Enhancing Surgical Performance through Simulation

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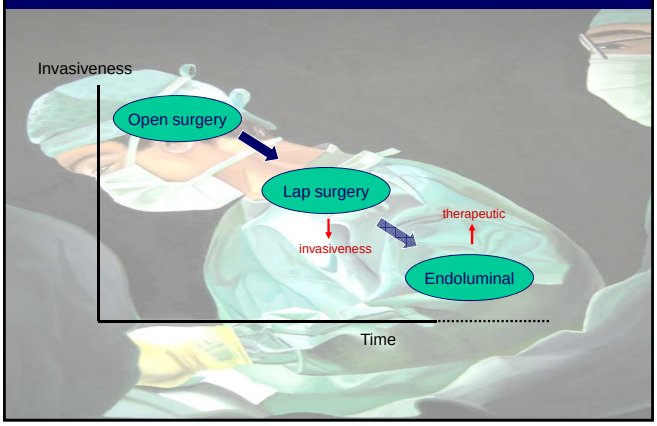
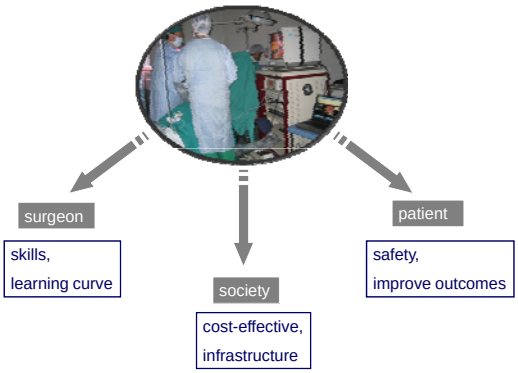
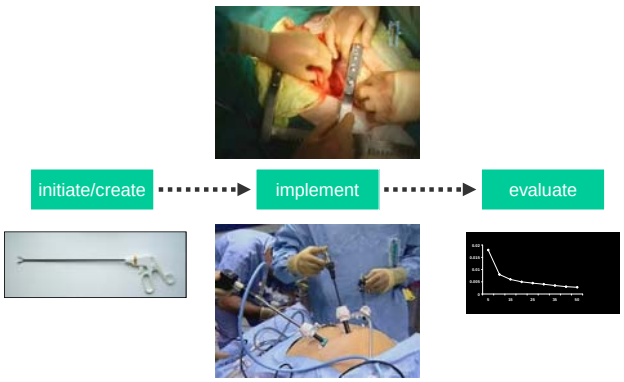
Changes to the Delivery of Surgical Care



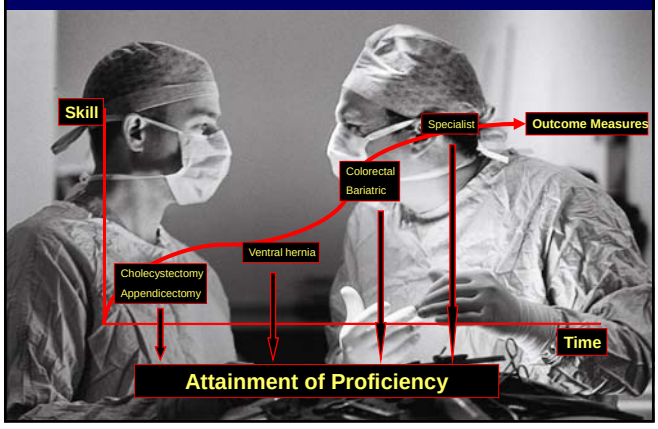
New Surgical Technologies



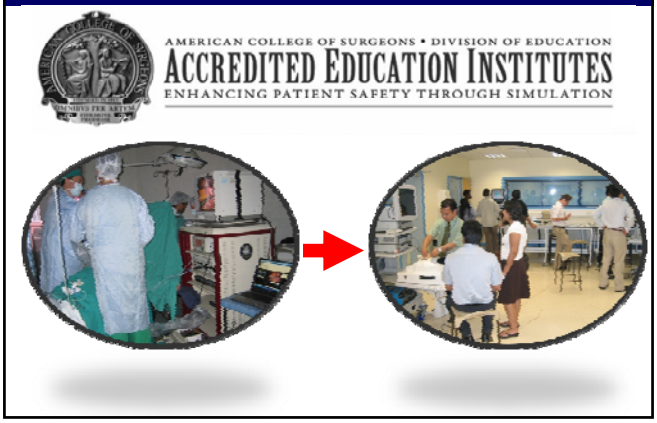
Innovation pathway



Learning Curve…



Training Needs to Shift from the OR to the Skills Lab



Proving the Value of Simulation in Laparoscopic Surgery

A Meta-Analysis of the Training Effectiveness of Virtual Reality Surgical Simulators

