Digital Anatomy, Collaborative Learning and Surgical Simulation

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Overview

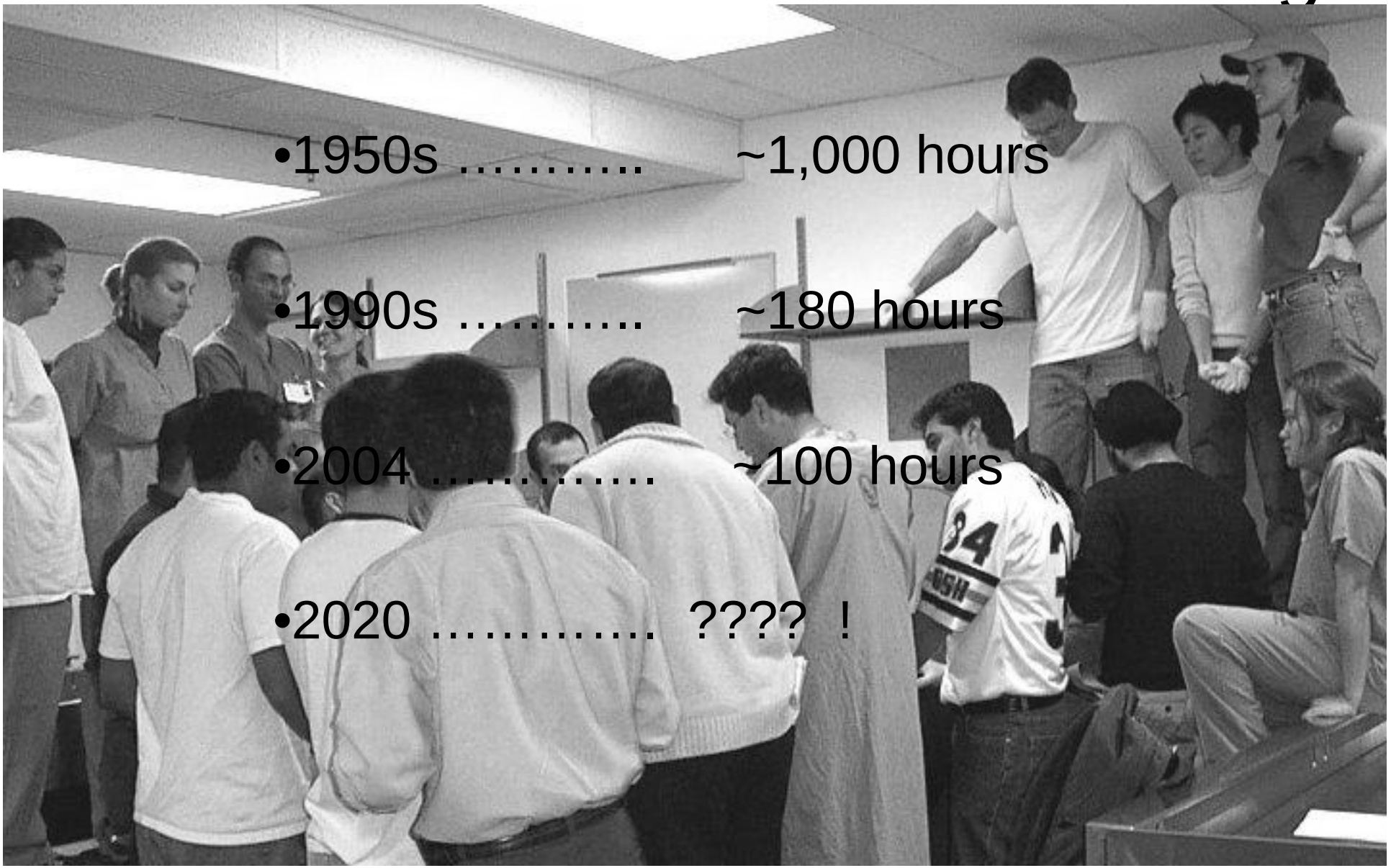
Problems faced in anatomy education

Digital anatomy resources

Collaboration over the Internet

Surgical simulation and learning

Reduced hours of teaching



- 1950s ……. ~1,000 hours
- 1990s ……. ~180 hours
- 2004 …… ~100 hours
- 2020 …… ???? !

Not enough anatomists

The Importance of Anatomy in Health Professions Education and the Shortage of Qualified Educators

RS McCuskey, SW Carmichael, DG Kirch

Academic Medicine (2005) 80: 349-351

Students are “digital natives”

