



# **SIMULATIONS IN SURGERY**

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# SIMULATIONS IN SURGERY

- **“See one, do one, teach one”** is one way to paraphrase what has been the traditional teaching method of surgical education in the operating rooms worldwide over a hundred years
- surgical simulation and training offers an opportunity to teach and practice laparoscopic skills outside of the operating room environment



# SIMULATIONS IN SURGERY

- novel methods of developing these skill sets are necessary because it is becoming increasingly clear that minimally invasive surgery requires a completely different skill set from the one used in traditional, open surgery
- threedimensional operative field is transferred on two-dimensional video screen
- small intraabdominal space, limited degree of freedom of instruments difficult camera angles and the fulcrum effect
- the trainee needs to develop an understanding of the spatial relationship and the related hand manoeuvres required to manipulate instruments and tissue in a two-dimensional video rendering of a threedimensional operation field



# SIMULATIONS IN SURGERY

- laparoscopic procedures have evolved from diagnostic laparoscopy to advanced, more complex procedures
- advanced procedures require highly developed psychomotor skills
- the surgeon's anatomic awareness must be developed in concert with the ability to safely achieve exposure and identify and control important structures
- specialized equipment
- instruments require a great deal of expertise in order to be used effectively and safely



# SIMULATIONS IN SURGERY

**The current goal of simulator training is to help trainees acquire the skills needed to perform complex minimally invasive surgical procedures prior to practicing them on living patients**

- minimally invasive surgery primarily involves laparoscopic techniques
- thoracic, gynecologic, head and neck surgery, orthopedics, or any other field where the size of the incisions and the degree of injury to the patient can be minimized with advanced techniques and equipment



# SIMULATIONS IN SURGERY

- in the last decade of the 20th century the idea of using simulation surfaced
- it has become apparent that **there is no better solution** to offset the problems of curtailed apprenticeship, and to train and assess technical skills
- image-based procedures, such as minimal access surgery and flexible endoscopy, have become the backbone of modern surgery



# SIMULATIONS IN SURGERY

- has rapidly been accepted as a helpful tool in the development of specific surgical skills
- to cope with the often complex interfaces encountered during modern operative procedures



# SIMULATIONS IN SURGERY

**Currently available training and evaluation devices for laparoscopic surgery**

- Box trainers***
- Animal models***
- Virtual reality simulators***
- Augmented reality simulators***



# SIMULATIONS IN SURGERY

## Box trainers

- uses real surgical instruments and equipment including video monitors, cameras, and laparoscopes
- an opaque box that approximates the size of the adult human abdominal cavity
- laparoscopic instruments are then inserted into the box through the ports on the anterior surface of the box
- flexible arm acts as a camera holder
- tactile feedback is limited, as it is in laparoscopic surgery, by the instruments used

# SIMULATIONS IN SURGERY

## Box trainers





# SIMULATIONS IN SURGERY

## Box trainers

### Advantages

- ✓ use of real instruments and equipment is clearly the strength of these systems
- ✓ low acquisition cost
- ✓ the most widely available training system
- ✓ physical sensory feedback conferred via the instruments in a box trainer is equivalent to that of surgery

## Box trainers

### Disadvantages

- require assessment by an external observer
- need to take a box trainer-based exam at a specialized test center
- measurement of performance and objective evaluation of skills, or metrics, requires an independent teacher/evaluator



# SIMULATIONS IN SURGERY

## Animal models

- involve the use of a live, anesthetized animal
- abdomen in the porcine model is comparable in size to the adult human
- cholecystectomy in this model provides tactile feedback in an environment where technical errors and complications such as gallbladder perforation or common bile duct injury can occur without consequence to a human patient



# SIMULATIONS IN SURGERY

## Animal models

### Advantages

- ✓ the most realistic training
- ✓ enable trainees to work together as a team on an operation

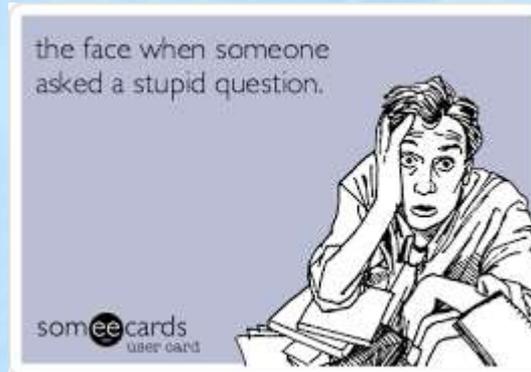
### Disadvantages

- ethical issues regarding the use of animals for training and studies are not to be discounted
- cost issues are prohibitive

# SIMULATIONS IN SURGERY

## Virtual reality simulators

### *What is virtual reality??*



**Virtual reality (VR)** typically refers to [computer](#) technologies that use [software](#) to generate realistic images, sounds and other sensations that replicate a real environment (or create an imaginary setting), and simulate a user's physical presence in this environment, by enabling the user **to interact** with this space and any objects depicted therein using specialized [display screens](#) or projectors and other devices.