Randomized trial

Randomized clinical trial of virtual reality simu
laparoscopic skills training

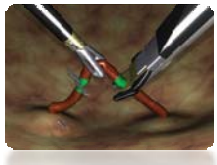
Proving the Effectiveness of Virtual Reality Simulation for Training in Laparoscopic Surgery

Surgical Simulation
A Systematic Review

Virtual Reality Training Improves Operating Room Performance
Results of a Randomized, Double-Blinded Study

Virtual Reality Simulation for the Operating Room
Proficiency-Based Training as a Paradigm Shift in Surgical Skills Training

VR Laparoscopic Simulators



VR Training Curriculum

Easy Level – settings
7 tasks performed twice on the same day in two sessions, each session >1 hour apart

Medium Level – settings
7 tasks performed twice on the same day in two sessions, each session >1 hour apart

Difficult Level – settings
2 tasks (Lifting and Grasping, and Clip Applying)
Performed for a maximum of two sessions per day, each session >1 hour apart
Completion of training when all of the following levels of skill are achieved on two consecutive sessions

Difficult Level (Lift & Grasp)
R Path length <1.2m
L Path length <1.2m
Time taken <40 secs

Difficult Level (Clip Applying)
R Path length <1.2m
L Path length <1.2m
*Error score <0.33
Time taken <80 secs

Dissection Module
Two sessions per day, each session >1 hour apart

Completion of training when all of the following levels of skill are achieved on two consecutive sessions:
Time taken (450 secs); Dissected volume (>20%);
R Path length (3.0 metres); L Path length (3.0 metres)

Aggarwal R, Grantcharov TP, Eriksen JR, Blirup D, Kristiansen V, Funch-Jensen P, Darzi A. An evidence-based virtual reality training program for laparoscopic surgery. Ann Surg. 2006 Aug; 244(2): 310-4.

Application of a VR curriculum to real procedures

Pre-assessment – Glove model

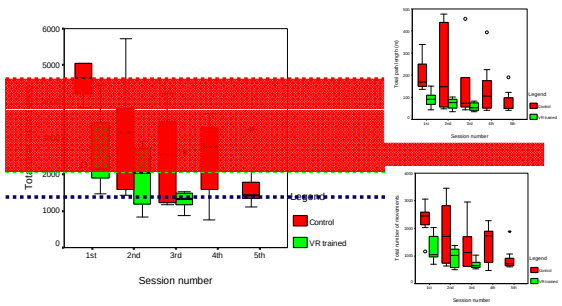
Theory

VR training curriculum
LapSim (basic + dissection)

Cadaveric pig GB
Cadaveric pig GB
Cadaveric pig GB

Cadaveric pig GB
Cadaveric pig GB
Cadaveric pig GB
Cadaveric pig GB
Cadaveric pig GB

Learning curves – Motion analysis



Transfer Effectiveness Ratio for Surgical Simulation

$$TER = \frac{Yo - Yx}{X}$$

where *Yo* is the median time required by the control group to reach performance criterion and *Yx* is the corresponding measure for the VR trained group after having received a median of *X* amount of training time on the simulator, which is also the denominator.

