

ULTRASOUND IN SPACE MEDICINE

S. A. Dulchavsky, A.E. Sargsyan

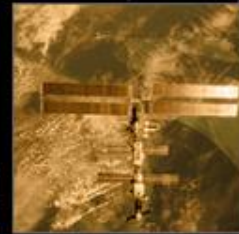
WINFOCUS

Bologna, Italy, November 2009

ADUM

ADVANCED DIAGNOSTIC ULTRASOUND IN MICROGRAVITY

wyle
laboratories



EXPERIMENT OVERVIEW

ULTRASOUND IMAGERY

EXERCISES



OPE

SKIP S

QUIT ESC VOLUME - +

Research Goals

Determine accuracy of ultrasound in novel clinical conditions

Determine optimal training methodologies

- Determine microgravity associated changes

- Develop intuitive ultrasound catalog to enhance autonomous medical care

Ultrasound Protocols: ADUM

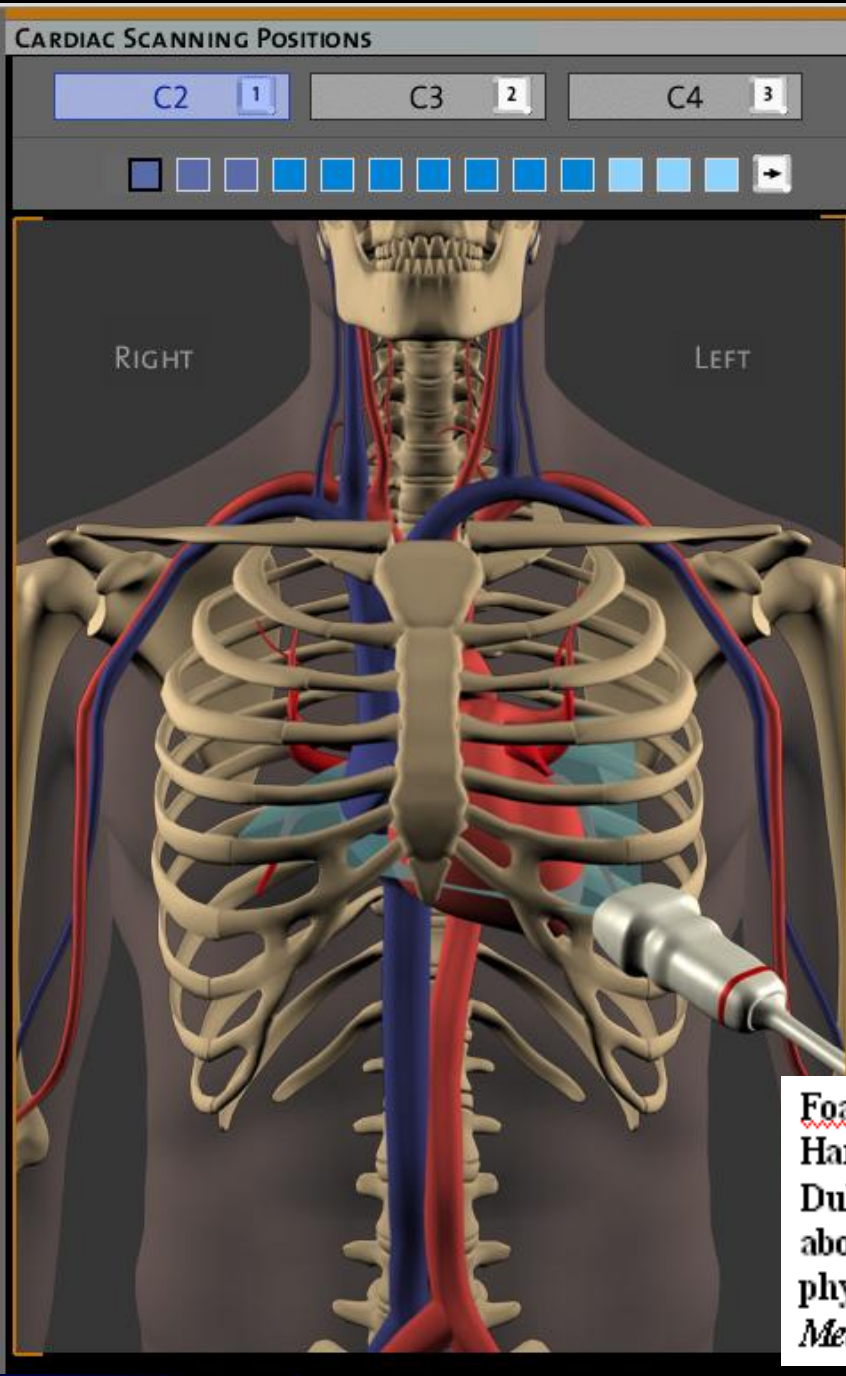
- Cardiac
- Abdominal
 - Spleen
 - Liver
 - Gallbladder
- Retroperitoneal
 - Kidneys
 - Pancreas
 - Abdominal Aorta
 - IVC
- Genitourinary
 - Bladder
 - Prostate
- Musculoskeletal
 - Rotator Cuff
 - Knee, Ankle, Elbow
- Thyroid
- Dental
- Sinus
- Eye
- Peripheral Vessels
 - Carotid/Jugular
 - Maneuvers
 - DVT R/O







SHIFT F1	INTRODUCTION
SHIFT F2	EXPERIMENT SYNOPSIS
SHIFT F3	BRAIN GYM
SHIFT F4	ADVANCED DIAGNOSTIC ULTRASOUND OPERATIONS
SHIFT F5	REMOTE GUIDANCE TERMINOLOGY
SHIFT F6	ANATOMY
SHIFT F7	SCANNING
	CARDIAC
	THORACIC
	CARDIAC & THORACIC DEMOS
SHIFT F8	ULTRASOUND EXERCISES
SHIFT F9	CONCLUSIONS
SHIFT F10	BLOOPERS
SHIFT ↑	PREVIOUS SEGMENT
SHIFT ↓	NEXT SEGMENT
	OPE v1.0
VOLUME	- [Slider] +
VIEW REMOTE GUIDANCE CARD	SHIFT V
QUIT	ESC SWITCH LANGUAGE
	SHIFT L



ULTRASOUND

ADUMTEST
NASA Cardiac Lab
E003
P4-2 A.Card/Tilt
08 Aug 03
10:35:24 am
TIs 0.0
MI 1.0
15.4c

Map 3
170dBIC 3
Persist Low
2D OptHRes
Fr RateHigh

DETAIL

POSITION DESCRIPTION

PLACE THE PROBE IN THE C2 POSITION
POINTING UPWARDS IN THE DIRECTION OF

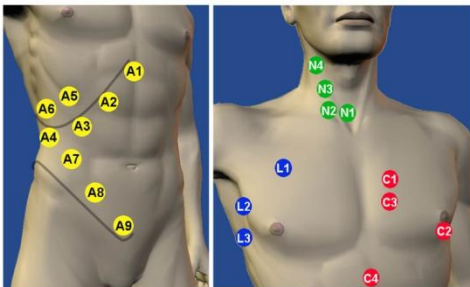
Foale CM, Kaleri AY, Sargsyan AE, Hamilton DR, Melton S, Martin D, Dulchavsky SA Diagnostic instrumentation aboard ISS: just-in-time training for non-physician crewmembers. *Aviat Space Environ Med.* 2005 Jun; 76(6):594-8.

Cue Card and Reference Image sets

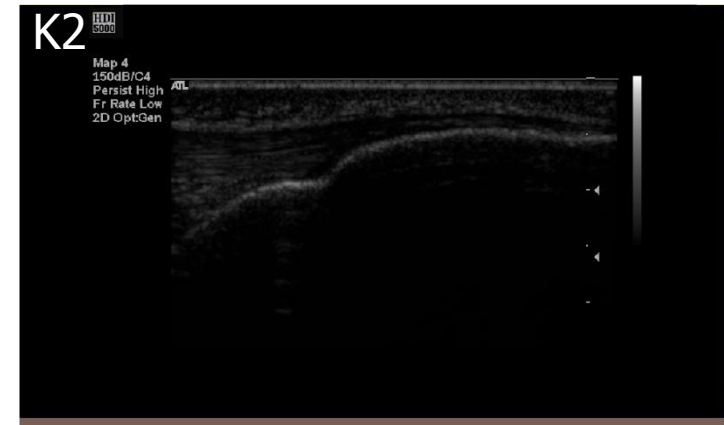
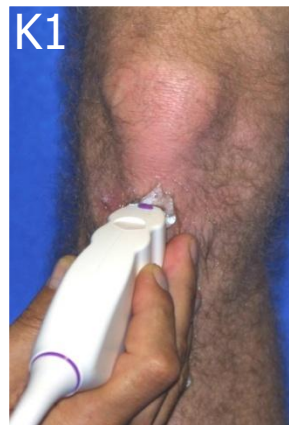
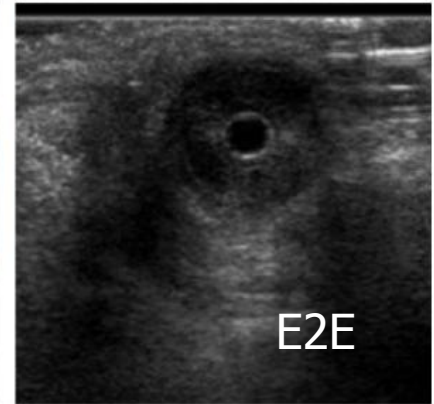
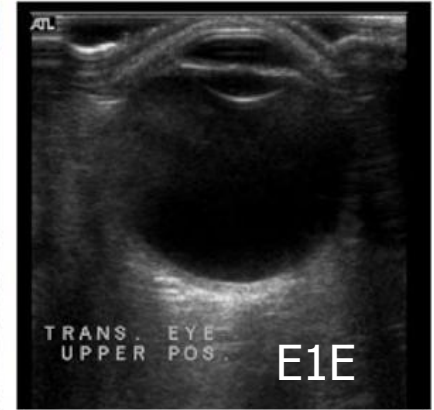
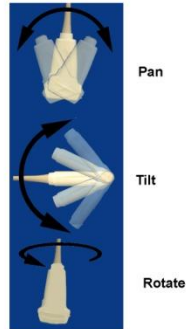
HRF Ultrasound Keyboard