- the immersive environment can be similar to the real world in order to create a lifelike experience— e.g. in simulations for pilot, combat training, etc...



# SIMULATIONS IN SURGERY

## Virtual reality simulators

- the performance records make it possible for the educator to evaluate the performance of a laparoscopic task
- upper and lower endoscopy, endoscopic retrograde cholangiopancreatography (ERCP), hysteroscopy, and cystoscopy
- time to complete a task, economy of hand motion, dexterity, and instrument path length
- the progress of laparoscopic skills



# SIMULATIONS IN SURGERY

## Virtual reality simulators

- ProCedicus MIST
- Haptica ProMIS
- METI SurgicalSIM
- Simbionix Lap-Mentor
- Surgical Science LapSim

# SIMULATIONS IN SURGERY





# SIMULATIONS IN SURGERY

## Augmented reality laparoscopic simulator

- most virtual reality simulators lack realistic haptic feedback
- a new laparoscopic simulation system offering a combination of physical objects and VR simulation
- AR simulators retain realistic haptic feedback and provide objective assessment of the performance of the trainee
- previous studies have shown that realistic haptic feedback is fundamental for good laparoscopic training and results in significantly improved skills transfer to the trainee compared with training without haptic feedback



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- Aggarwal R, Moorthy K, Darzi A (2004) Laparoscopic skills training and assessment. *Br J Surg* 91:1549–1558
- Botden SMBI, Torab F, Buzink SN, Jakimowicz JJ (2008) The importance of haptic feedback in laparoscopic suturing training and the additive value of Virtual Reality simulation. *Surg Endosc* 22(5):1214–1222
- Hyun KK, Rattner D, Srinivasan MA (2004) Virtual-reality-based laparoscopic surgical training: the role of simulation fidelity in haptic feedback. *Comput Aided Surg* 9(5):227–234



# SIMULATIONS IN SURGERY

## About our simulation center

### Simbionix Lap-Mentor

### Why just Simbionix??

- a leader in innovation of medical simulators and educational solutions
- a wide spectrum of minimally invasive simulators and training and development
- Installed over 1,700 simulators worldwide



# SIMULATIONS IN SURGERY



# SIMULATIONS IN SURGERY



## Simbionix Mentor™ product line

- the most advanced, largest and most respected line of minimally invasive simulators on the market
- proven track record of continuous development of additional modules and new simulators
- realistic hands-on training environment
- the most extensive simulation training system on the market



# SIMULATIONS IN SURGERY

## Simbionix Lap-Mentor

- complete training curriculum of basic tasks and skills to hands-on training full procedures
- procedural modules including
  - laparoscopic cholecystectomy
  - laparoscopic appendectomy
  - incisional hernia repair
  - bariatric gastric bypass
  - colorectal surgery - resection of colon sigmoideum
  - Urology - Nephrectomia
  - Gynecologia - basic gynecological procedures and total laparoscopic hysterectomy



# SIMULATIONS IN SURGERY

## Simbionix Lap-Mentor

### Haptic feedback -

tactile resistance tissue transmitted through surgical instruments delivers a realistic experience of work and handling different types of tissue