Audio

- ***Mobile phone***
- ***Music***

Visual

- ***Television***
- ***Web lecture***

Interaction

- ***Web surfing***
- ***Instant messaging***

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Dissection

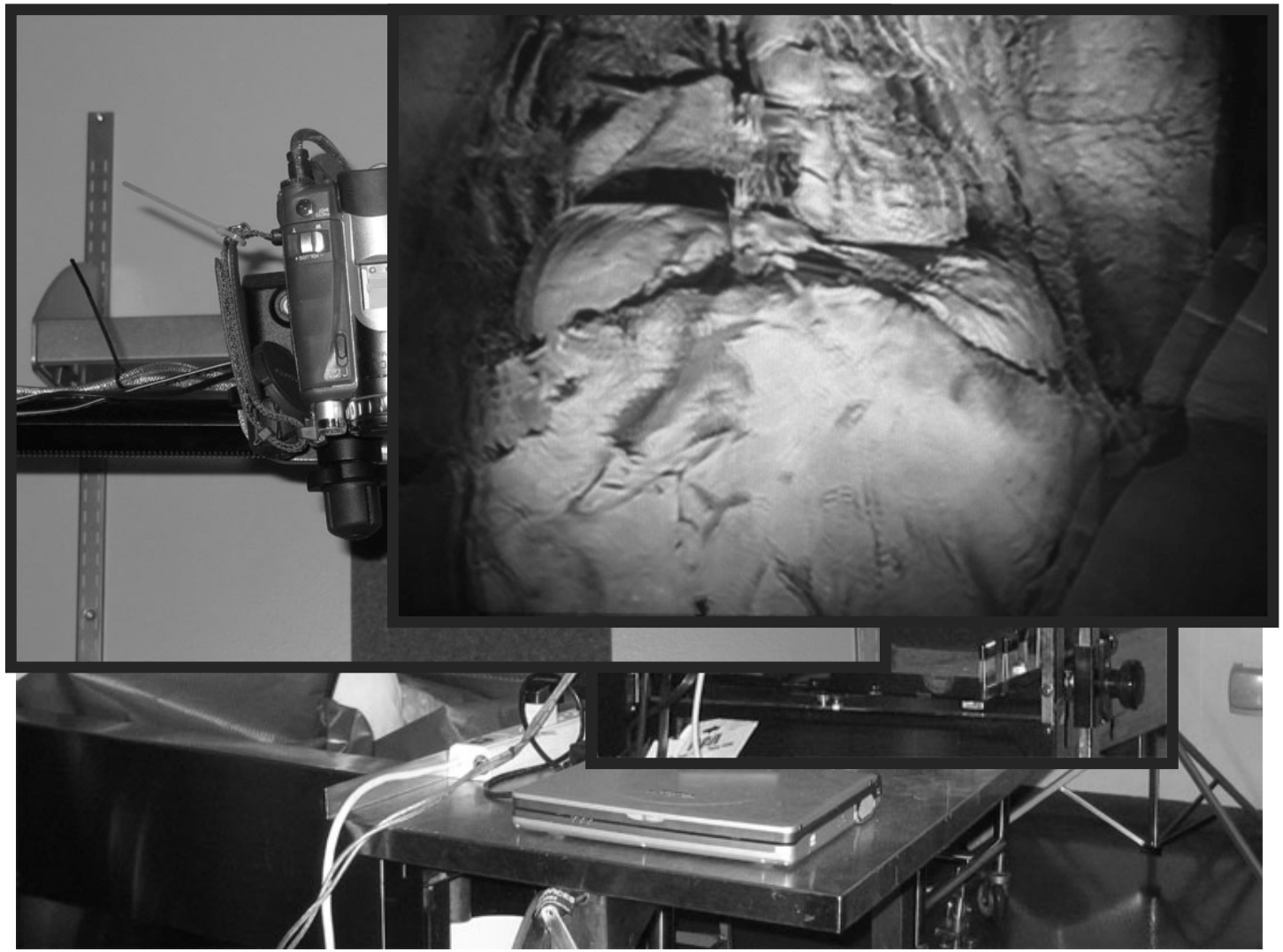
Digital images

Stereo images -> 3D view

Stereo video

Simulated dissection

Stereo video of dissection



Bassett stereographic images

1500 exquisite high resolution stereo pairs of dissection images

– originally available in 1950s via View Master

– now on the Web

Simulated dissection

Hand dissection photographed at 5 degree rotation