Probe Application Points

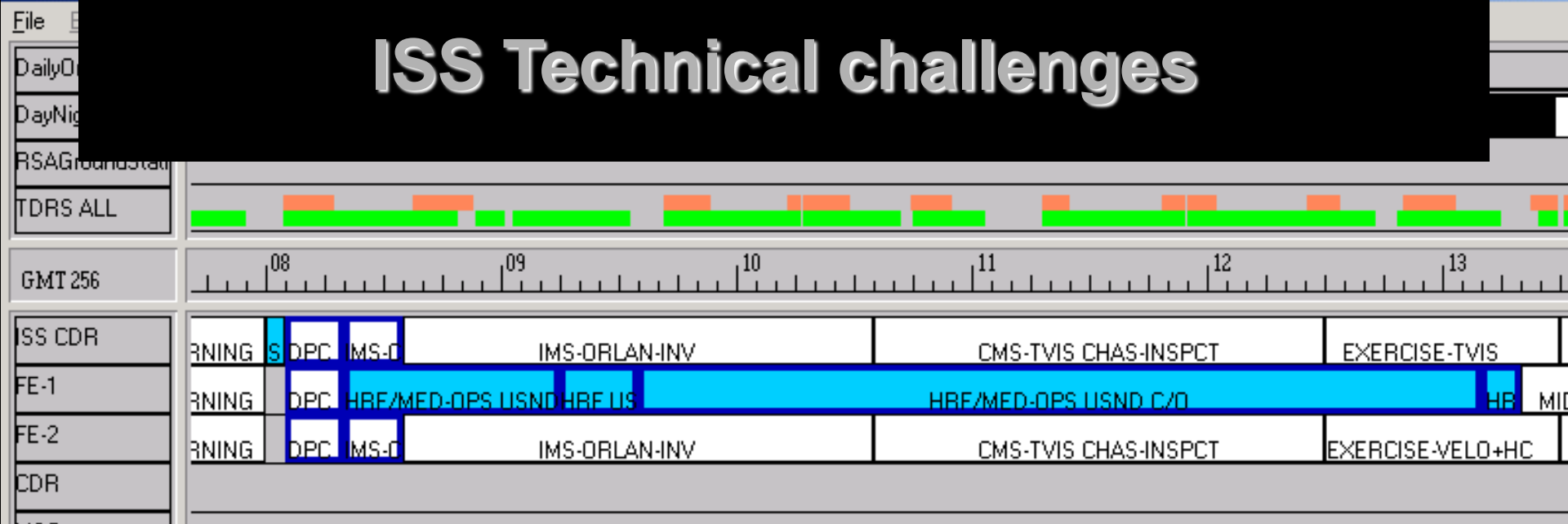


Probe Manipulation





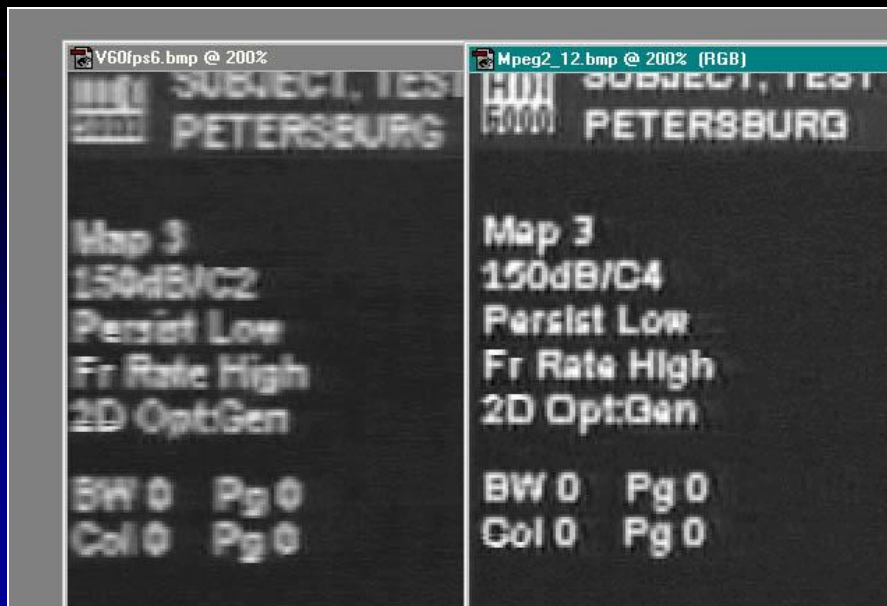
ISS Technical challenges



Ku-band = VIDEO

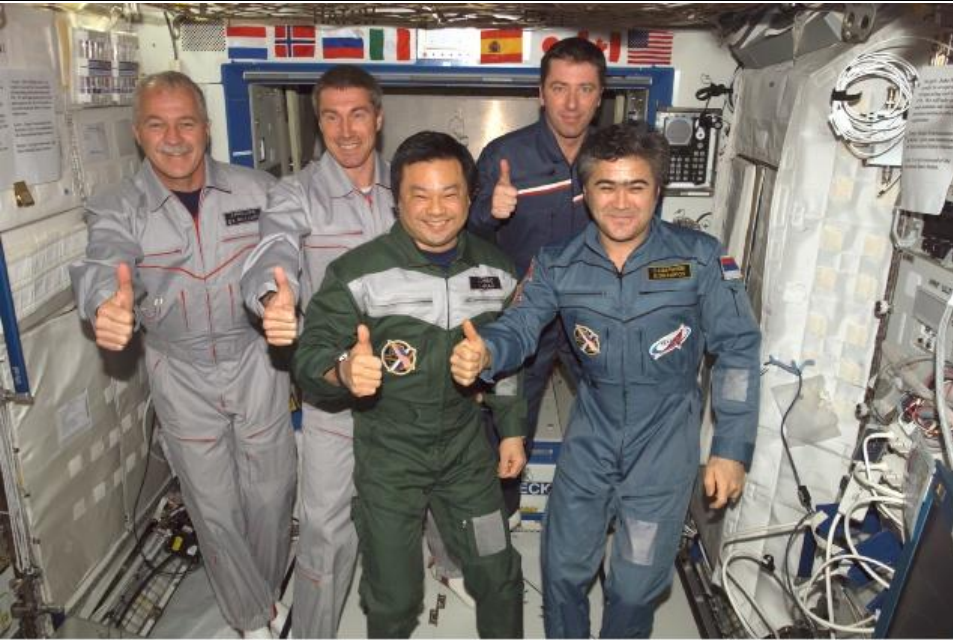


S-band = AUDIO



Hardware assembly / set up time
 Data transmission
 Video Degradation

ISS Crewmembers in Ultrasound Operations



ISS010E25158

ISS008E22256

1

ADUM Crew Experience

- **Leroy Chiao:** “ADUM was the single most valuable piece of scientific and operational work that came out of my expedition”
1/09/07

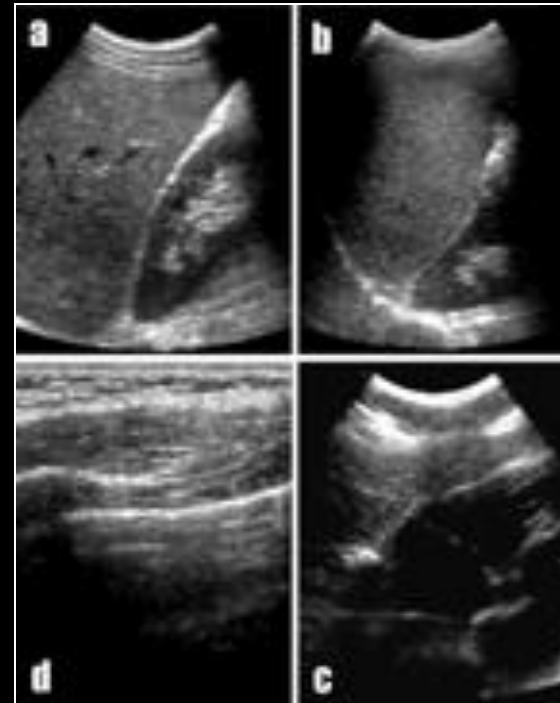


Focused Assessment with Sonography for Trauma (FAST)