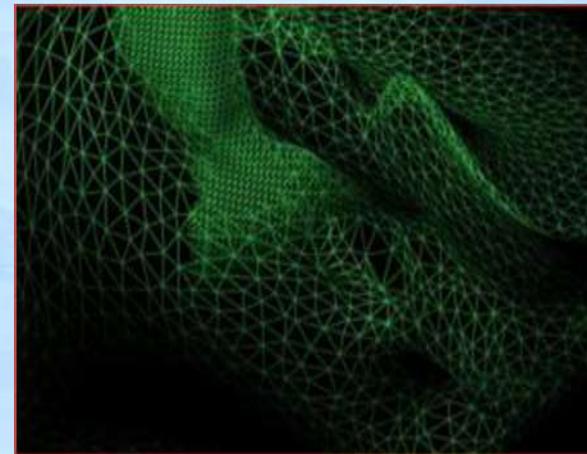
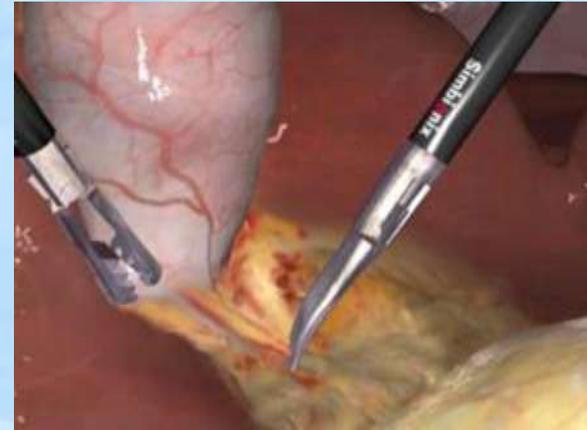


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## Simbionix Lap-Mentor

### Simulation complete procedures

- realistically displays and simulates tissue and organs, their behavior and responding to the work instruments
- ability to make decisions
- various anatomical conditions
- work safely and avoid problems and solve them



