Case Study: A Testbed for Teaching Laparoscopic Surgical Skills

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What to Train in Laparoscopic Surgery

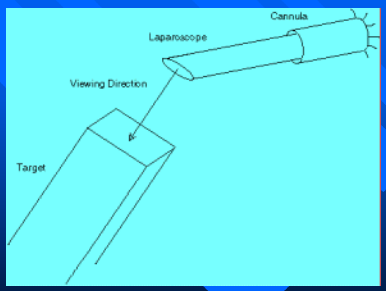
- Some basic skills can be adequately learned by most with practice in O.R.; use VE for assessment
- Complex perceptual motor skills (e.g., laparoscopic knot tying)
- Spatial skills and exposure
- Key steps of a procedure that may lead to complications if performed incorrectly

Textbook Biliary Anatomy

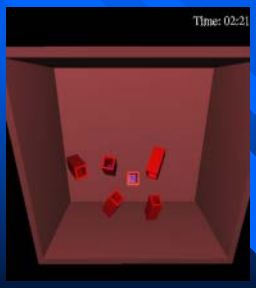
Critical Steps in Laparoscopic Cholecystectomy

- Use lateral traction on the infundibulum of the gallbladder during dissection
- Dissect the space between the gallbladder and cystic duct completely
- Clear the triangle of Calot enough to show the hepatic side of the infundibulum
- Use an angled scope to gain proper view of the triangle of Calot
- If the duct won't fit entirely within a 9mm clip, assume it is the common duct
- Any duct that look as if it goes behind the duodenum has to be the common duct

Angled Laparoscope



Angled Laparoscope Simulation



- Simulates 45 degree scope
- C and OpenGL
- Linux PC

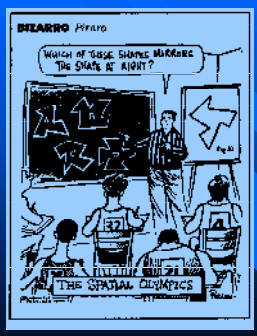
Scope Interface

(VIDEO)

Angled Laparoscope Simulation: Pilot Studies

- Residents attending Basic Course:
  - Median of 94 seconds to complete task
  - Range 35 to 305 seconds
- Advanced Course participants:
  - Up to 26 *minutes* to complete task

Spatial Cognition



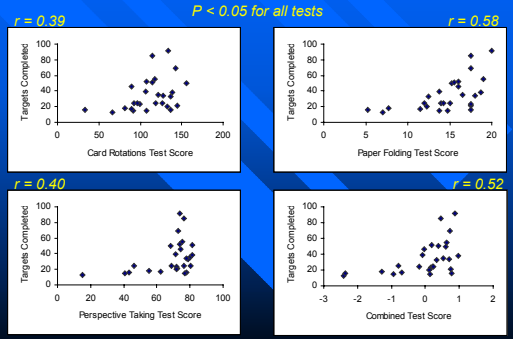
- Spatial cognition is the study of how humans acquire, store, retrieve, and process knowledge of the spatial properties of objects, events, and places in the world.
- Spatial properties include location, movement, extent, shape and connectivity.

Methods

- Novice subjects:
  - Berkeley undergraduates, ages 18-25
  - 14 males, 13 females
- Two 10-minute simulation periods
- Score: total targets completed

Spatial Ability and Performance in the Angled Scope Simulation

P < 0.05 for all tests



Angled Scope: Where We're Going

- Computational models of implicit strategies of experienced surgeons; explicit strategies from verbal protocols
- Learning curves of novices
- How to teach:
  - Can explicit strategies be taught to low spatial subjects?
  - Exercises of increasing difficulty
  - Haptic Guidance
- Validation of transfer to real scope

Cholecystectomy Simulation: Will it Work?

Still cartoon-ish...

... but principles might best be learned in a simplified environment

Where we're going:

Versatile testbed

Better technical elements, esp. tissue modeling

Teach (and validate) cognitive skills, rather than entire procedures

Challenges

- Developing and maintaining a flexible research software platform
- Running major software project on small grants
- Validation of training transfer