Cross-sectional images

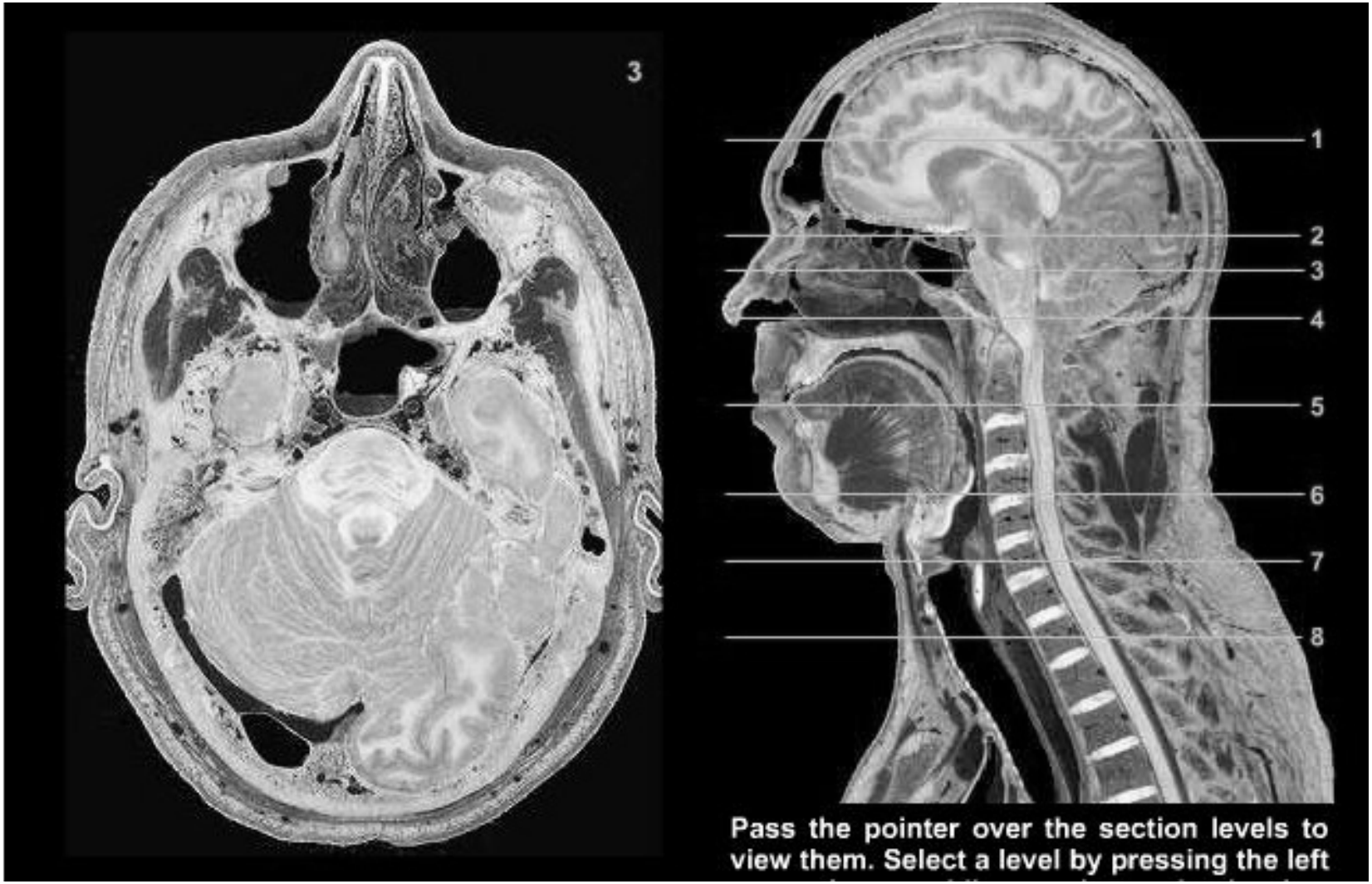
Cross-sections of anatomy

Cross-sections of micro-anatomy

Radiographic cross-sections

- MRI
- CT

Cross-sectional anatomy

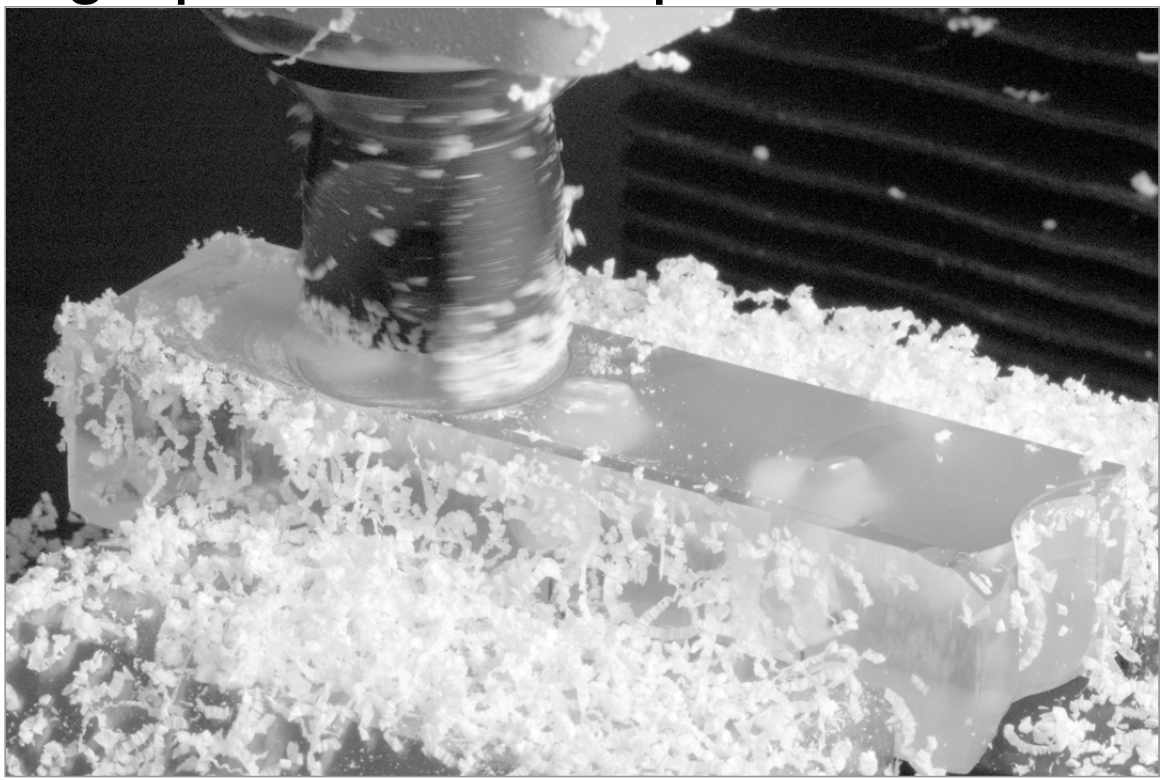


Photographic micro cross-sections

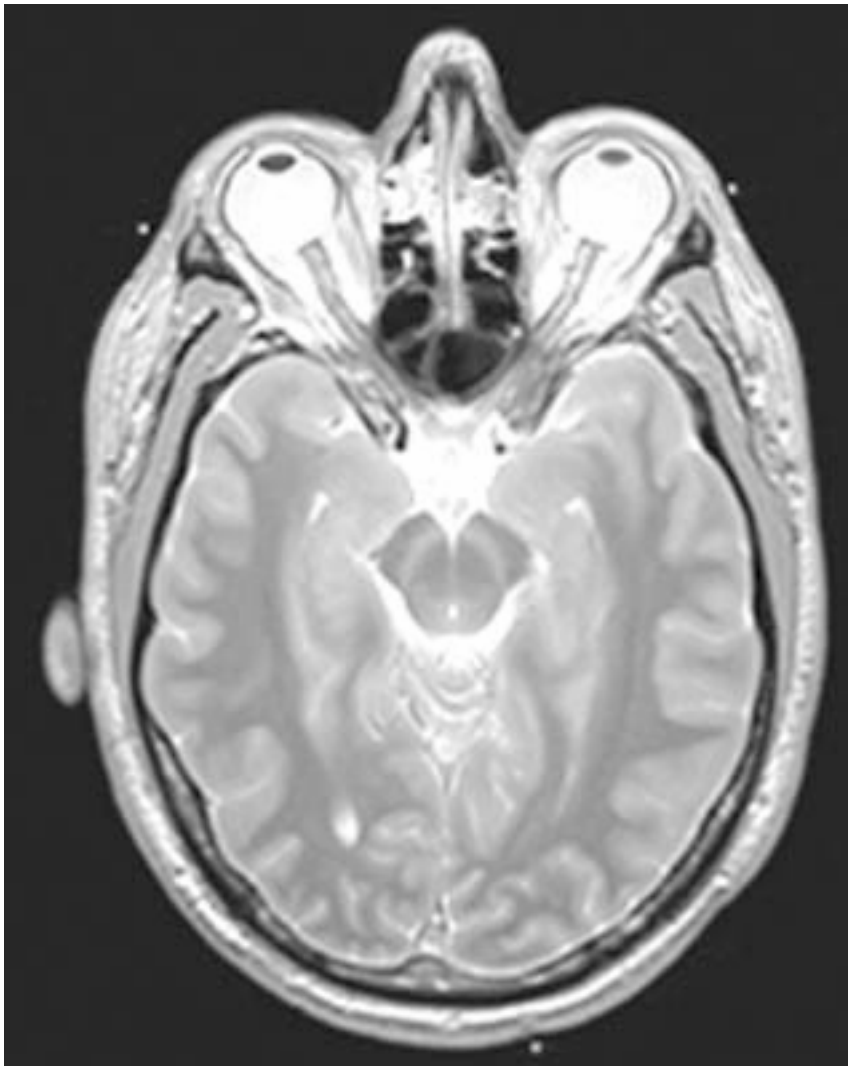
Object (teeth) embedded in resin

Microgrinding removes thin layer

Photograph taken of exposed section

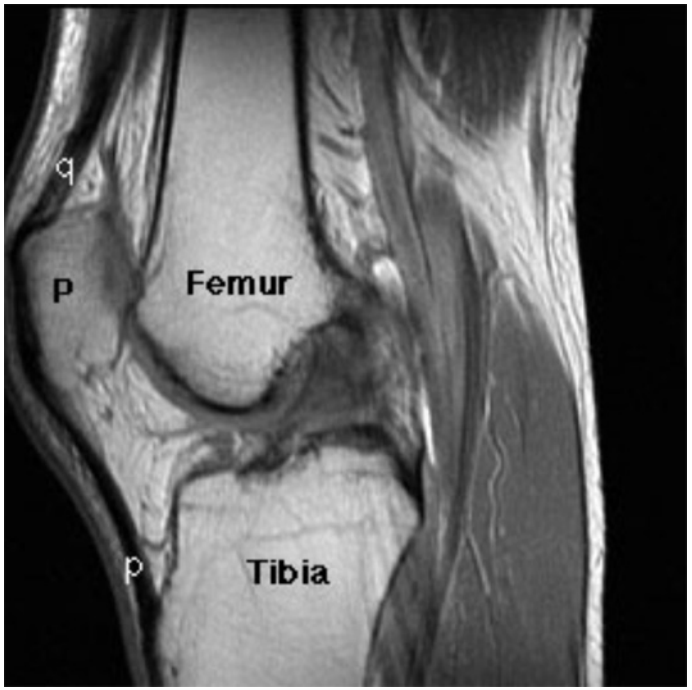


Cross-section from MRI



Digital images from radiology

Radiology departments generate many gigabytes of clinical images every day.