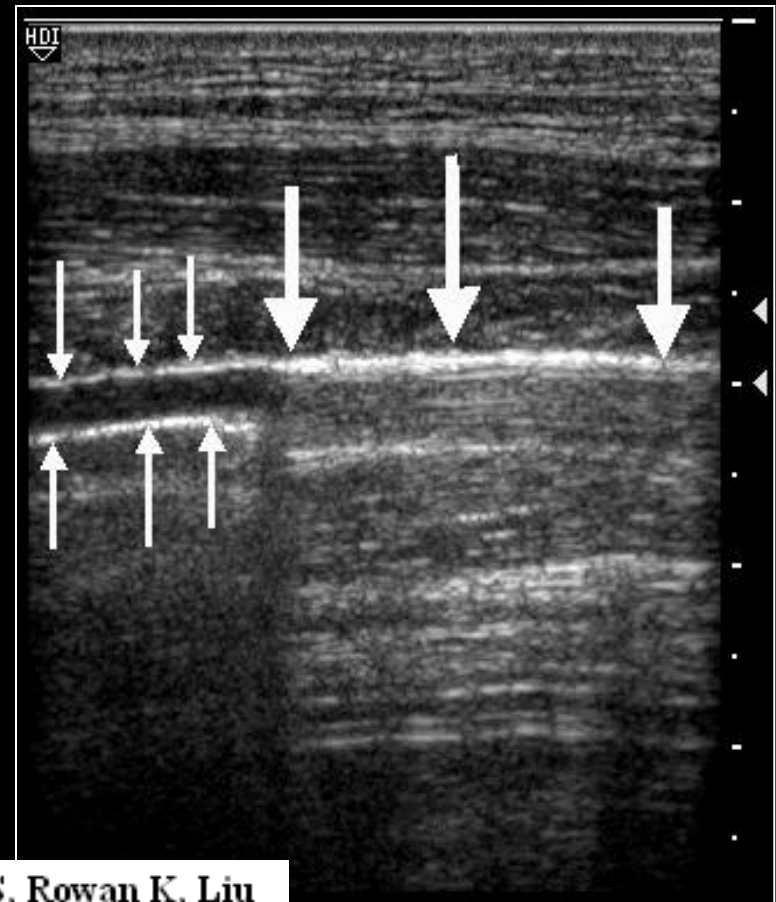
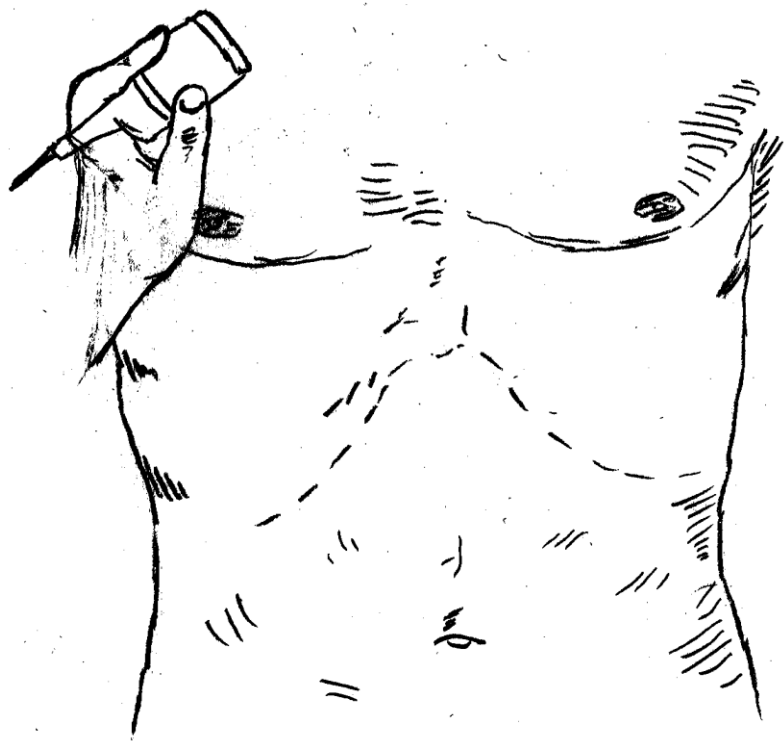


Example: FAST (Focused Assessment by Sonography for Trauma)

- Where does the fluid go?
- No “dependent” locations
- With no gravity, weaker forces come into play and determine fluid distribution



Sargsyan AE, Hamilton DR, Jones JA, Melton S, Whitson PA, Kirkpatrick AW, Martin D, Dulchavsky SA. FAST at MACH 20: clinical ultrasound aboard the International Space Station. *J Trauma*. 2005 Jan;58(1):35-9.



Kirkpatrick AW, [Nicolaou S](#), Rowan K, Liu D, Cunningham J, Sargsyan AE, Hamilton D, Dulchavsky SA. Thoracic sonography for pneumothorax: the clinical evaluation of an operational space medicine spin-off. *Acta Astronaut.* 2005 May-Jun;56(9-12):831-8.

Musculoskeletal Ultrasound

PHIL
BREaK

Philips Healthcare

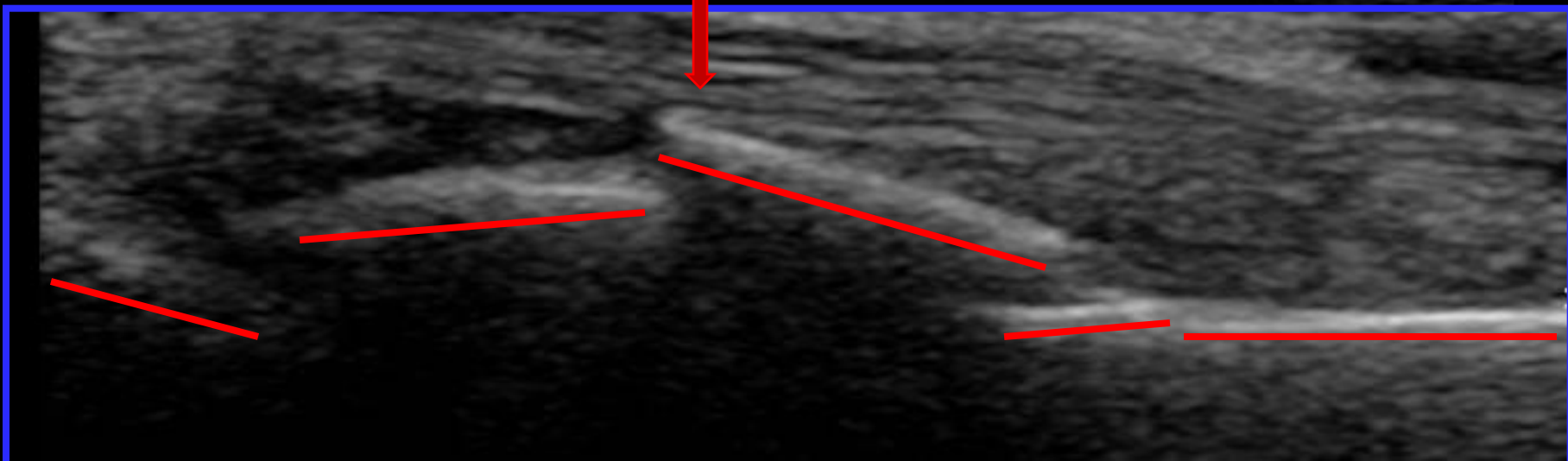
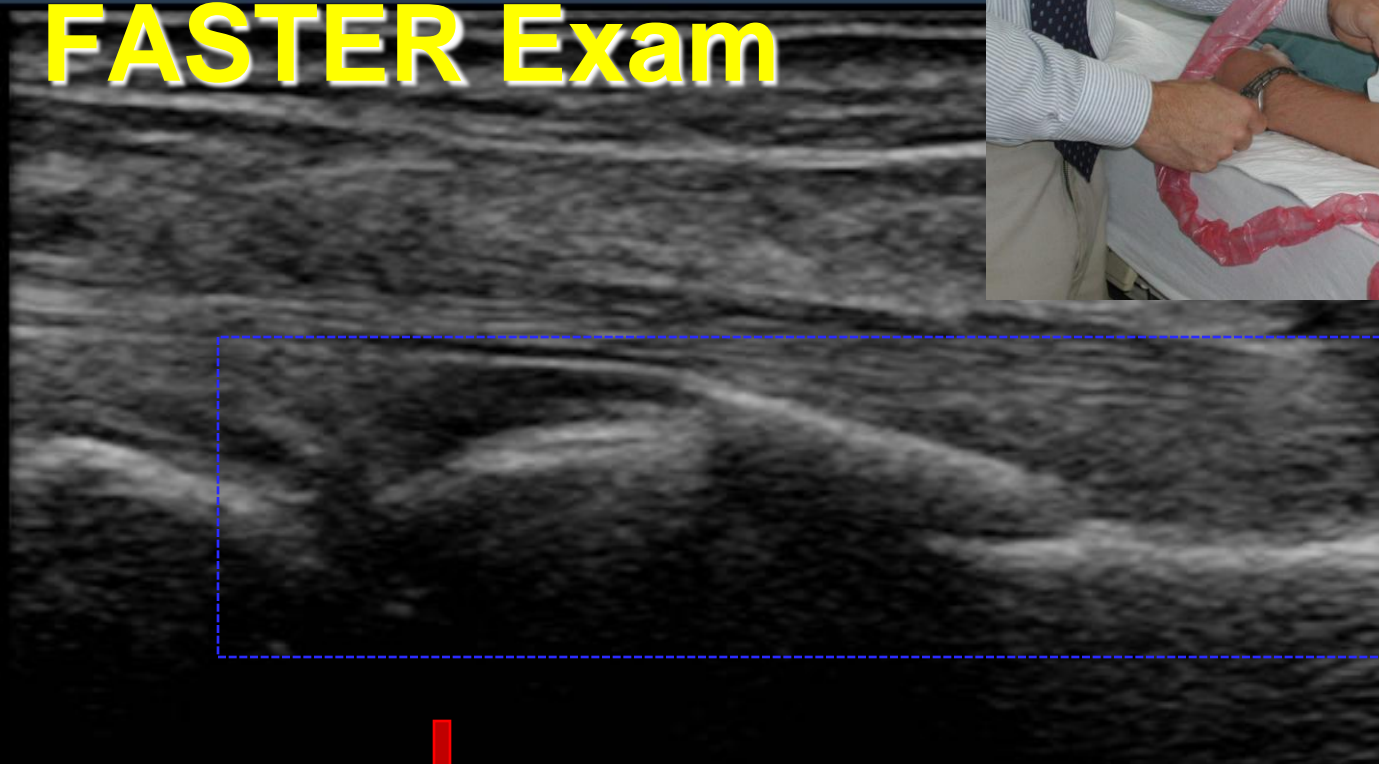
FASTER Exam