# SIMULATIONS IN SURGERY

## Simbionix Lap-Mentor

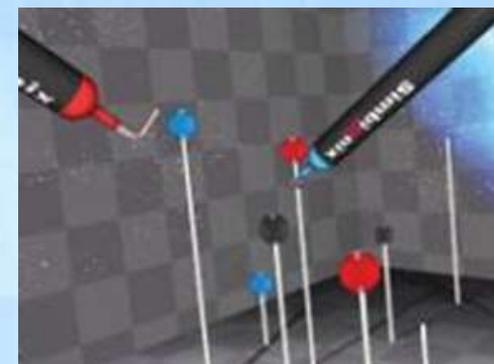
Laparoscopic basic skills - 9 tasks



navigation camera - 0 °



navigation camera - 30 °

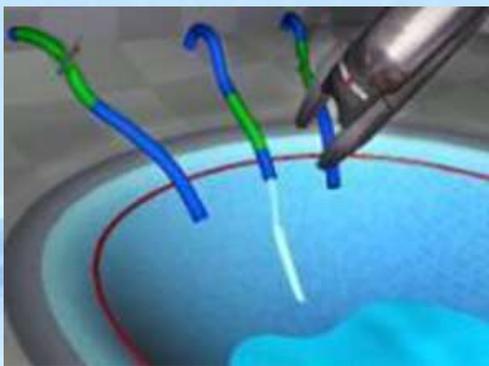


hand coordination and eye

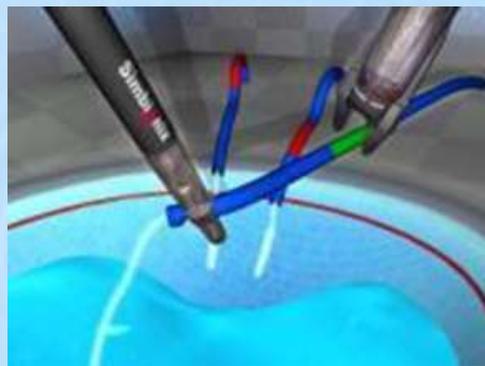
# SIMULATIONS IN SURGERY

## Simbionix Lap-Mentor

Laparoscopic basic skills - 9 tasks



clipping



grasping and clipping



two-handed manipulation

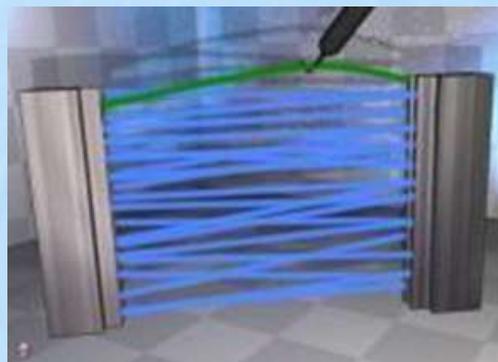
# SIMULATIONS IN SURGERY

## Simbionix Lap-Mentor

Laparoscopic basic skills - 9 tasks



cutting



electrocoagulation



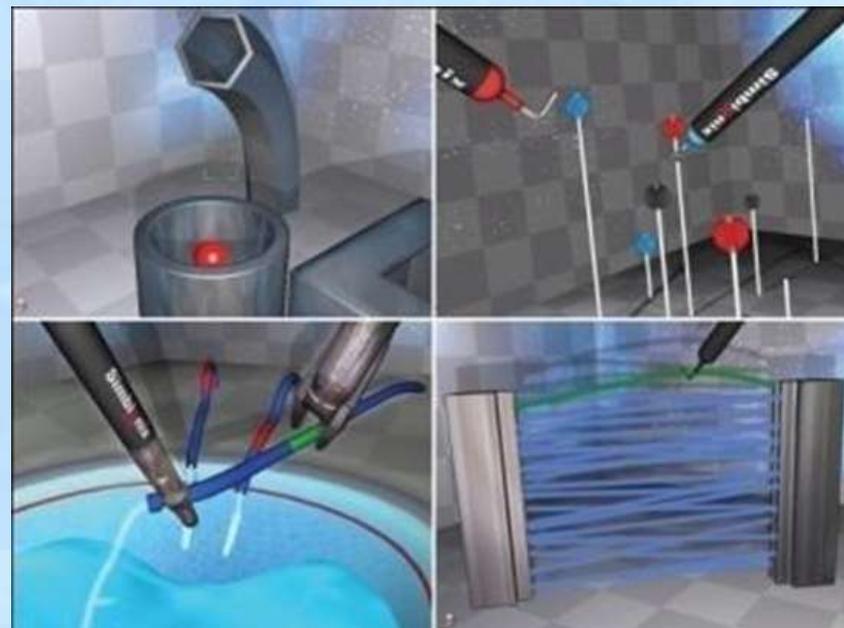
translocation objects

# SIMULATIONS IN SURGERY

## Simbionix Lap-Mentor

### Laparoscopic basic skills - 9 tasks - Objectives of the module:

- work and manipulate the camera in space
- hand coordination and eye
- training of the clipping
- practicing two-handed work
- laparoscopic cutting
- acquiring skills for the safe use of electrocoagulation
- effective translocation objects





# SIMULATIONS IN SURGERY

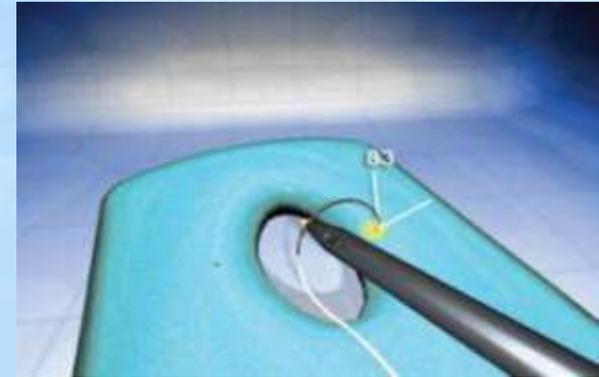
## Simbionix Lap-Mentor

Basic sewing modules - 6 tasks

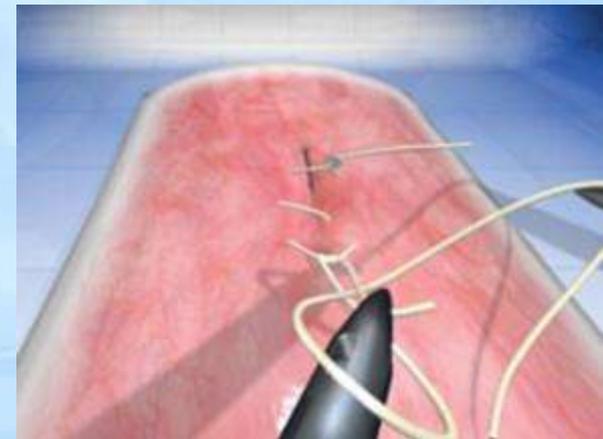
### Objectives of the module:

Basic sewing modules: handle needle, correct stickin the needle, correct tightening knot, single stitch and continuous

- learn and practice techniques handle needles and penetration into tissue
- learn the various techniques than half knot, knot round, tie a surgical knot
- create and follow individual stitches