3D anatomy from cross-sections

Radiology is rich source of cross-sectional images

3D reconstruction from cross-sections is improving every year

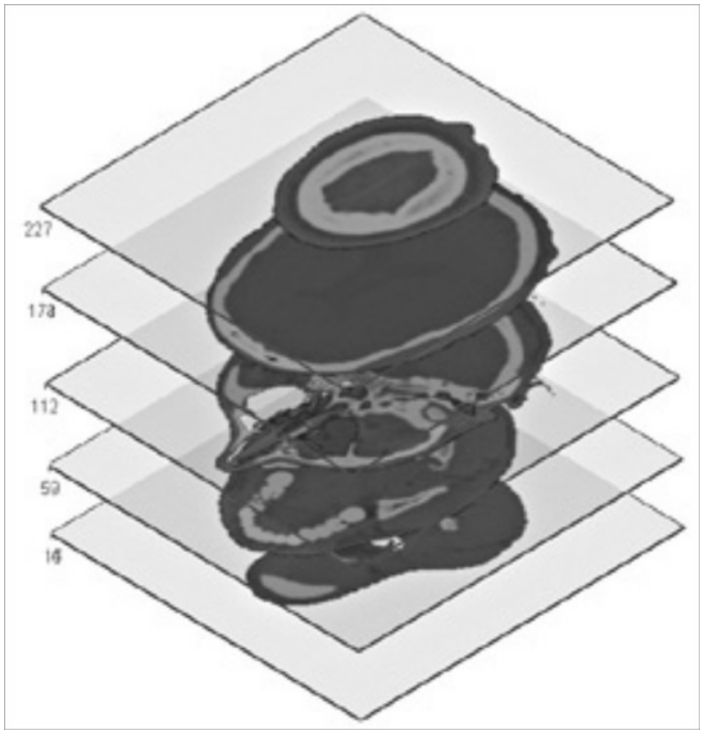
Excellent source for normal and pathologic anatomy

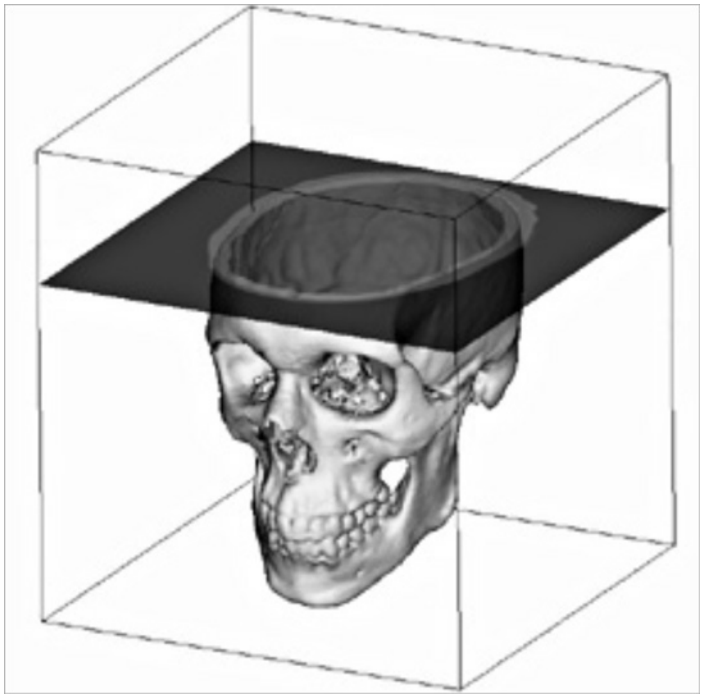
Constructing anatomy from slices

Slices are stacked vertically

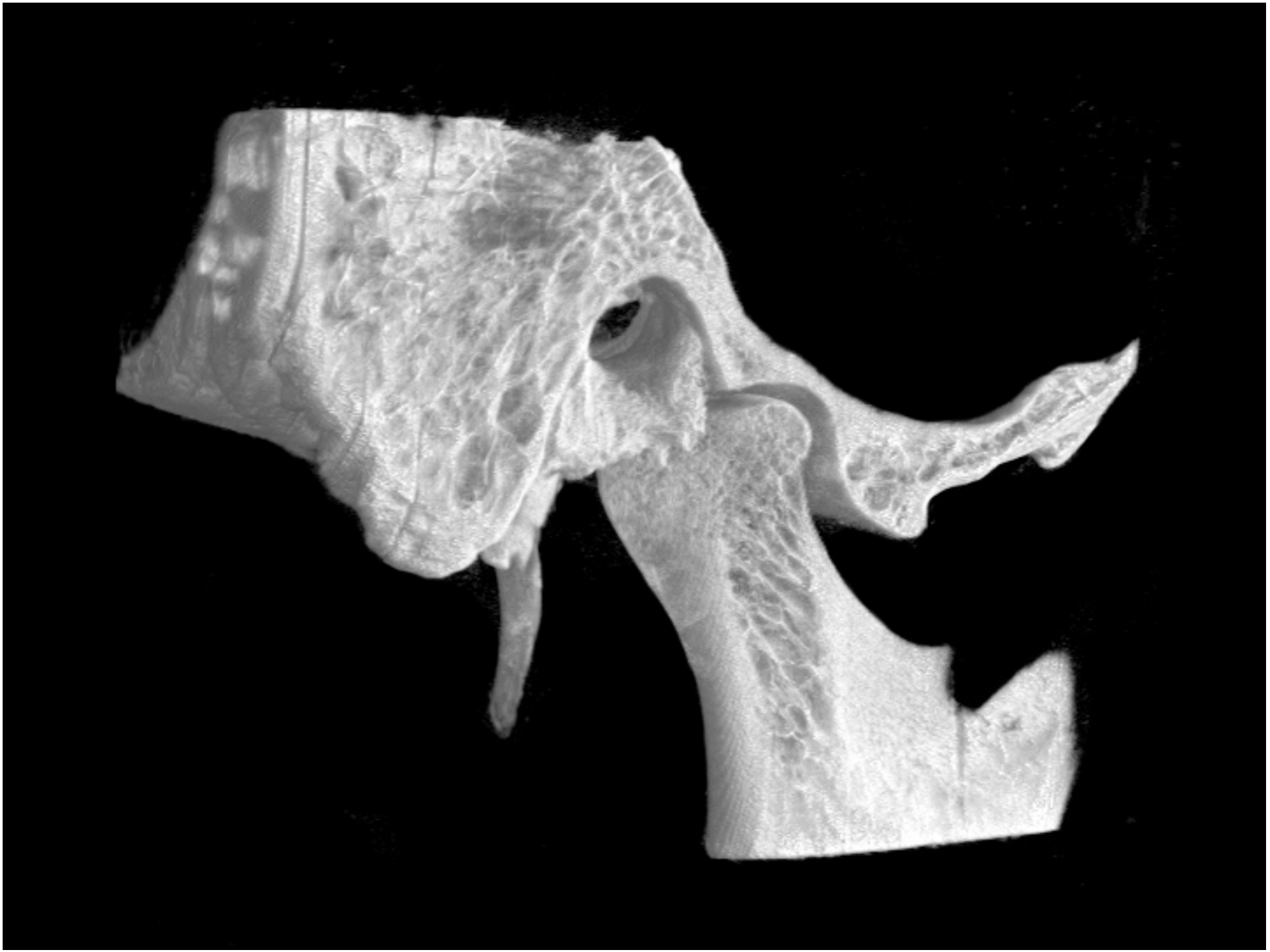
Bone outlines are extracted from each slice