Superficial
L12-3
43Hz
3cm

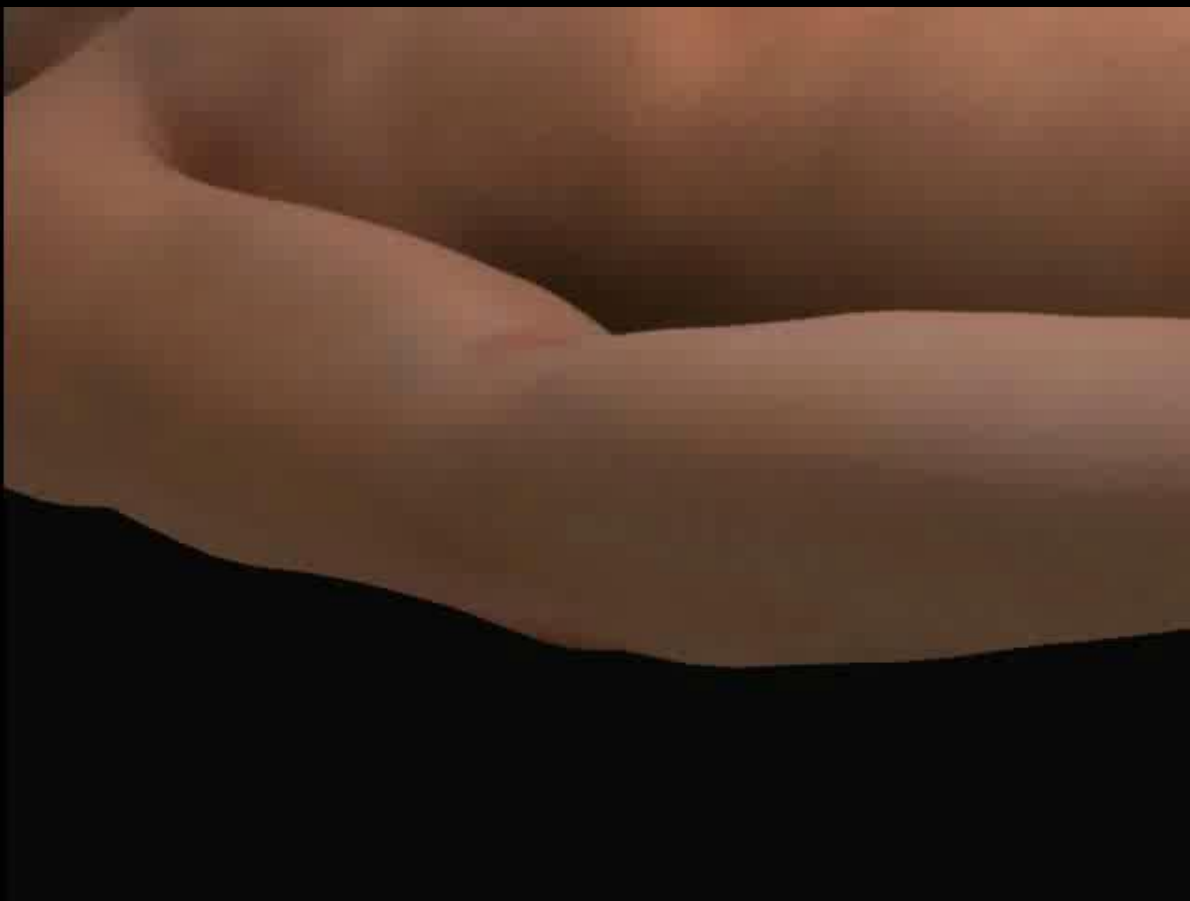
P

2D

Res
Gn 50
C 56
3 / 3 / 3

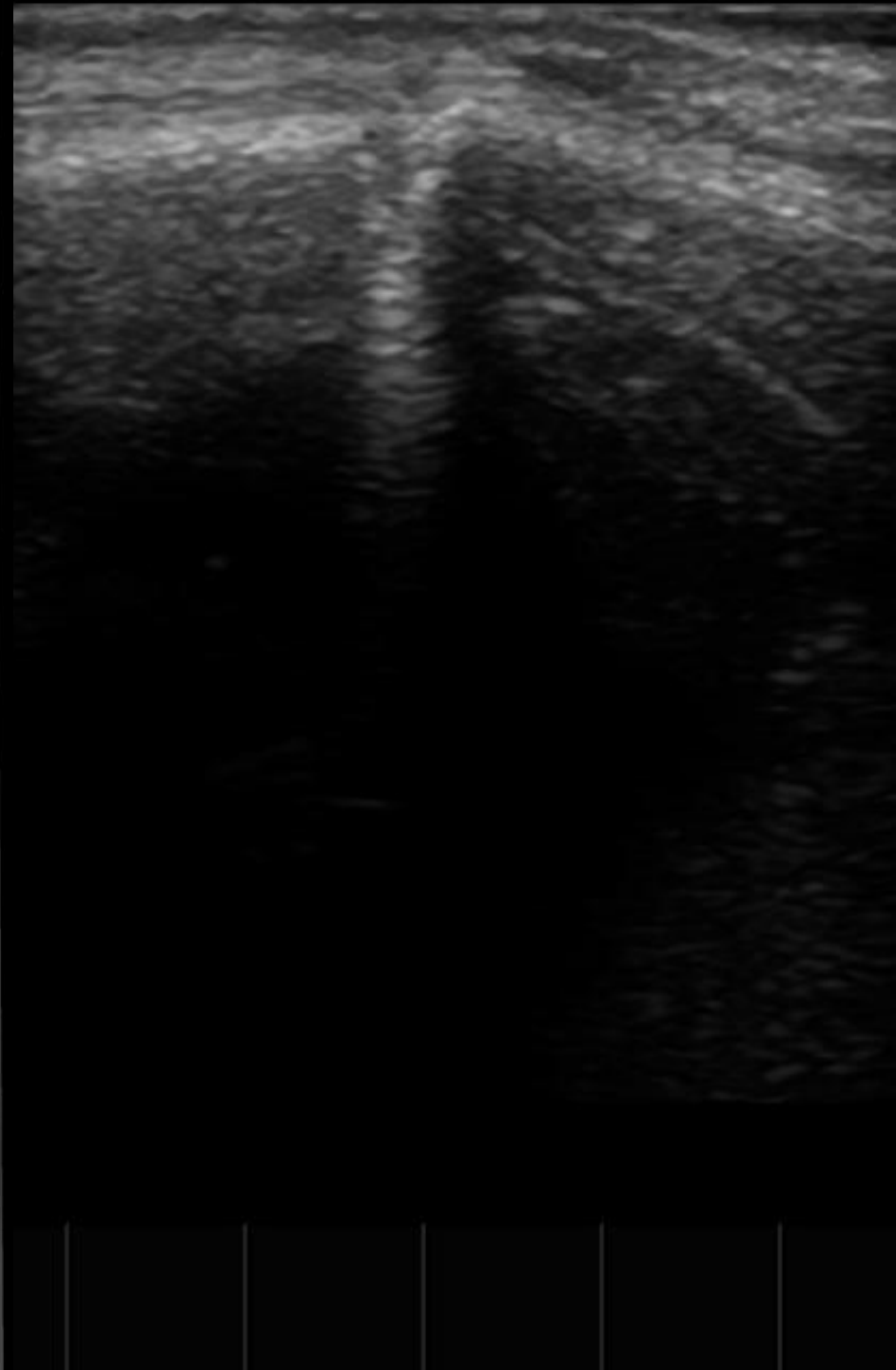


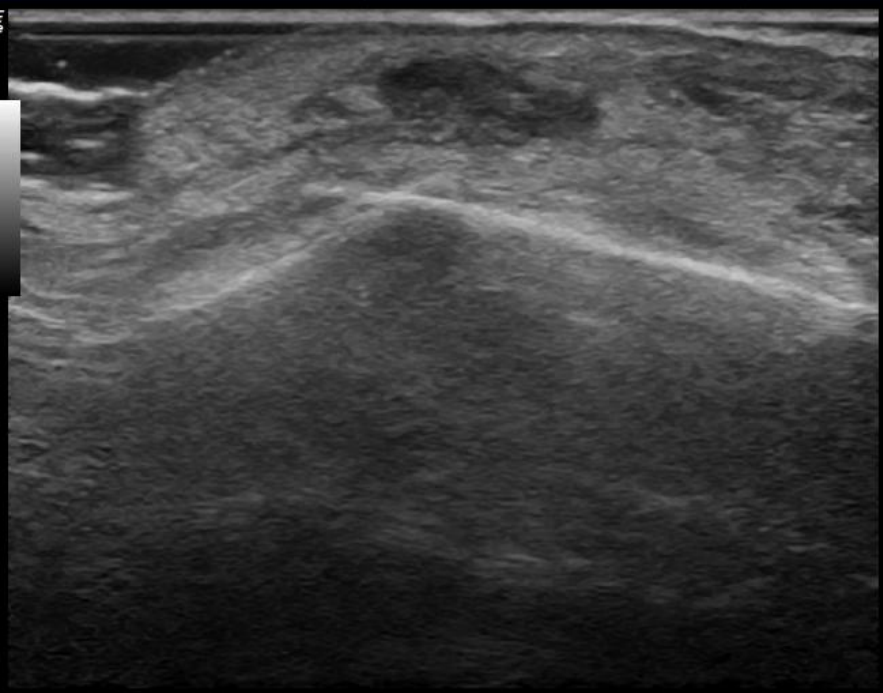
Just in time training videos



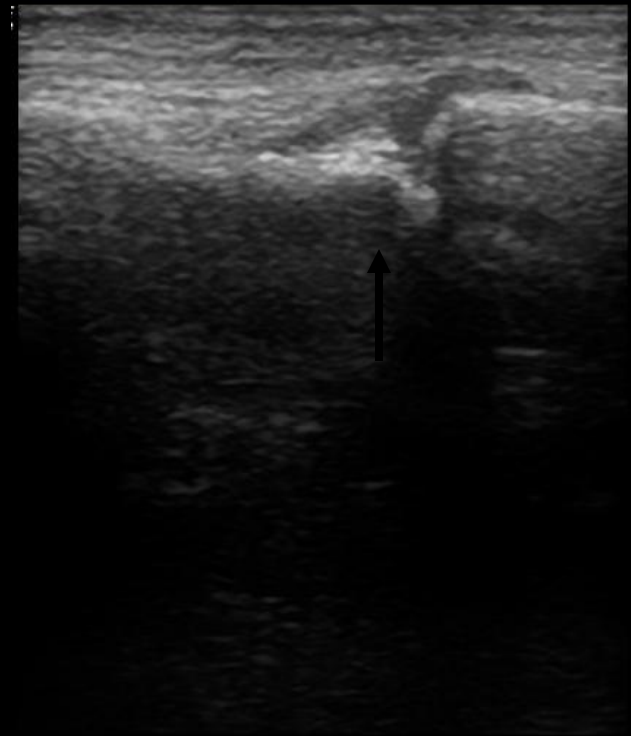


R
712





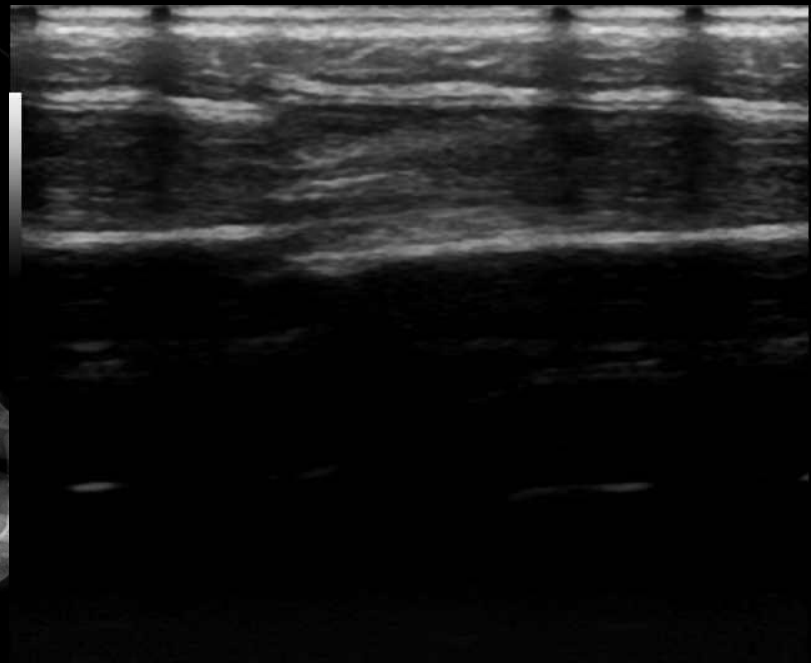
Fracture Healing

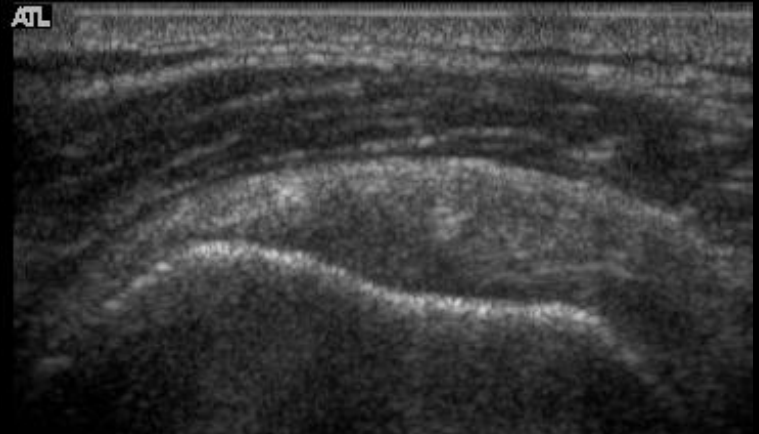


Ultrasound image of a fracture of the 5th metacarpal which also shows the callus formation around the fracture. Ultrasound image was taken 1 month after fracture.



