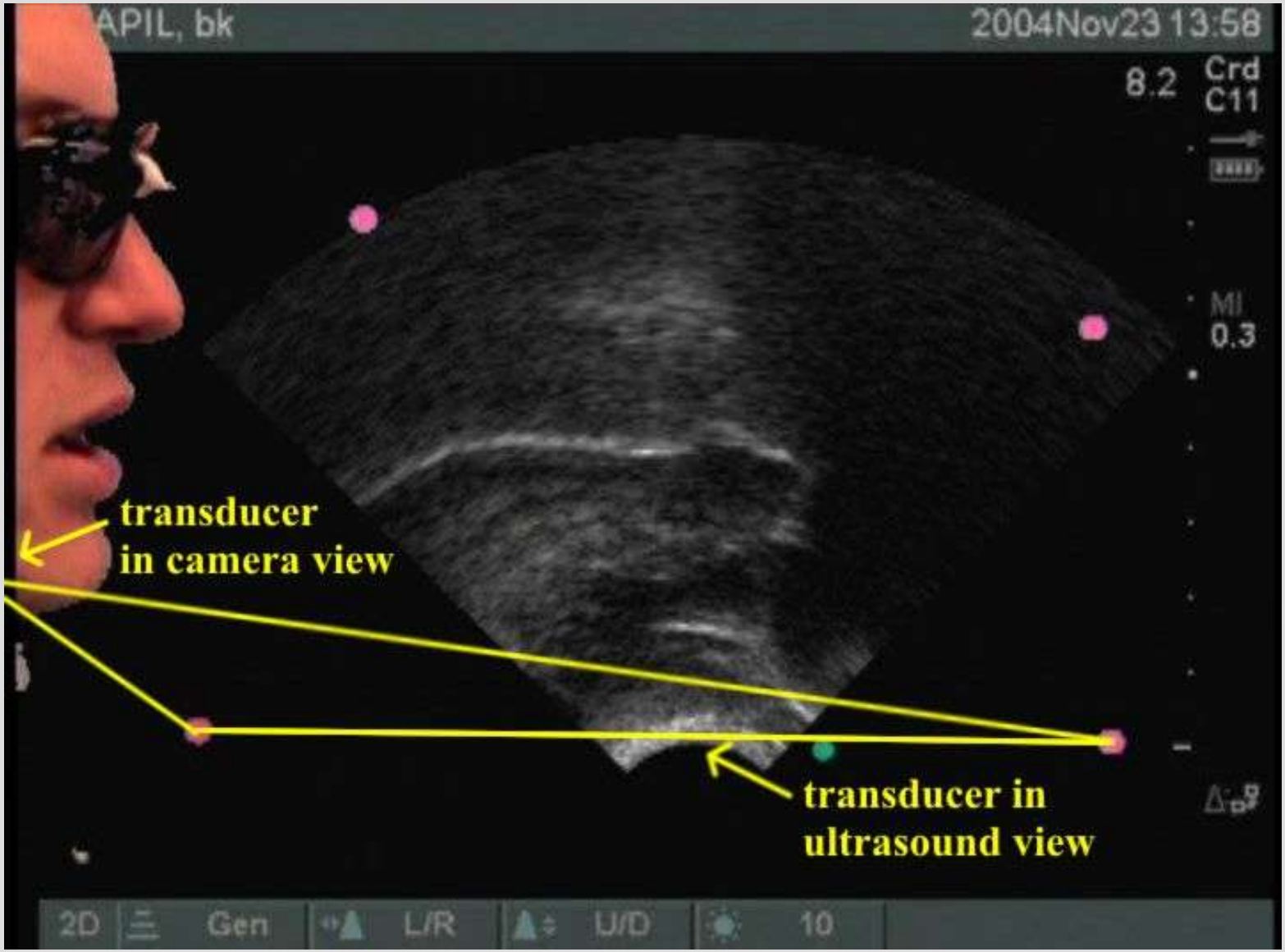
Get head and transducer angles



Compensate for angles