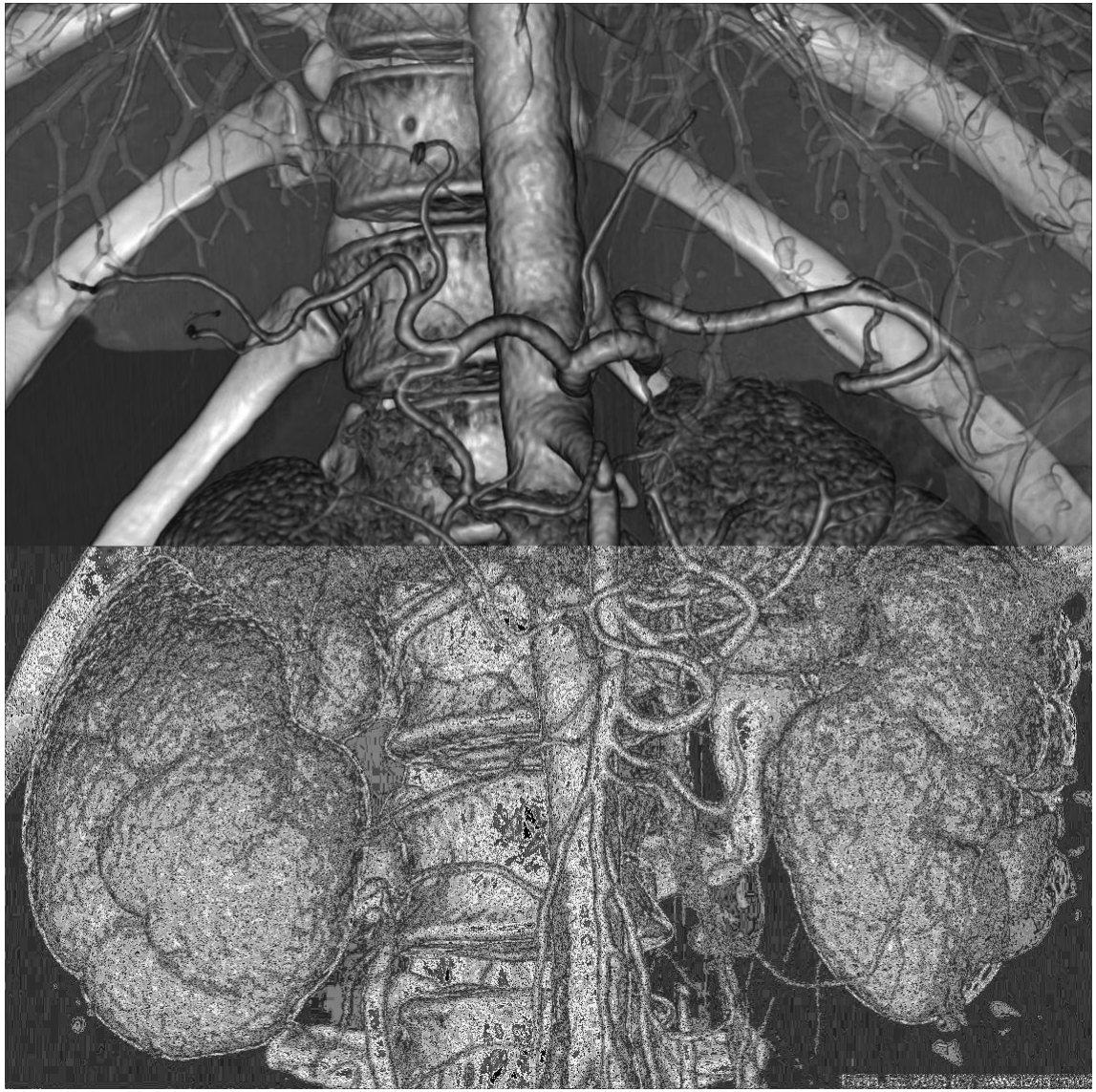
The outlines are smoothly connected





Mandible reconstruction





www.fovia.com

Special collections & rare images

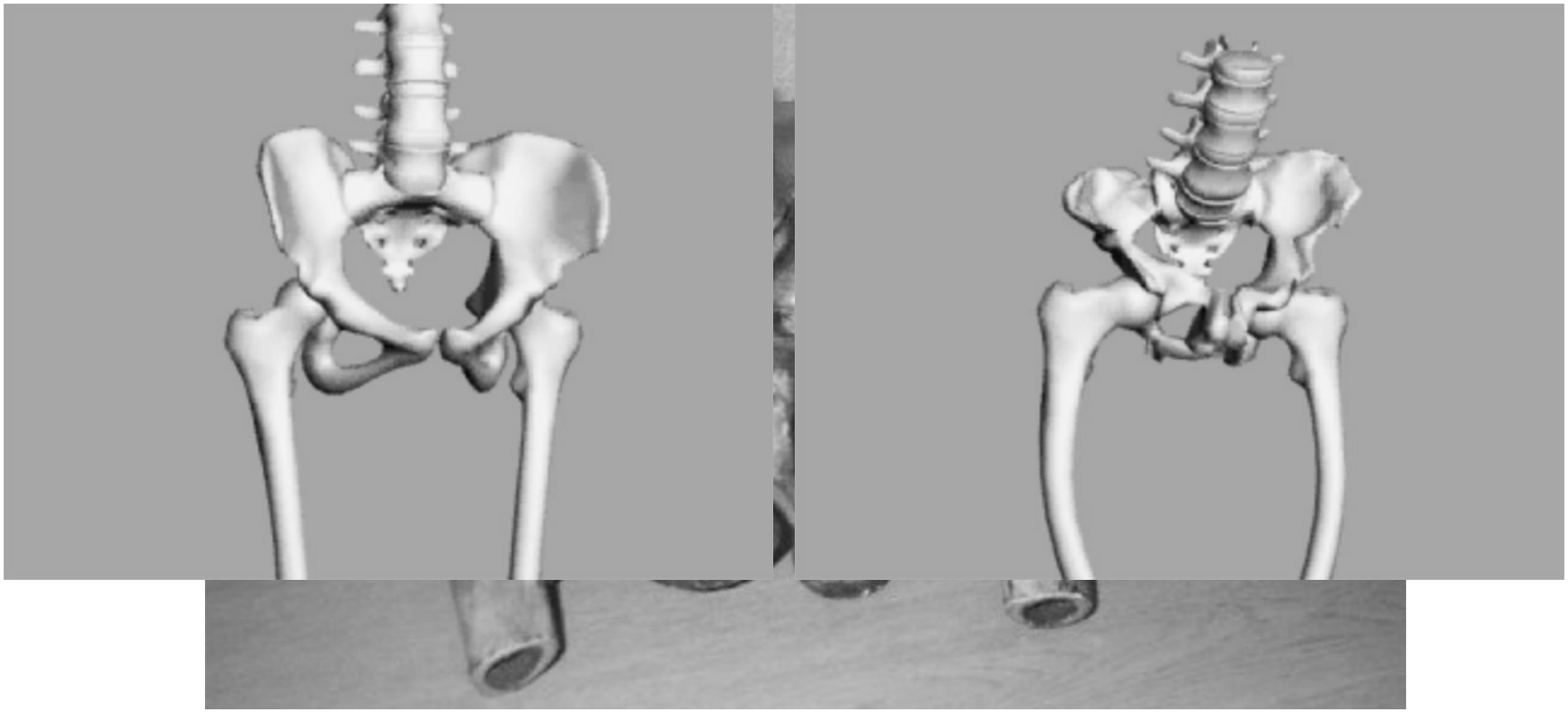
- Many countries and regions have unique and rare anatomic collections that are being lost
- Collections developed by anatomists, biologists and physicians specific to each country
- Region-specific diseases, such as tropical diseases
- Collections of importance to anthropologists or archaeologists

Rare collections

Virtual Pelvis Museum - Manchester, UK

http://www.hpv.informatics.bangor.ac.uk/Sim/Pelvis/index.html

Showed conditions for Caesarean section surgery after “rickets”



How real is digital anatomy?