RT 268



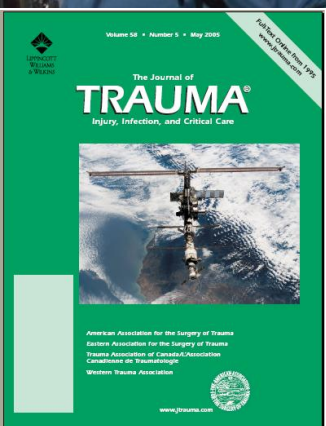
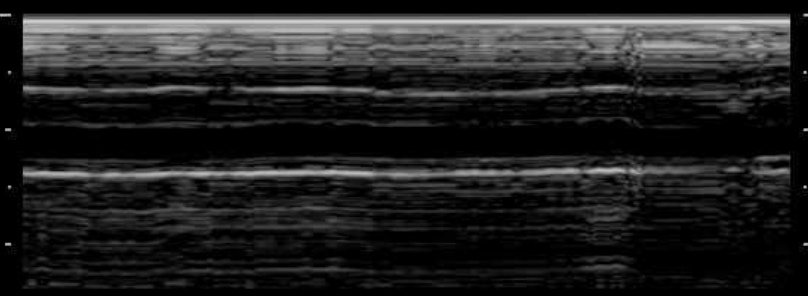
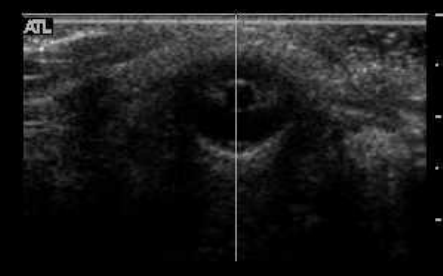


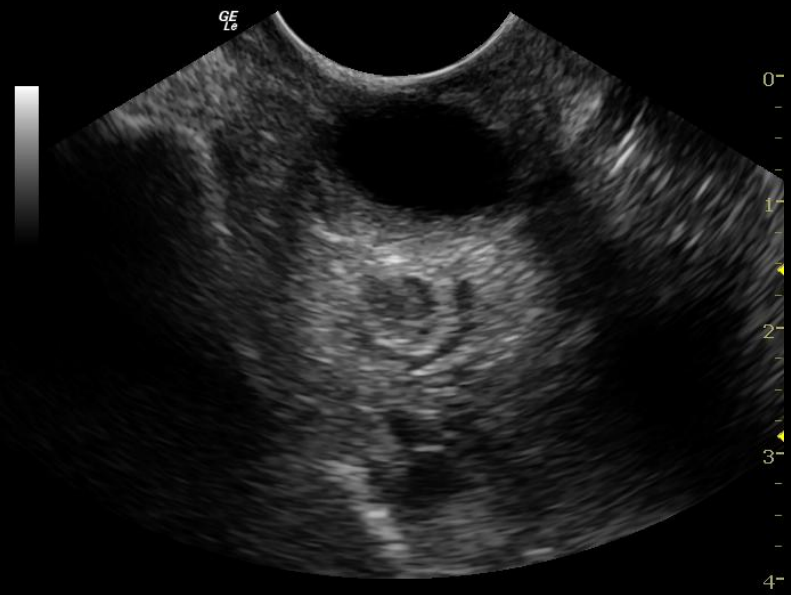
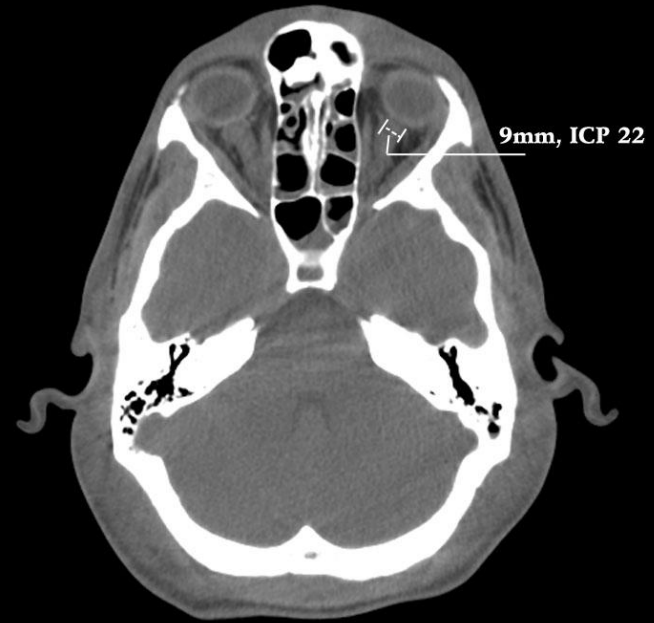
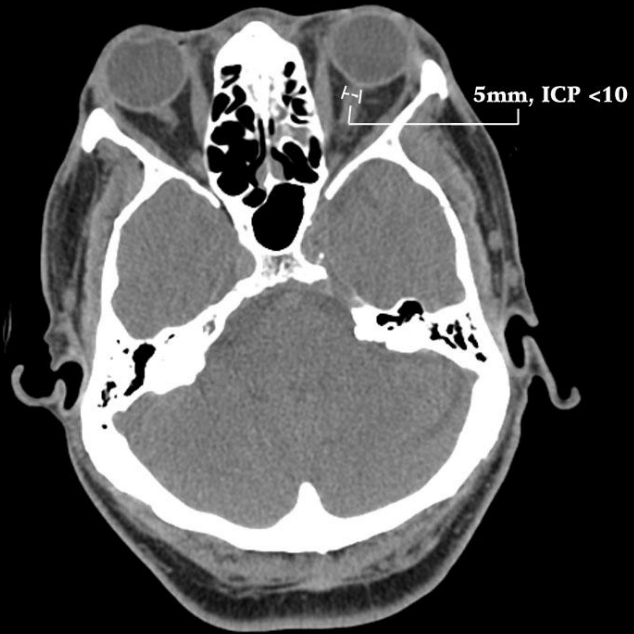
Fincke EM, Padalka G, Lee D, van Holsbeeck M, Sargsyan AE, Hamilton DR, Martin D, Melton SL, McFarlin K, Dulchavsky SA. Evaluation of shoulder integrity in space: first report of musculoskeletal US on the International Space Station. *Radiology*. 2005 Feb;234(2):319-22. Epub 2004 Nov 8.