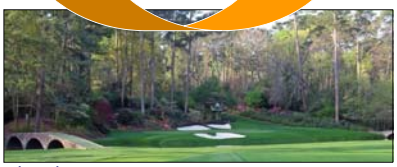
The control group required a median of 14,759 seconds (*Yo*) to complete five cadaveric porcine LCs, whilst the VR-trained group required a median of 5,700 seconds (*Yx*) to complete three LCs. In addition, the VR-trained group underwent a median of 3967 seconds (*X*) training time on the simulator. Applying this data to the TER equation results in a calculation of:

$$TER = \frac{14759 \text{ seconds} - 5700 \text{ seconds}}{3967 \text{ seconds}} = 2.28$$

Learning to play golf…

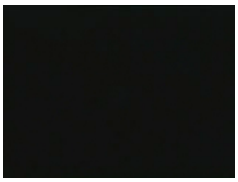
driving range

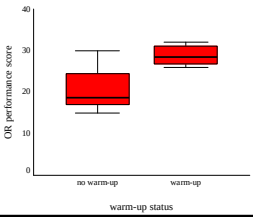
in the bar… (debrief)



play the course…

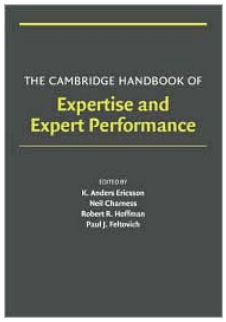
The role of warm up (simulation)

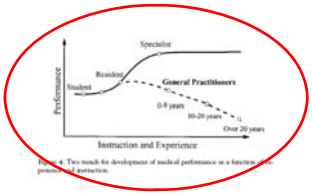




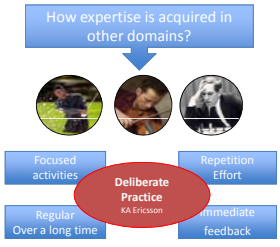
Performance under Varied Conditions…

The role of Deliberate Practice



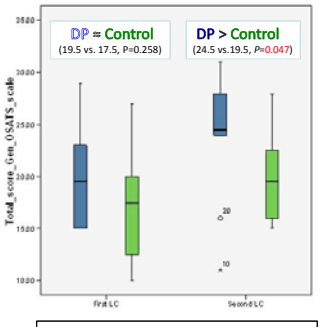


Deliberate practice – K. Anders Ericsson

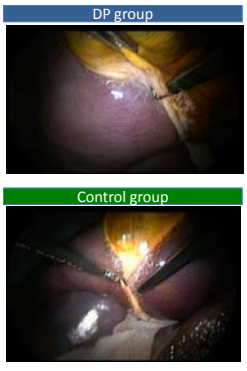


Would it work for surgery ?

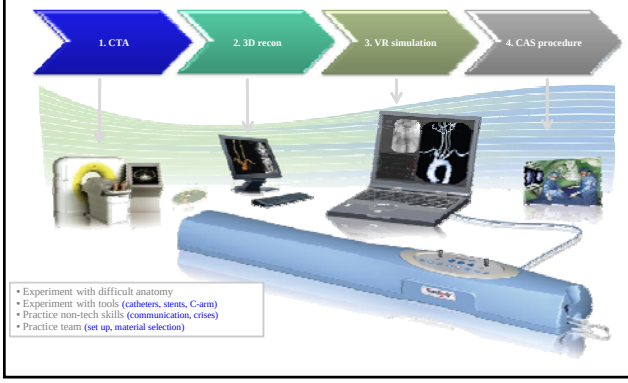
Results on porcine laparoscopic cholecystectomy model



Total score Generic Global OSATS scale

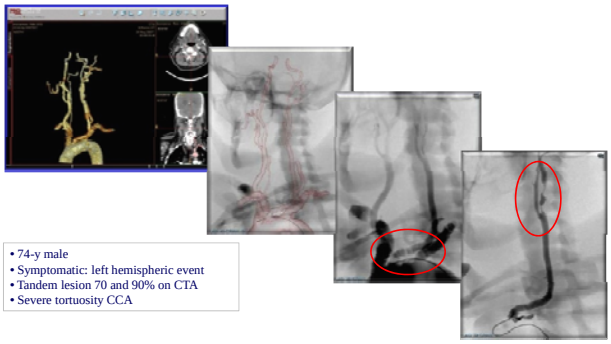


Procedure rehearsal for endovascular intervention



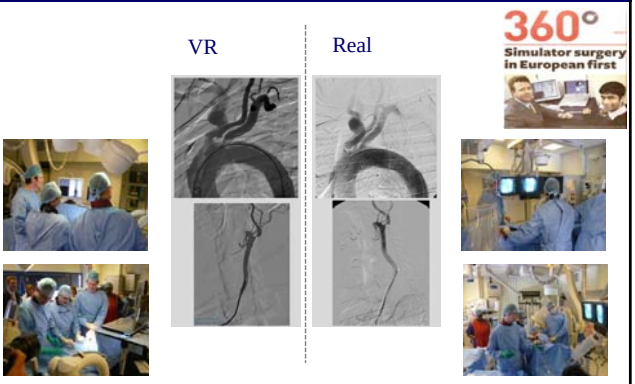
- Experiment with difficult anatomy
- Experiment with tools (catheters, stents, C-arm)
- Practice non-tech skills (communication, crises)
- Practice team (set up, material selection)