Photographs and videos of dissections are excellent representations of anatomy.

- When viewed in stereo, they are visible in 3D and give a very good feeling for the shape and size of the anatomy.

3D digital models can show types of anatomy and disease that cannot be seen on the cadaver dissection table.

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Internet2 supports real-time interaction and collaborative learning

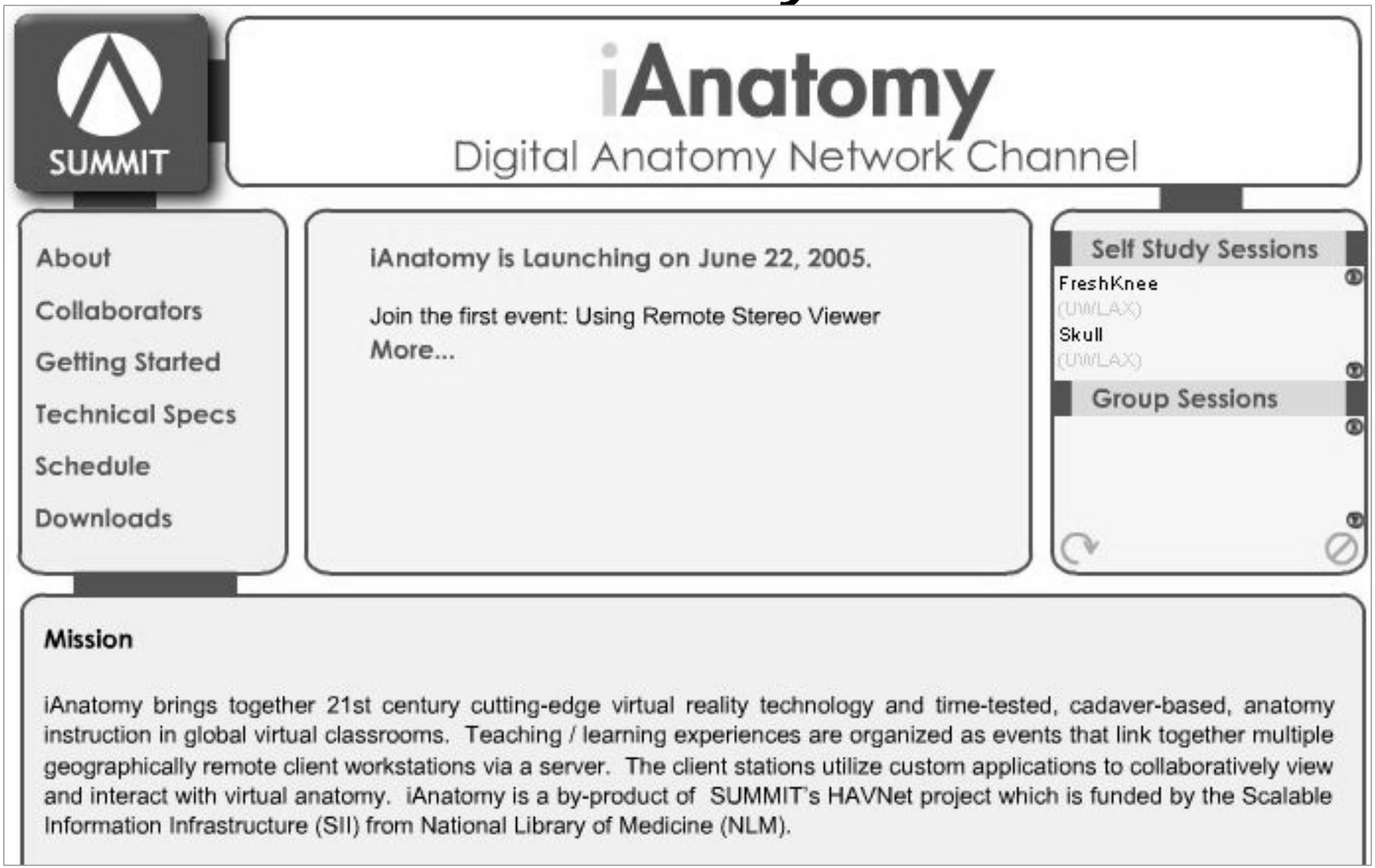
Remote teaching of anatomy

Ubiquitous Human Anatomy

Creating structures of interest
with broadband access

Wireless Access

iAnatomy.stanford.edu



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3D anatomy used for surgical simulators