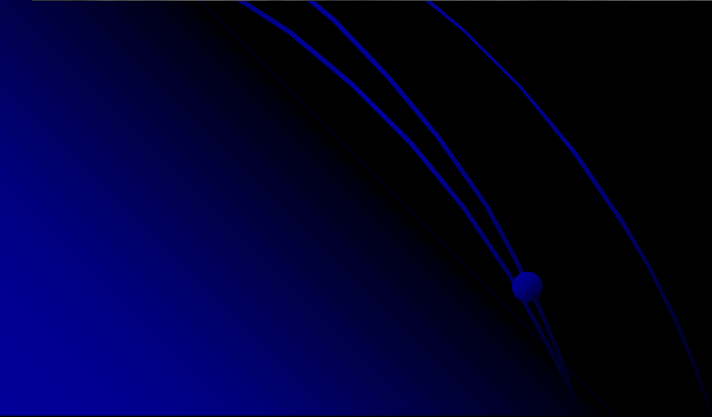
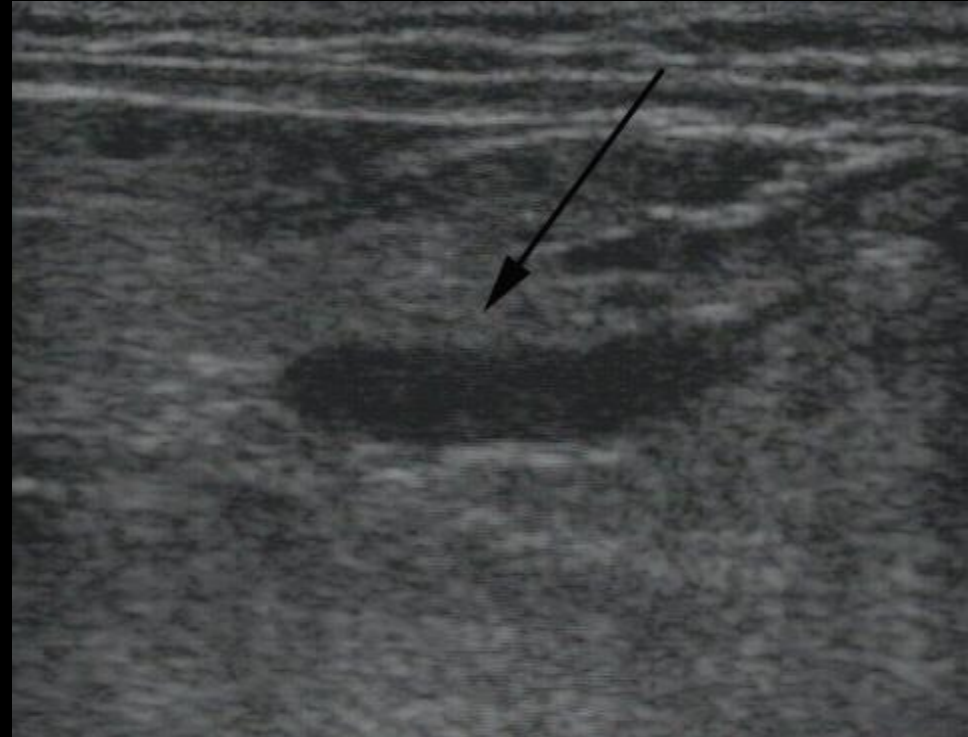
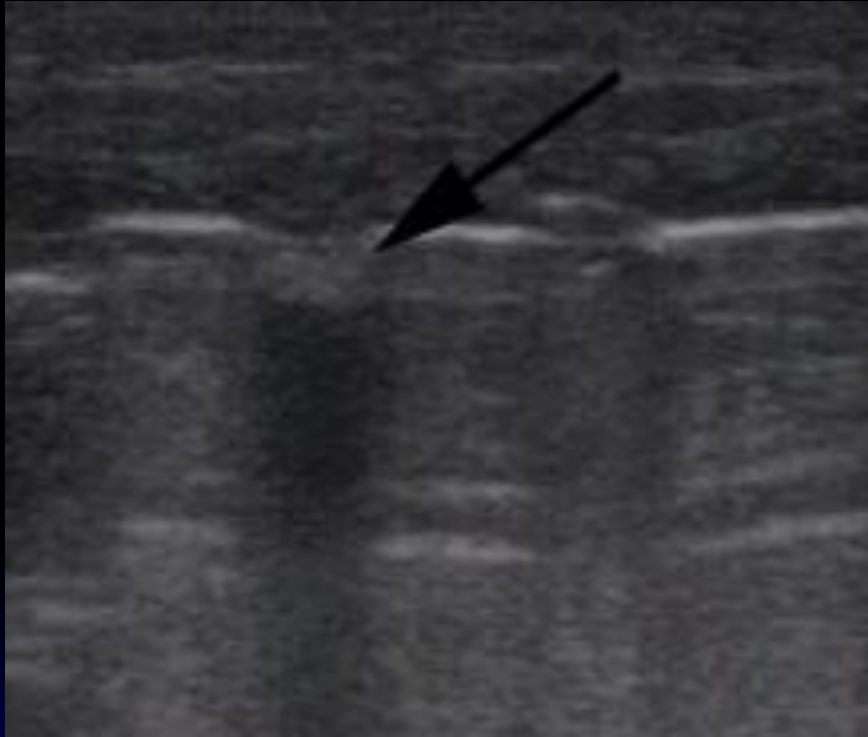
FID 5000	UIIU PENSACOLA	04/12/16:141407 L12-5 38 CVasc/Car	16 Dec 04 14:35:08	TIs 0.1 MI 0.7 Fr #794 2.4 cm
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Map 2
150dB/C3
Persist Low
Fr Rate High
2D Opt:Gen