Transducer location/orientation



Head location/orientation

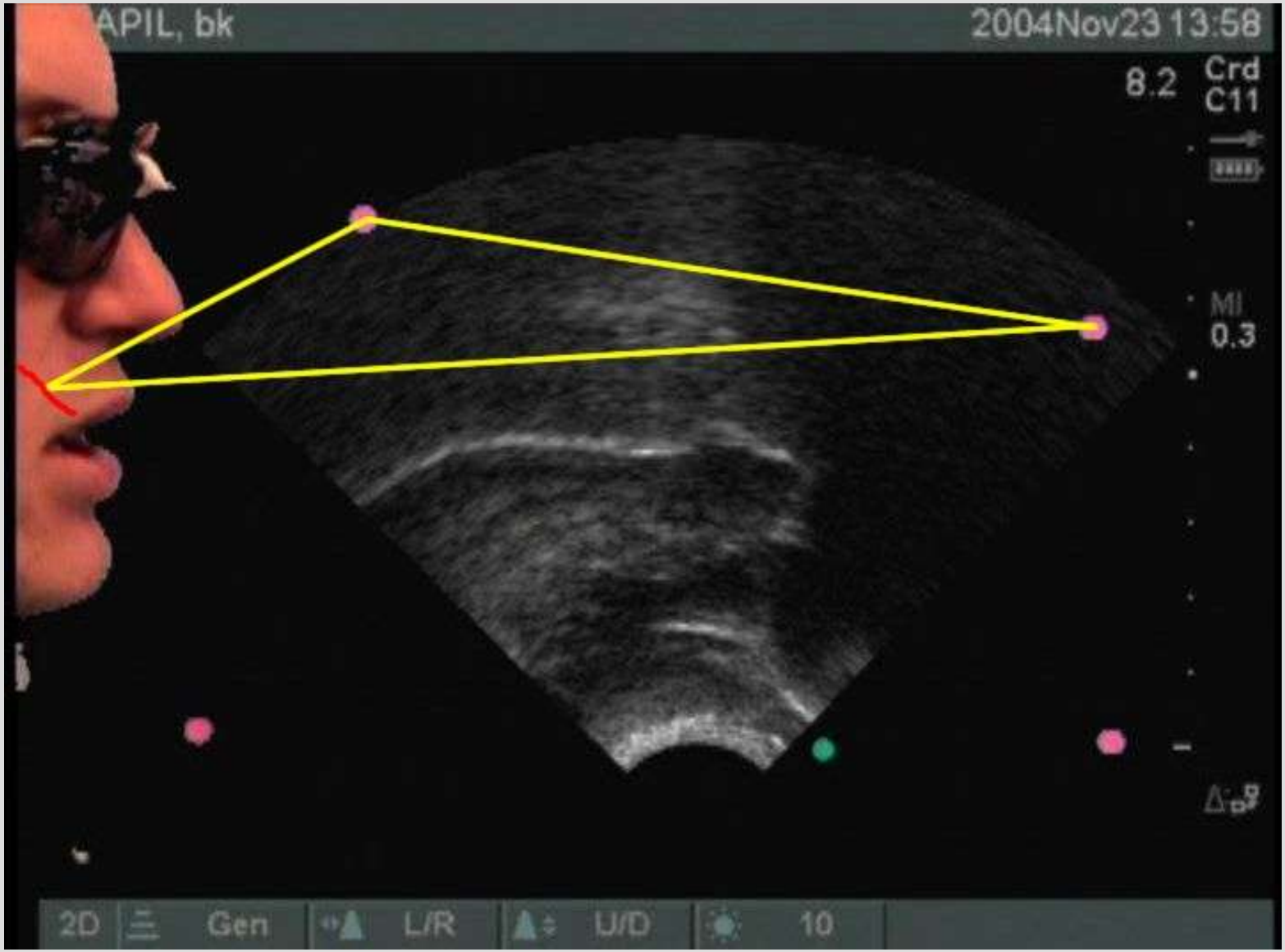