**Suturing Task 1 - needle loading and suture placement**



**Suturing Task 6 – Continuous/interrupted suture**

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## Simbionix Lap-Mentor



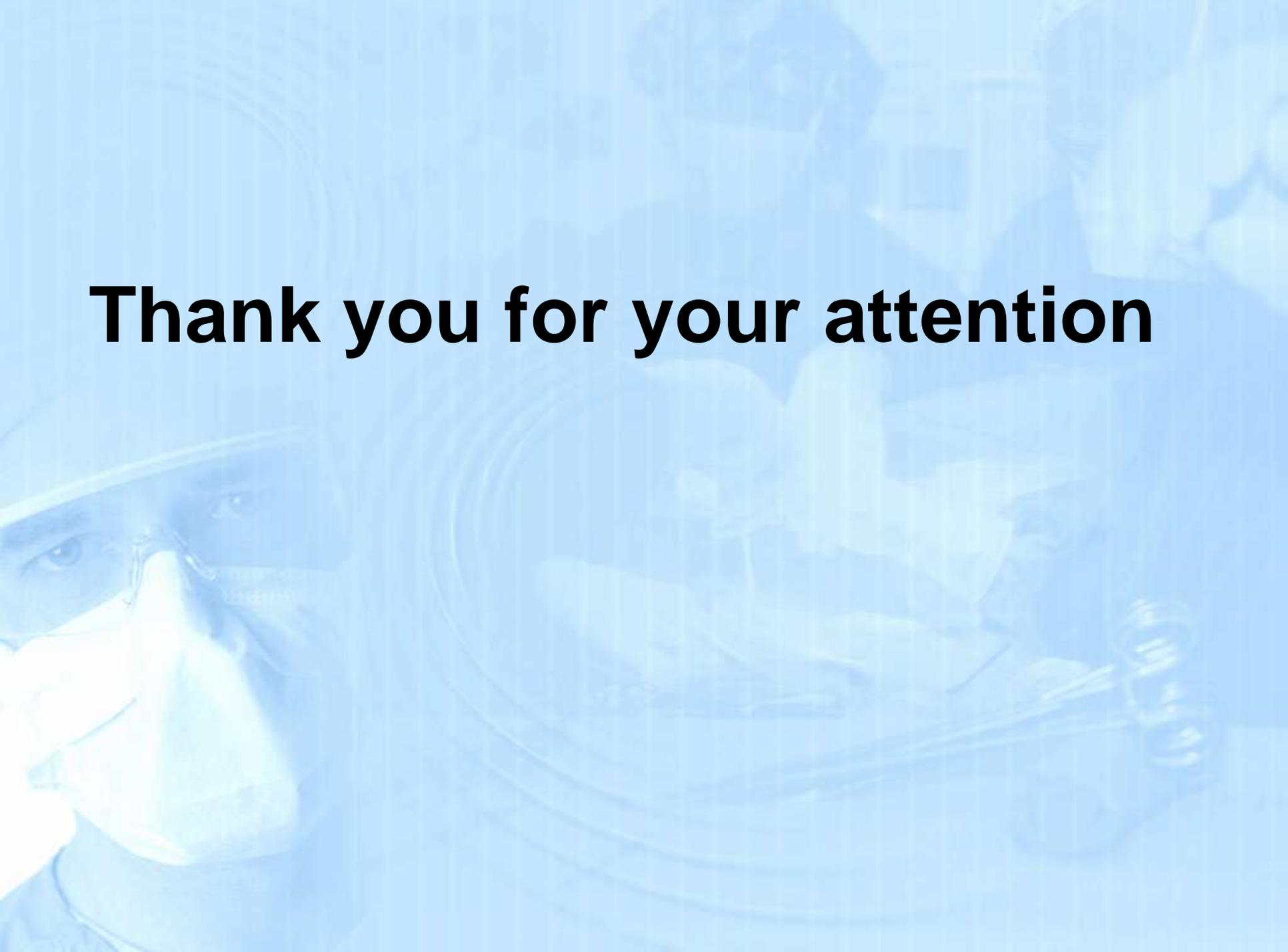
- every student of 4-th study year minimally once per semester train on simulator
- student's research work



# SIMULATIONS IN SURGERY

## Conclusion

- surgical skills training is undergoing a dramatic transformation
- simulators in their current form can facilitate the improvement of laparoscopic skills and operating room performance of surgical residents
- simulation has enormous potential as a tool for the delivery surgical skills training
- allows experienced surgeons to develop expertise in new procedures
- the ability to objectively measure and validate technical skills which have been trained to a quantitatively established proficiency level



**Thank you for your attention**