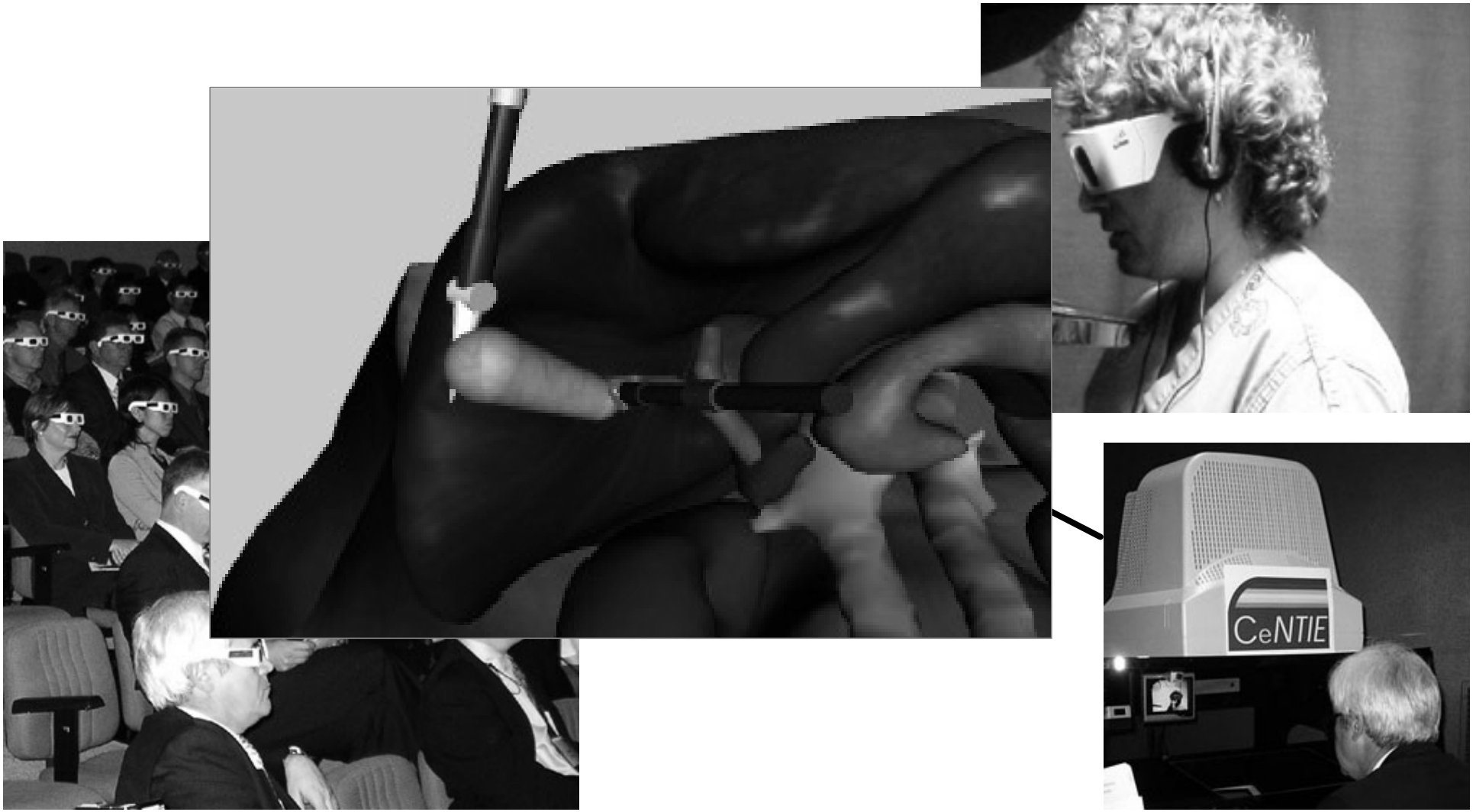
Haptic imagery - “feeling” virtual objects

At a distance

Low latency

Transmit force, field, model

California and Australia doing simulated surgery



Assessing Learning

Digital Anatomy:

- We have surveyed the students. They like it and want more.

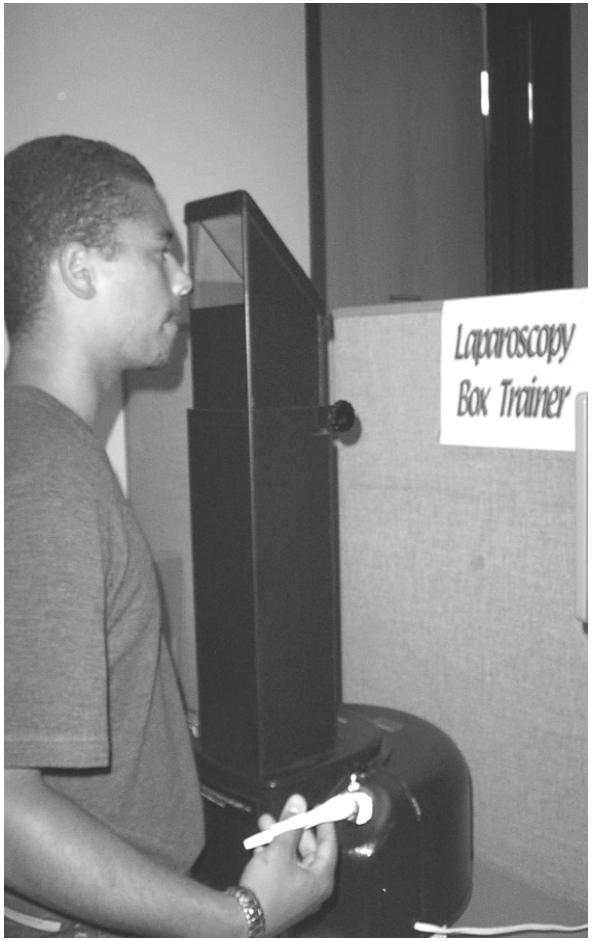
Surgical simulation:

- We have completed a controlled study.