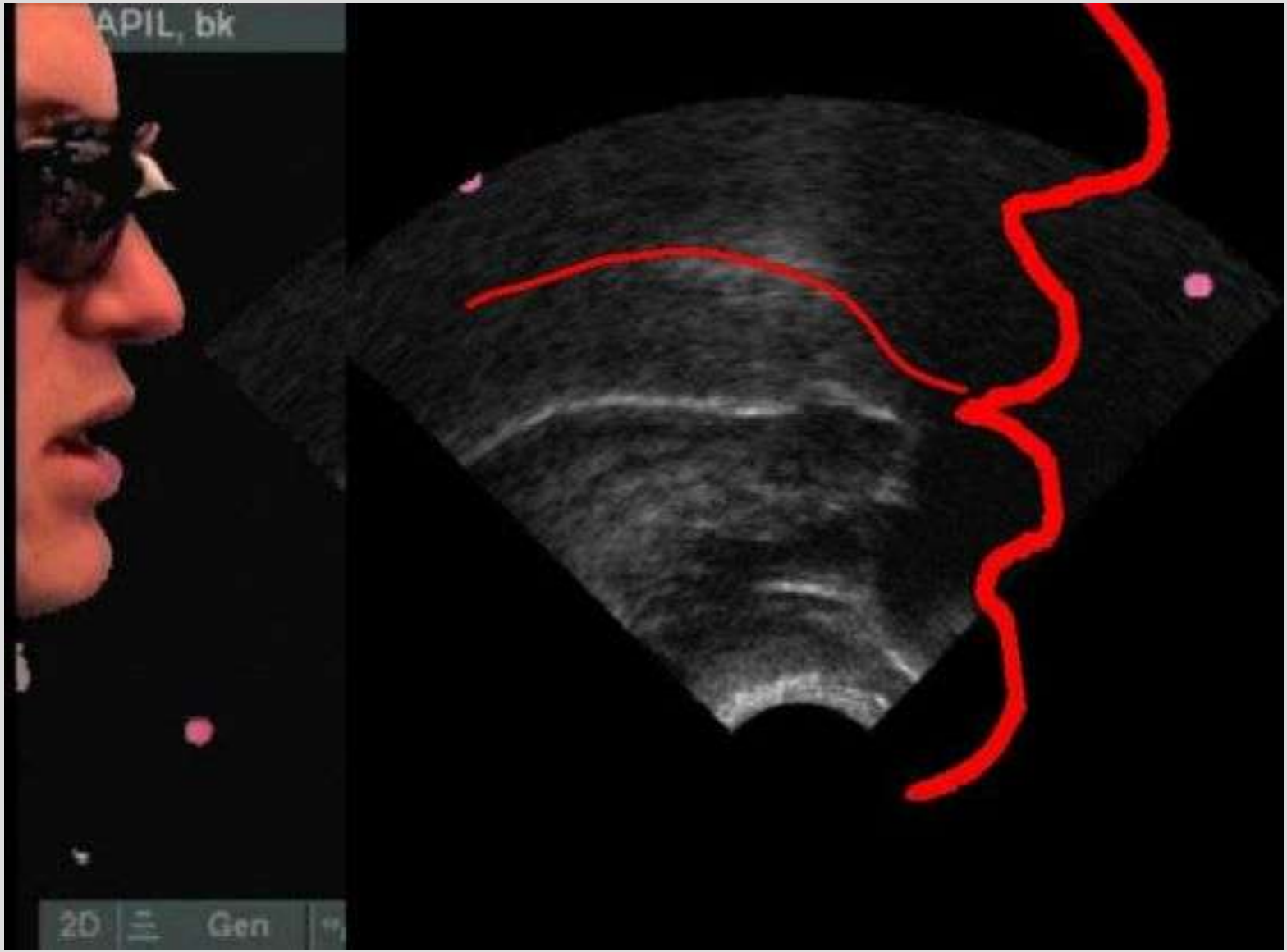
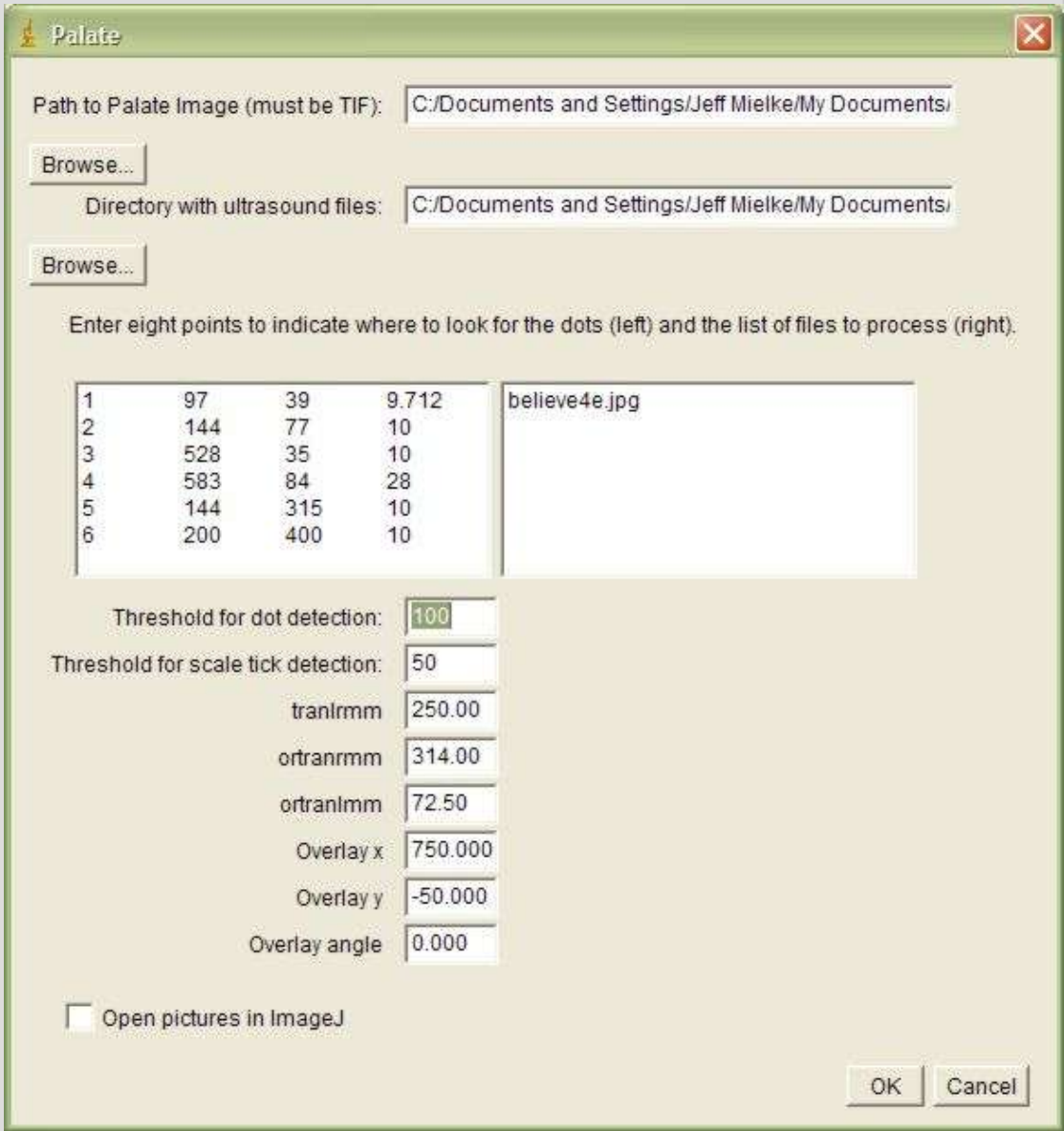