Methods – procedural case

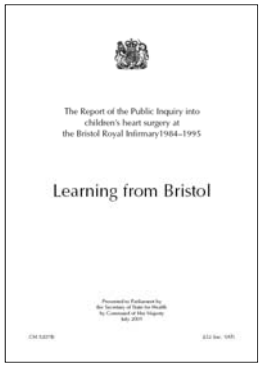


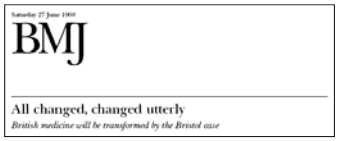
- 74-y male
- Symptomatic: left hemispheric event
- Tandem lesion 70 and 90% on CTA
- Severe tortuosity CCA

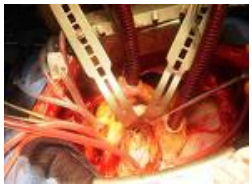
First real case Procedure rehearsal



Cardiac surgery

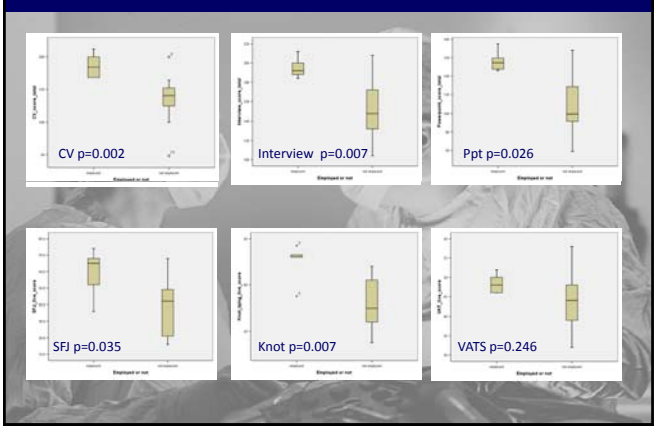


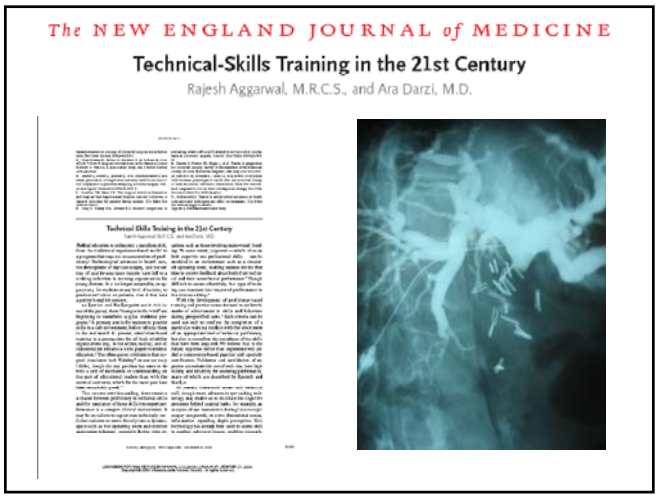




Bench-top Technical Skills Assessments

Comparison of APPOINTED versus NOT APPOINTED – live





The New Intakes at Imperial College Medical School…



Thank you!

- Professor Ara Darzi
- Professors Nick Cheshire, Charles Vincent and Guang Zhong-Yang

- Patrice Crochet, Sonal Arora, David James, Vishal Patel, Willem Willaert, Isabelle Van Herzeele, Rosamond Jacklin, Roger Kneebone, Debra Nestel, Fernando Bello, Cordula Wetzel, Julian Hance, Julian Teare, Tanya Tierney, Rachel Davies, Kate Miles, Julian Leong, Aristotelis Dosis