Comparing the LapSim, a Box Trainer and no training

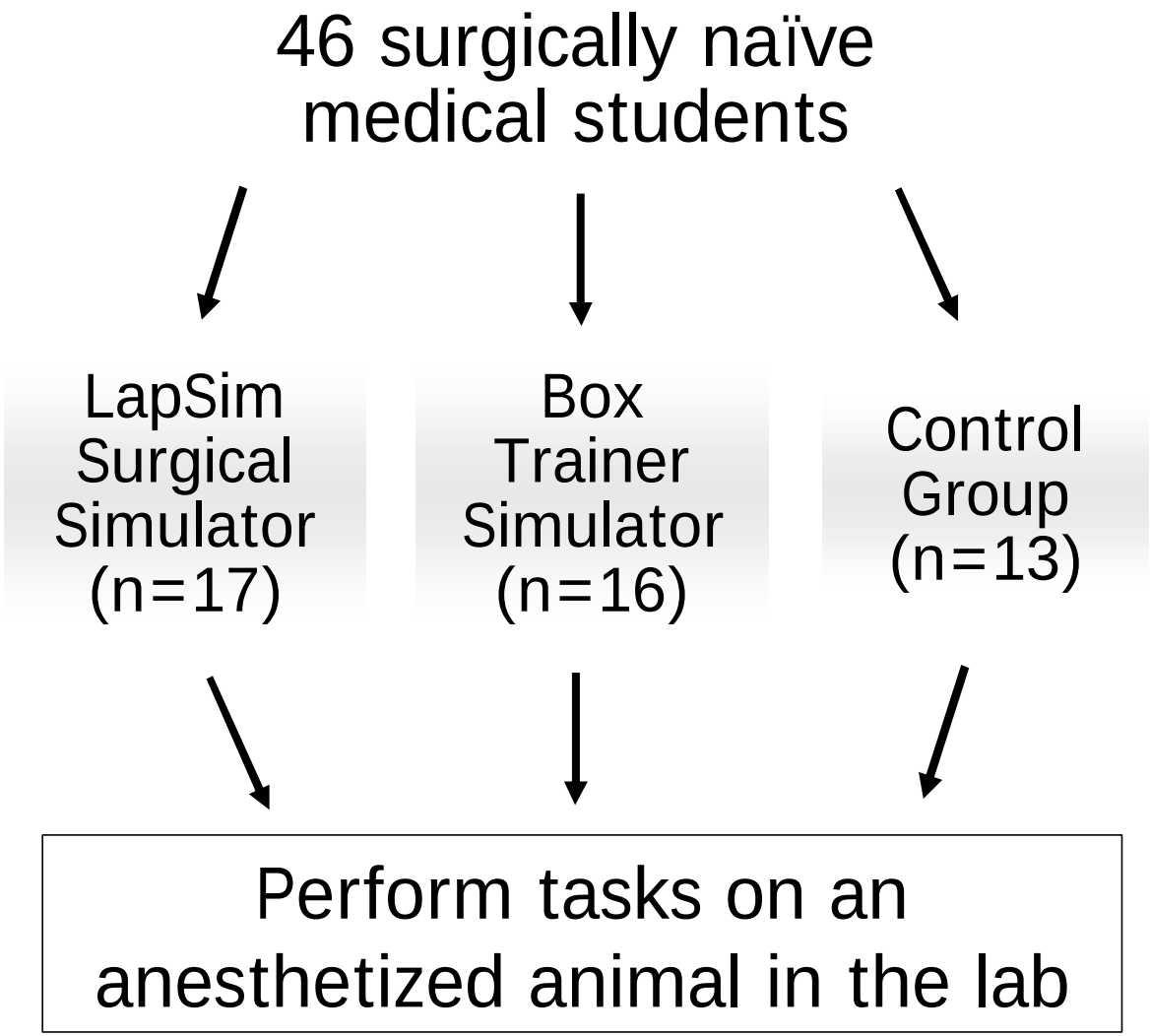
- 3 treatment groups
- 4 x 45 min training sessions
- 3 laparoscopic tasks
- Assessment in animal lab

Lapsim simulator



Box trainer

Evaluation Design



Final assessment in animal lab

Findings ($p<.05$):

- LapSim VR group outperformed the Box Trainer group on 3 measures

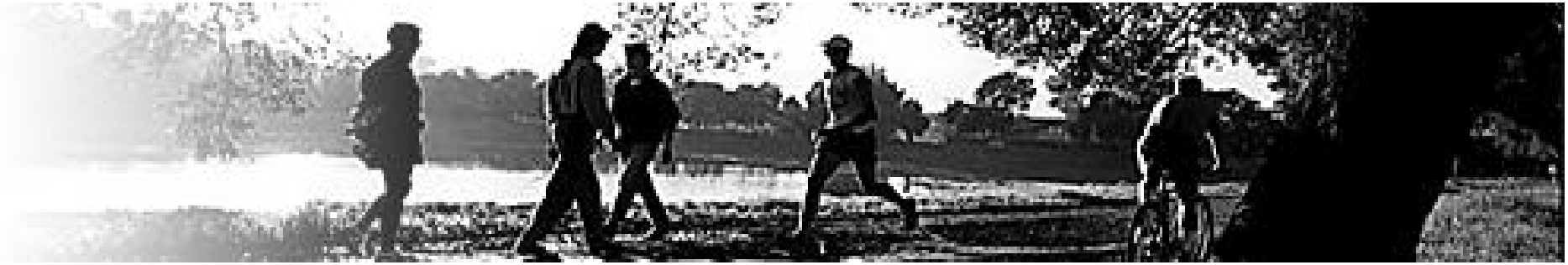
Conclusion

- Digital anatomy will be essential for future medical education
- Many rich sources of digital images
- 3D anatomy used for surgical simulators
- Many countries and regions have unique and rare anatomic collections that are being lost
- Internet2 supports rich real-time interaction and collaborative learning

http://summit.stanford.edu/

Thanks for your attention!

Parvati.Dev@stanford.edu



Information about Visible Human and other 3D digital anatomy

http://www.nlm.nih.gov/research/visible/visible_human.html -- Visible Human at National Library of Medicine

http://www.crd.ge.com/esl/cgsp/projects/vm/ -- Visible Male at General Electric

http://www.hpv.informatics.bangor.ac.uk/Sim/Pelvis/ -- virtual pelvis museum

http://www9.biostr.washington.edu/da.html -- Digital Anatomist at University of Washington

http://summit.stanford.edu/ourwork/PROJECTS/LUCY/lucywebsite/home.html -- Stanford Visible Female

http://health.internet2.edu/WorkingGroups/anatomyBOF.html -- digital anatomy community at Internet2

http://ianatomy.stanford.edu/ -- an experiment in real time teaching of anatomy over Internet2 (needs password)

http://www.medicalstudent.com/ -- links to other anatomy resources