Image with palate



Palatron

- Implemented as a Java plugin for ***ImageJ*** (Wayne Rasband, NIH)



Experiment methods

- Subjects produce monosyllabic words with velar and alveolar stops and various vowels.
- Add palates to images by simply overlaying adjusted images and by transforming and overlaying with Palatron.
- Measure distance between tongue and palate in each case.

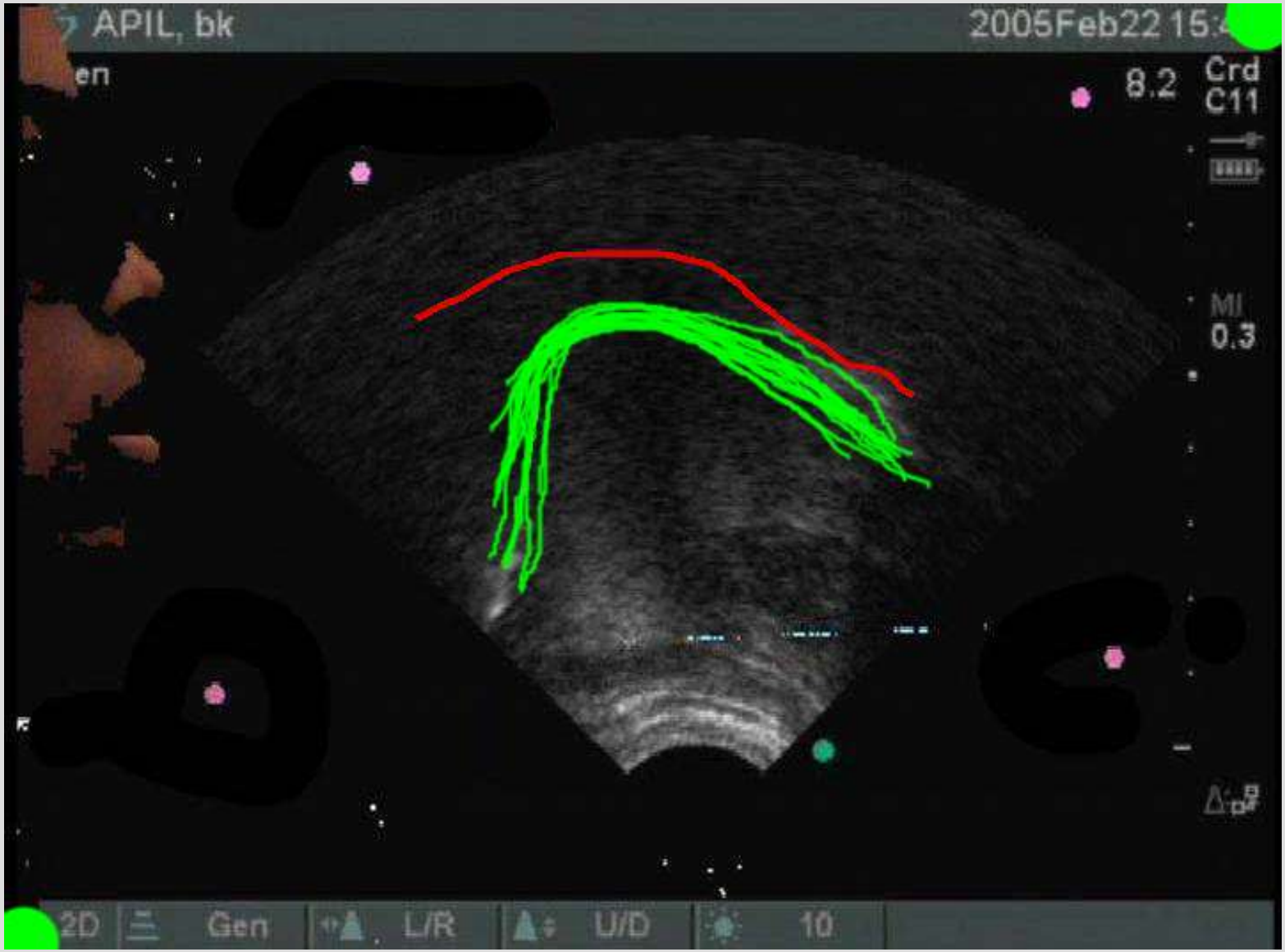
Average tongue-palate distance

- Subject 6:
  - unadjusted: 4.57 mm p < 0.001 (T-test)
  - Palatron: 3.67 mm
- Subject 8:
  - unadjusted: 5.60 mm p < 0.001 (T-test)
  - Palatron: 3.05 mm
- Subject 9:
  - unadjusted: 5.04 mm p < 0.001 (T-test)
  - Palatron: 2.32 mm

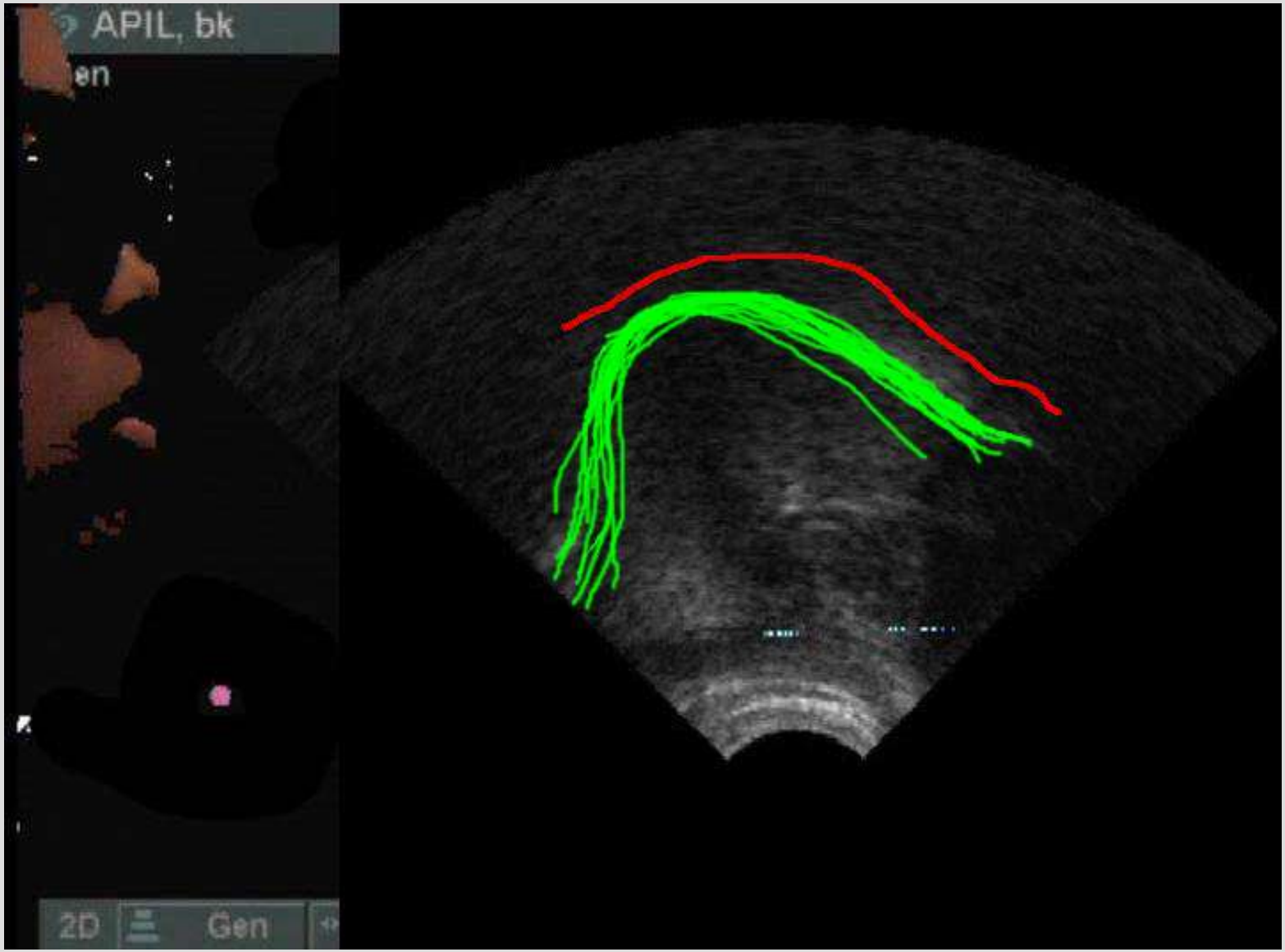
Average constriction location
(0 = most anterior, 1 = most posterior)