Dental and Sinus Infections



Terrestrial Applications



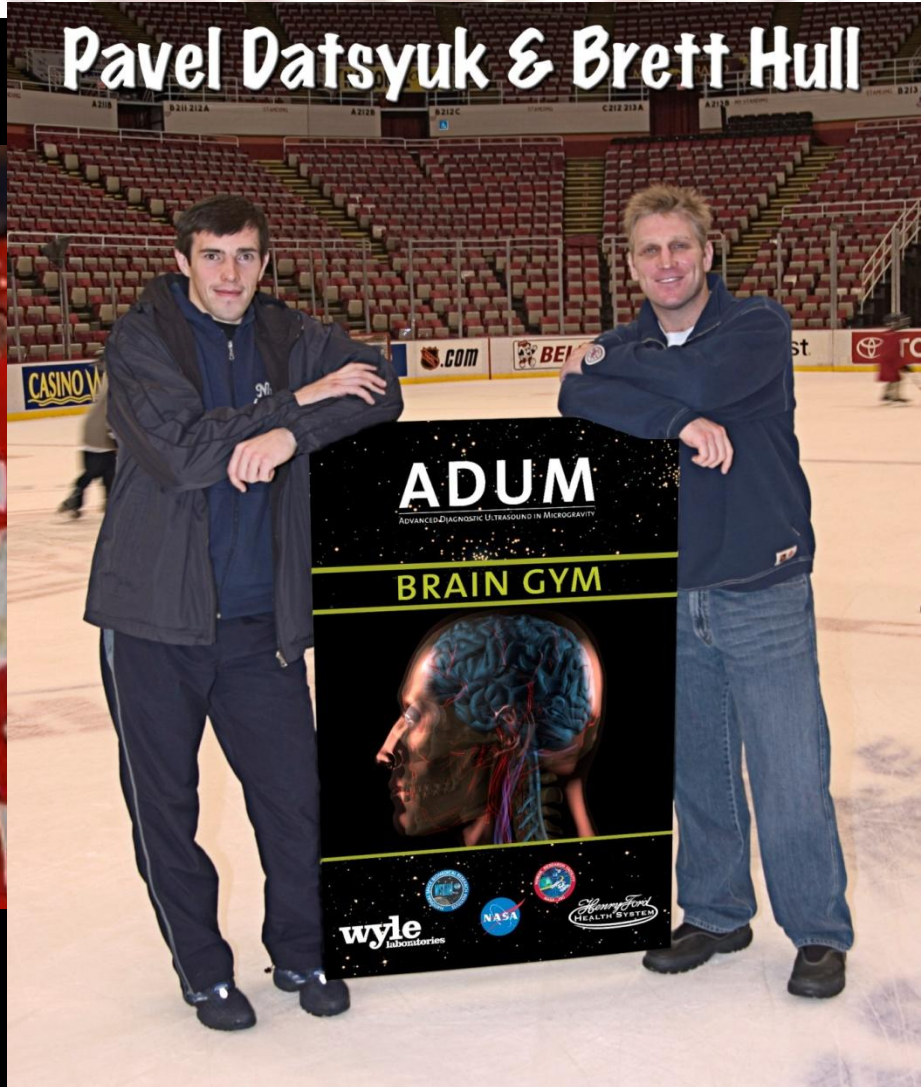


The official site of the 10-time Stanley Cup champion

Detroit Red Wings



Pavel Datsyuk & Brett Hull

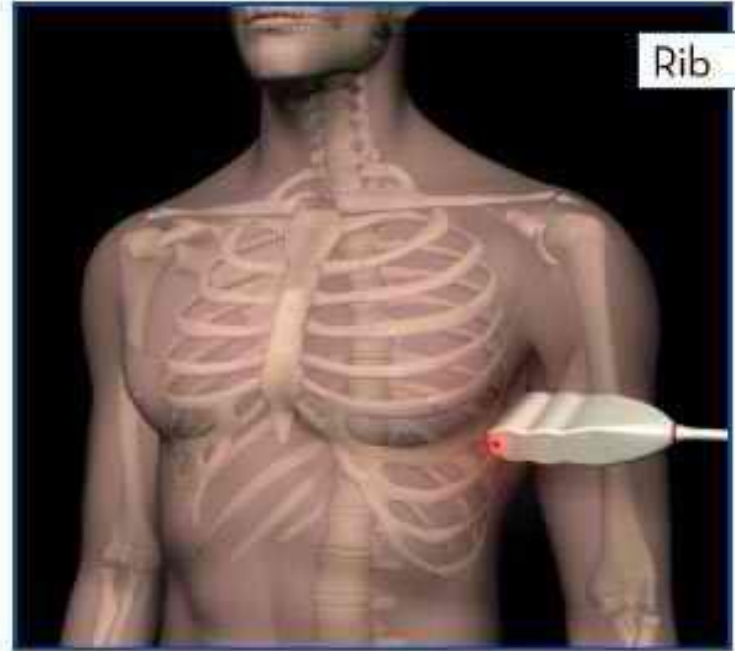


Initial Probe Positions

Shoulder



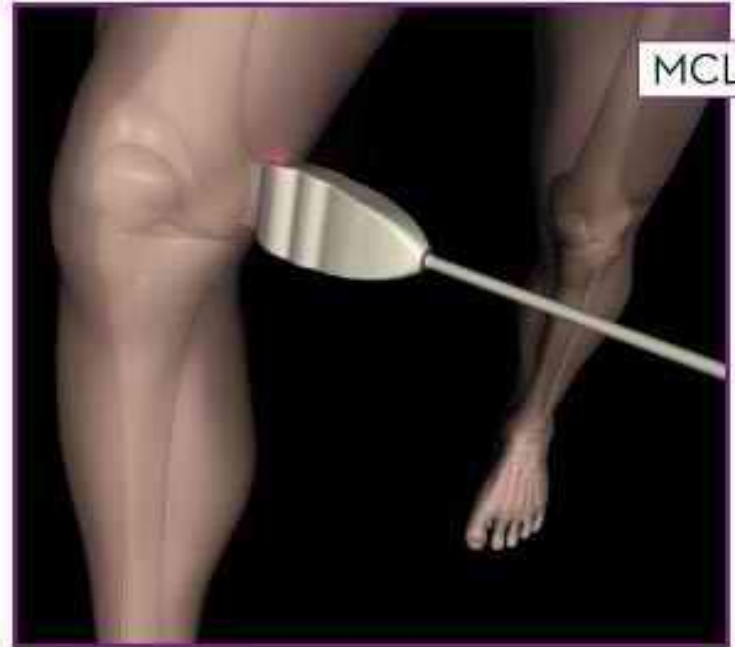
Rib

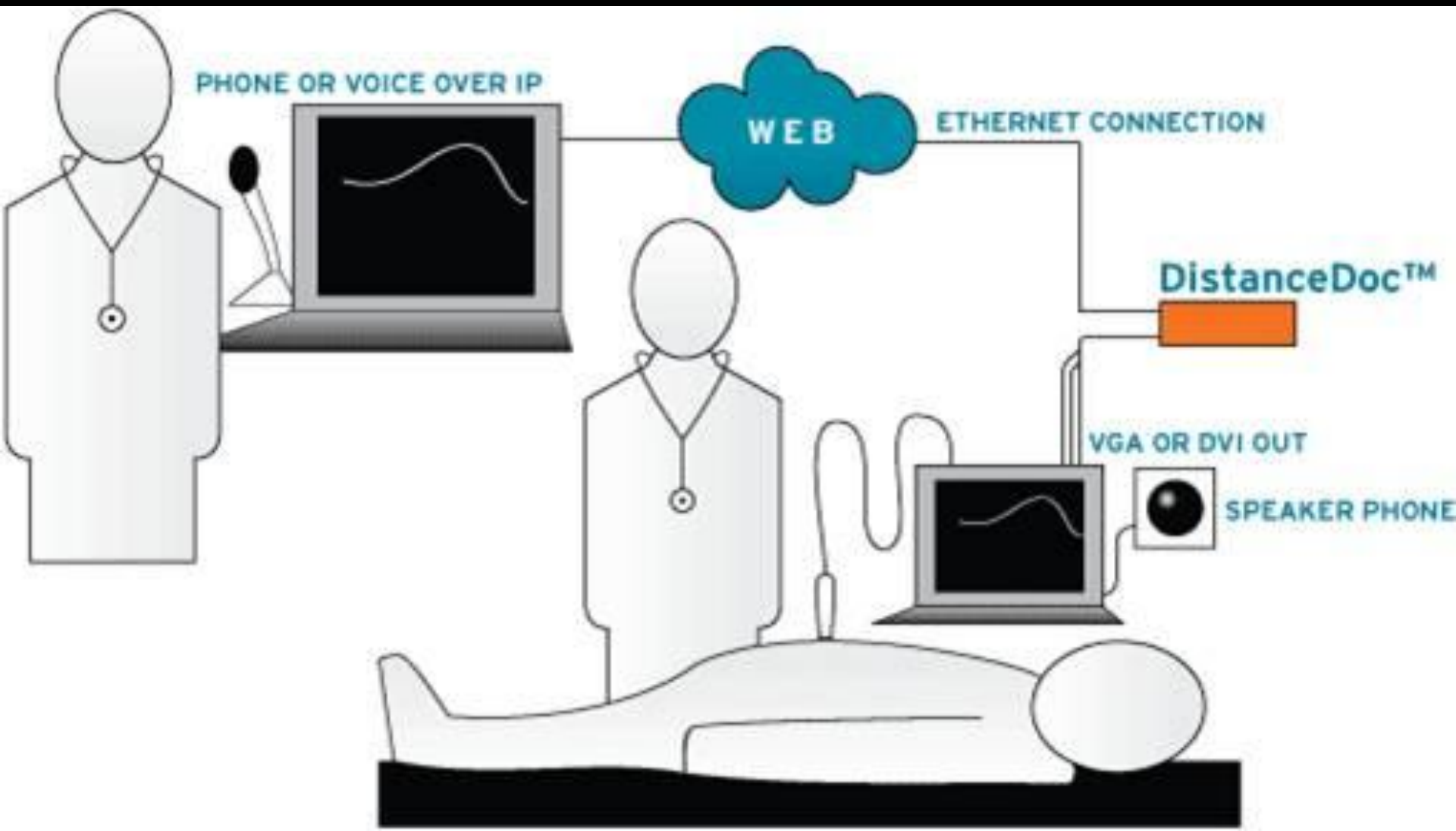


AC Joint



MCL







Hit me

world championship rings

DRAPER'S DECADE

MI

ADUM

OPEVI

INCREMENT 8



WINGS



XX Olympic Winter Games
10-26 February 2006



USA

1998
MOCKBA
OLYMPIC GAMES

EXIT

SONY
UP-D895/GE

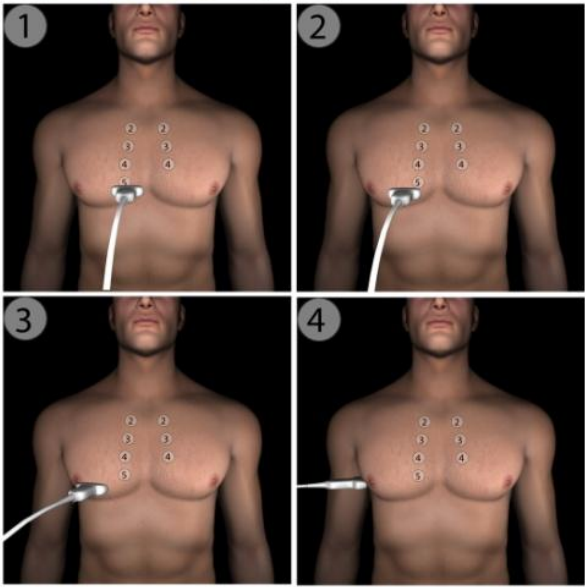
ADUM

us, us, F



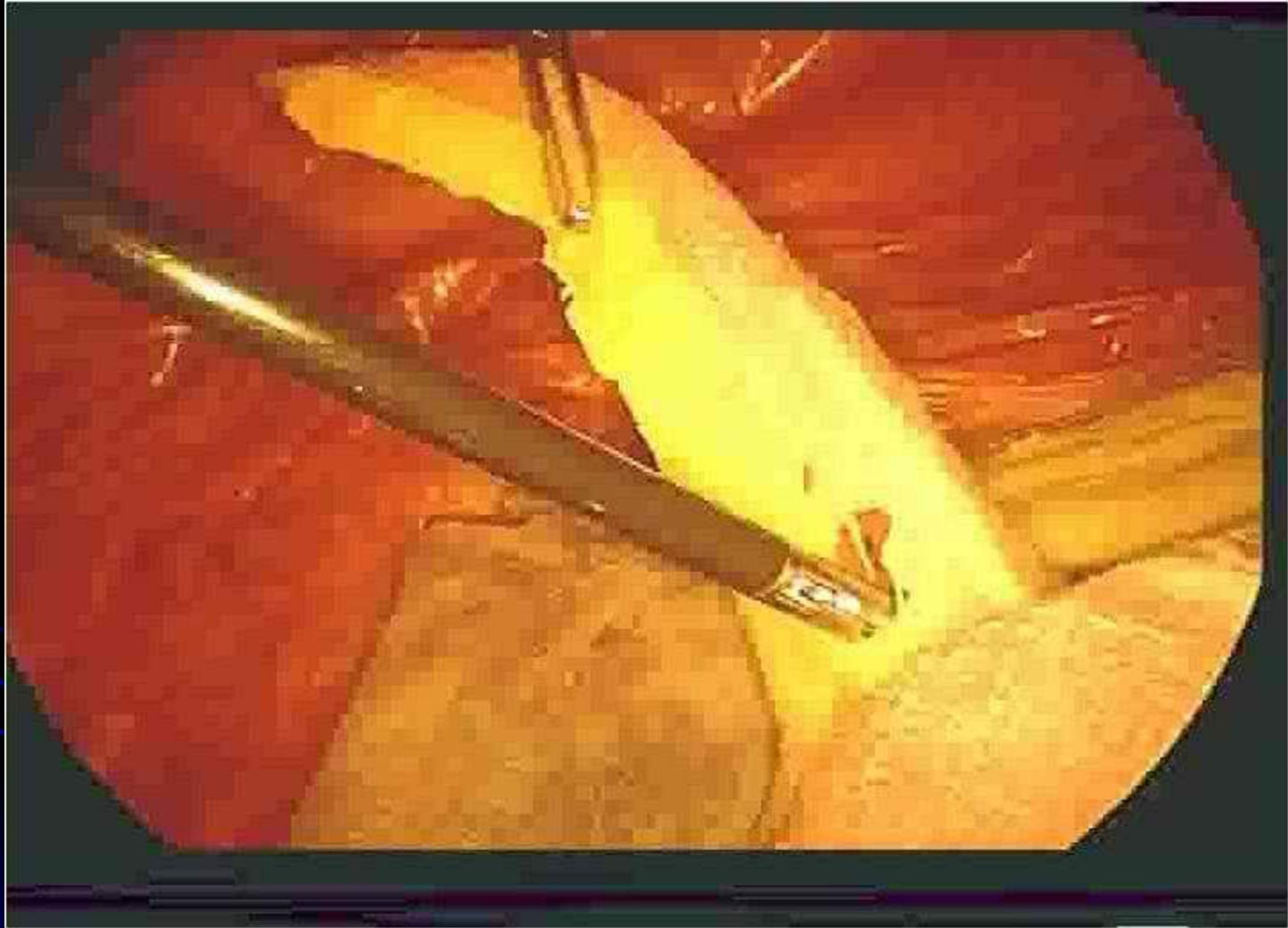














UN Millennium Development Goals

