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

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
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.
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

iAnatomy is Launching on June 22, 2005.

Join the first event: Using Remote Stereo Viewer
More...

Mission

iAnatomy brings together 21st century cutting-edge virtual reality technology and time-tested, cadaver-based, anatomy instruction in global virtual classrooms. Teaching / learning experiences are organized as events that link together multiple geographically remote client workstations via a server. The client stations utilize custom applications to collaboratively view and interact with virtual anatomy. iAnatomy is a by-product of SUMMIT's HAVNet project which is funded by the Scalable Information Infrastructure (SII) from National Library of Medicine (NLM).
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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
Evaluation Design

46 surgically naïve medical students

LapSim Surgical Simulator (n=17)

Box Trainer Simulator (n=16)

Control Group (n=13)

Perform tasks on an anesthetized animal in the lab
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!

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Information about Visible Human and other 3D digital anatomy


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://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