	alveolars	velars	diff.
• Subject 6:			
– unadjusted:	.03	.10	.07
– Palatron:	.13	.83	.80
• Subject 8:	alveolars	velars	
– unadjusted:	.27	.74	.47
– Palatron:	.17	.75	.58
• Subject 9:	alveolars	velars	
– unadjusted:	.07	.40	.33
– Palatron:	.12	.66	.54

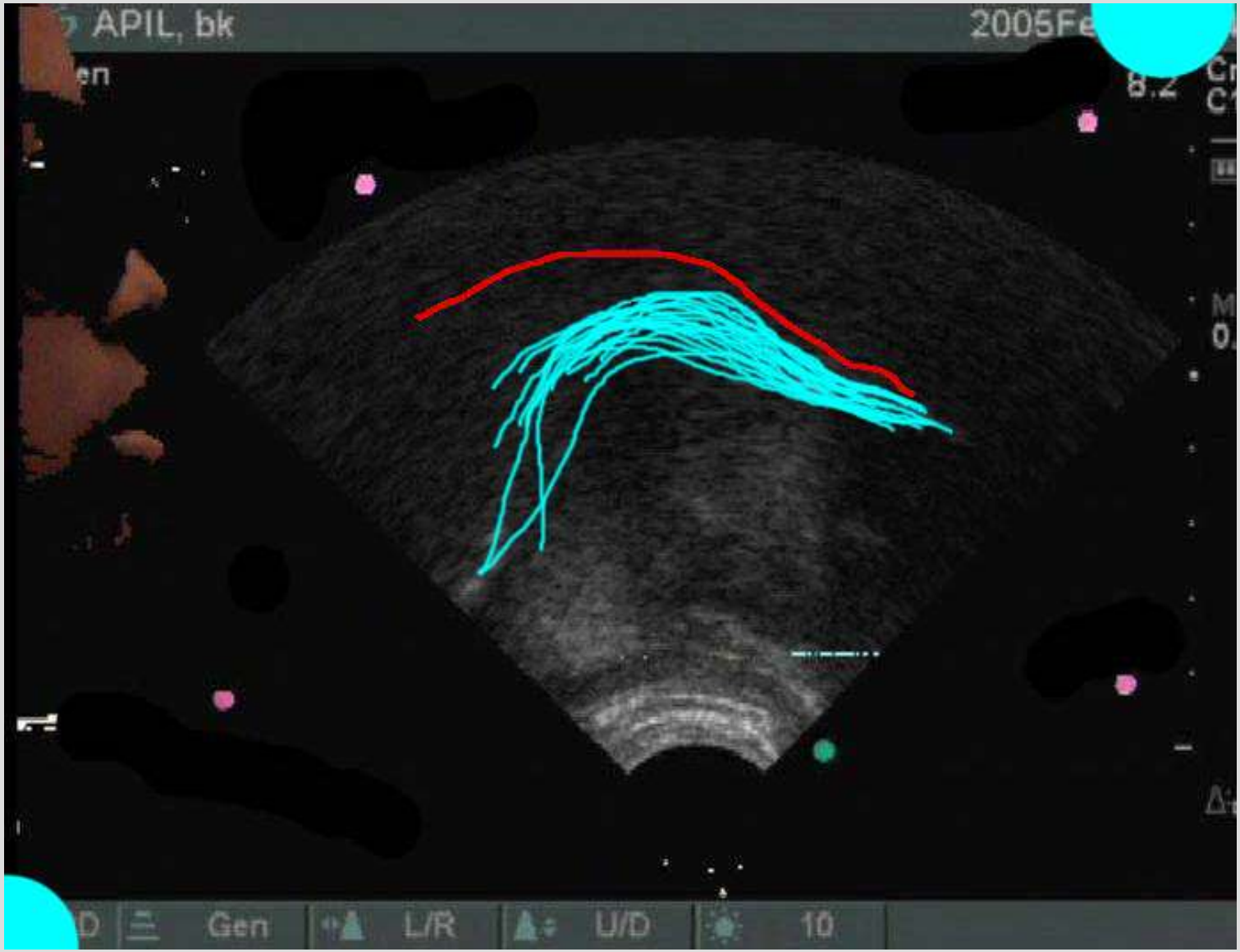
No adjustment: velar stops