Keep the promise
Millennium Development Goals



Human Anatomical Ultrasound Guide



PRINCIPLES OF
ULTRASOUND



REMOTE GUIDANCE



DATA COLLECTION



CUE CARDS

HEART

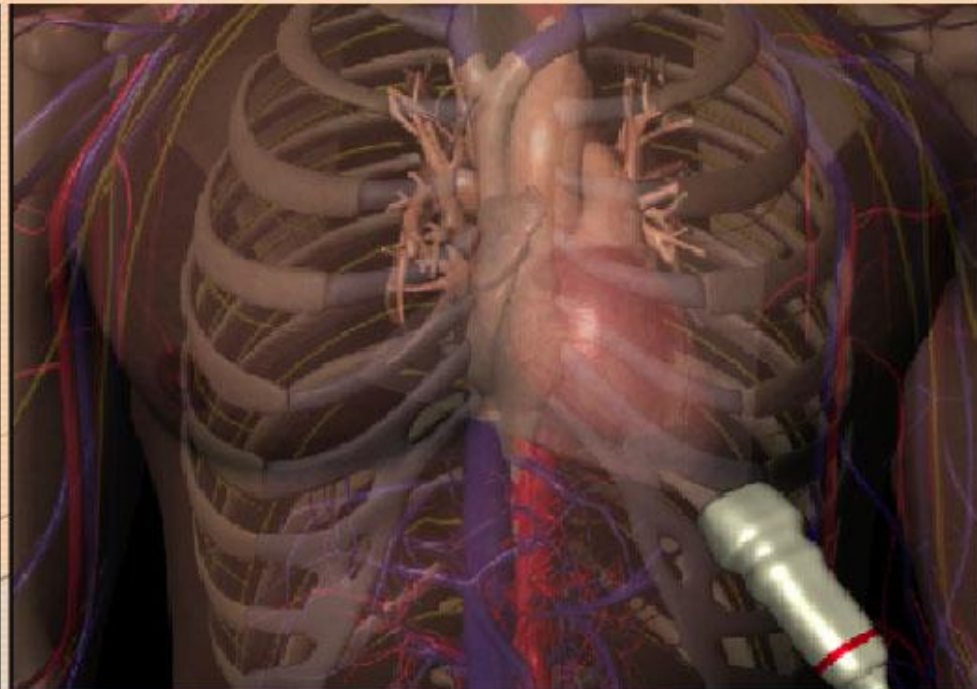
VIEW CUE CARD

Apical	Parasernal	Right Ventricular	Left Ventricular	Subcostal	Short-axis
4-Chamber	Long-axis	Inflow	Short-axis	4-Chamber	Mitral Valve
2-Chamber		Outflow	Long-axis	Short-axis	Aorta
Long-axis				IVC	

Info

Scanning

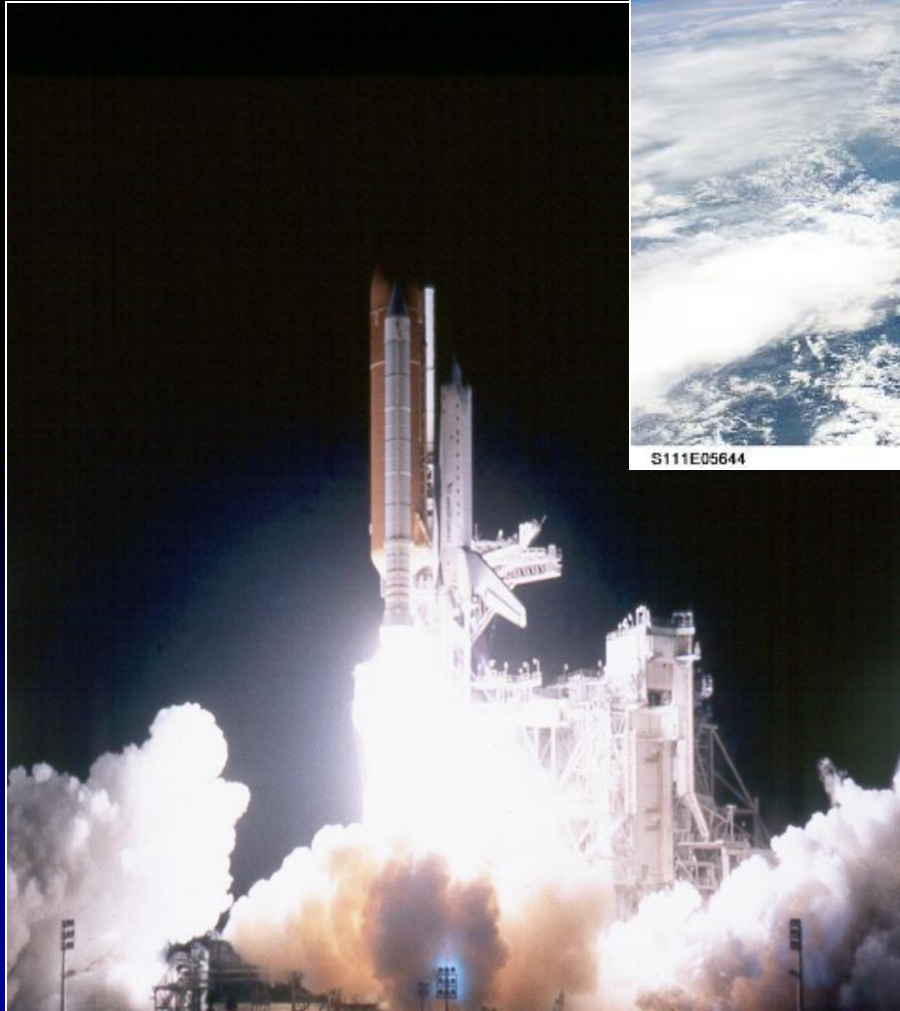
Pathology



Probe position:

Place probe in C2 position pointing towards the right shoulder with marker to 3 o'clock. Actual position and orientation may vary among subjects. The position/orientation of the heart is also expected to change in OG.





Discussion