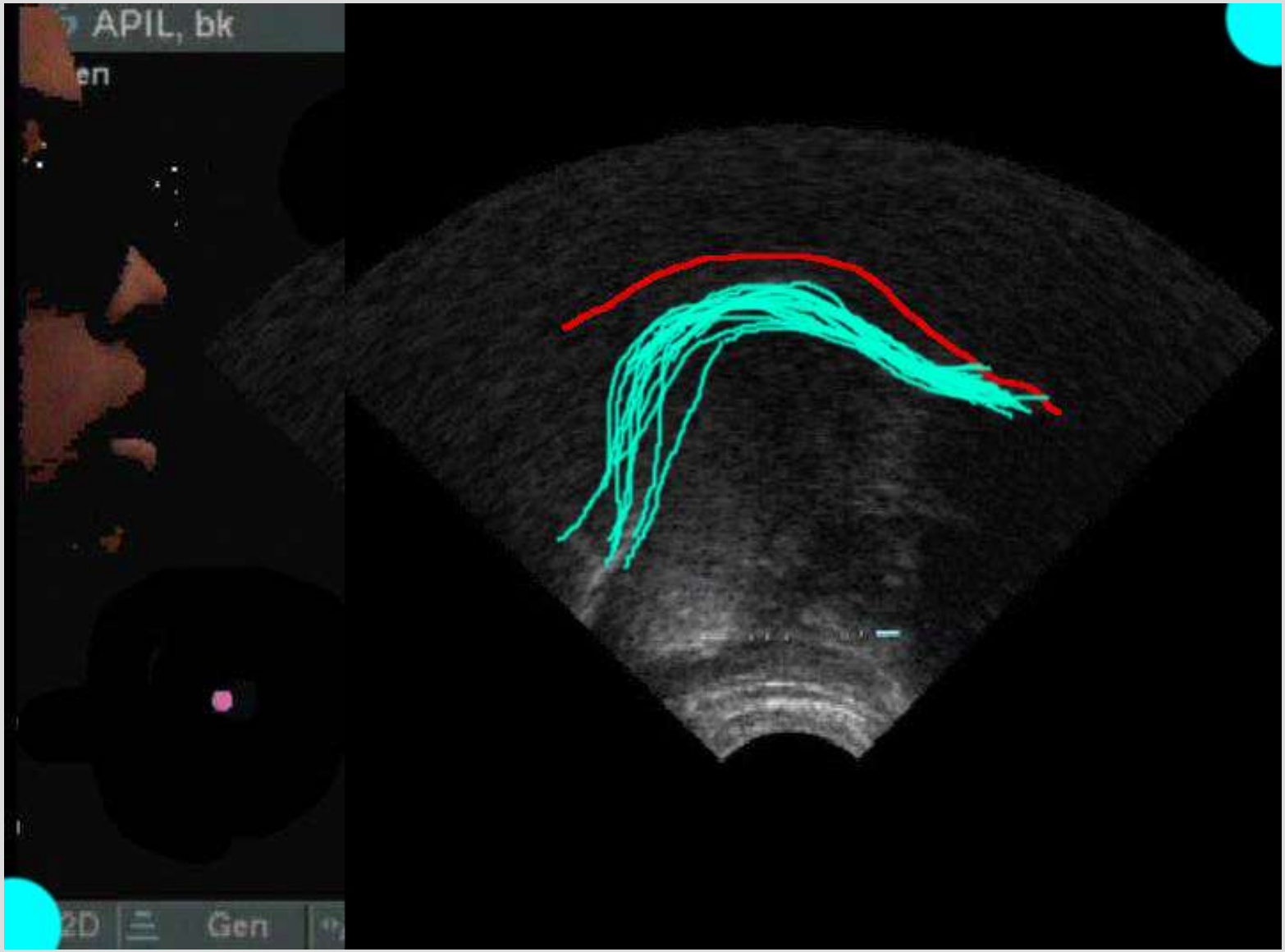
Palatron: velar stops



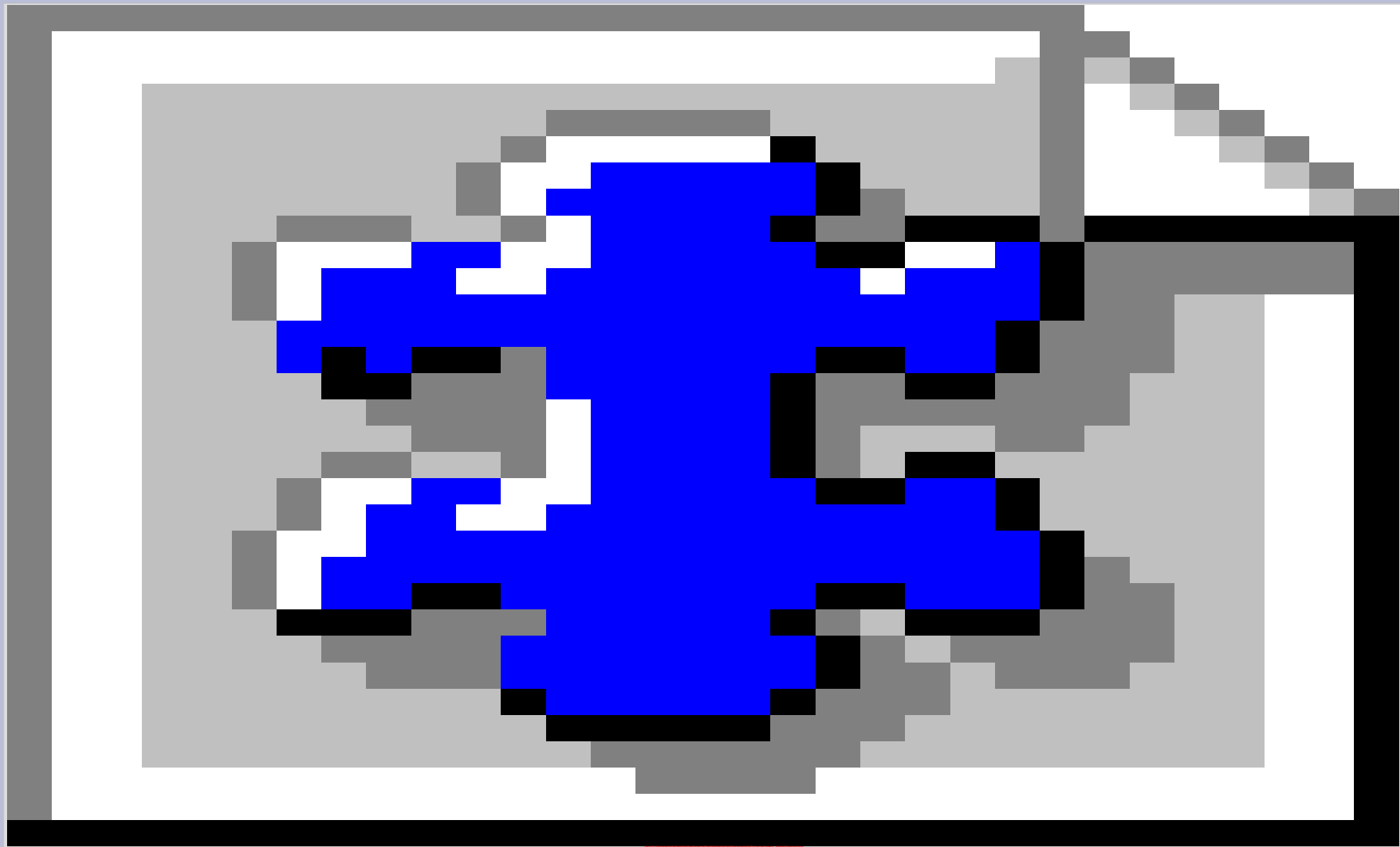
No adjustment: alveolar stops



Palatron: alveolar stops



Series: stationary palate



Conclusions

- Palatron compensates for head and transducer movements.
- Saves considerable time over hand-correction.
- Doesn't require much extra equipment.

Future directions

- Implement a version of Palatron that adds palates on the fly and displays them in real time.
- Consistently get (and interpret) location of incisors from video view.
- Figure out how to deal with velum movement.

Series: stationary fan