PRE-CONGRESS COURSE 9

SIG Reproductive Surgery

"Training and education in endoscopy"

CONTENTS

PRE-CONGRESS COURSE 9 - PROGRAMME

SIG Reproductive Surgery

Training and education in endoscopy

Course co-ordinator: S. Gordts (B)

Course description: the course intends to offer an overview of the actual different possibilities of training and to evaluate their potential advantage and influence on skills and learning curves. The course will also elucidate on the future guidelines and accreditation of the European commission and their practical application

Target audience: All those involved with endoscopy and education in gynaecology and reproductive medicine

Programme

09.00 - 09.30:	Endoscopic surgical skill lab – ***J. Deprest (B)***
09.30 - 09.45:	*Discussion*
09.45 - 10.15:	Objective evaluation of endoscopic skills -***R. Campo (B)***
10.15 - 10.30:	*Discussion*
10.30 - 11.00:	***Coffee break***
11.00 - 11.30:	(How) Does preclinical lab training influence the surgical learning curve in residents? -***G. Dewin (B)***
11.30 - 11.45:	*Discussion*
11.45 - 12.15:	What is the place of a specialised center in endoscopic surgical training? -***A. Wattiez (F)***
12.15 - 12.30:	*Discussion*
12.30 - 13.30:	***Lunch***
	Virtual reality training
13.30 - 14.00:	Setting up a multicenter clinical anatomy and surgical skills training programme (CASST) -***K. Kenton (USA)***
14.00 - 14.15:	*Discussion*
14.15 - 14.45:	The OR 1 of the future: system-integration and education for quality assessment -***D. Wallwiener (DE)***
14.45 - 15.00:	Discussion
15.00 - 15.30:	***Coffee break***
15.30 - 16.00:	Accreditation and training programmes in reproductive medicine: European EBCOG-ESHRE guidelines -***B. Tarlatzis (GR)***

16.00 - 16.15:	*Discussion*
16.15 - 16.30:	Validity of computer based methodology to evaluate surgical skill -***L. Mettler (DE)***
16.30 - 16.45	Is there still a need for a reproductive surgeon? -***S. Gordts (BE)***
16.45 - 17.00:	Round table: “Requirements for endoscopic surgical training” -***B. Tarlatzis, A. Wattiez, R. Campo, S. Gordts, D. Wallwiener***

Objective evaluation of endoscopic skills

R. Campo

Leuven Institute for fertility and Embryology

LIFE, Leuven, Belgium

European theAcademy of Gynaecological Surgery

Training in Gynaecological Surgery

The paradigm for training in surgery is the ***apprentice-tutor model***

- Trainee first observes then assists and finally operates.
- Procedures with increasing complexity are performed
- The presence of the tutor is permanently required
- Reported learning curves are usually very long, i.e. number of procedures needed for reaching proficiency is remarkably high, making this issue critical for gynaecologists.

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Training in Gynaecological Surgery

Critical factors for the current use of this model

1. the necessity of a high volume of surgical procedures,
2. the availability of a sufficient number of skilled mentors
3. the time consuming aspect of this system.
4. the difficulties in objective assessment of clinical competence on different surgical levels,
5. the limited methods of credentialing and the lack of correct reimbursement policy towards the mentors.

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Laparoscopic surgery

- Laparoscopy requires specific skills, different from those required in open surgery the Psychomotor Skills
  - Depth appreciation from 2D screen using subtle visual clues
  - Remote handling of instruments without tactile feedback
  - Hands-eyes coordination
  - Fine motor skills
    - Long Instruments
    - Fulcrum effect
- Effective acquisition of Laparoscopic Psychomotor Skills (LPS) is essential for minimal access surgery to become a real minimal invasive & atraumatic surgery.

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Training in Gynaecological Surgery

ALARMING REPORT IN THE NETHERLANDS

- Because of inacceptable amount of serious (lethal) complications in common laparoscopic procedures within general surgery and gynaecology the ministry of health performed a major inspection regarding patient safety
- Report is published in November 2007.

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Training in Gynaecological Surgery

Conclusion of report

- Training in laparoscopic techniques was found to be variable and inadequately structured.
- It is a matter of concern that the standards which a future laparoscopist must meet in order to operate, either independently or under supervision, have not been adequately established.

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Standardisation of training programs necessary !

- Using the patient as a model to acquire laparoscopic skills decreases patient safety!
- A standardised and quality-controlled in house training programme to acquire the laparoscopic skills does not exist.
- No test is currently accepted to differentiate laparoscopic surgeons in different levels of expertise.
- No test is available to score the basic skils of an individual and permit in OR laparoscopic surgical activities.

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Questions ?

- Is the classic apprentice-tutor model sufficient for acquiring the appropriate Laparoscopic skills?
- Do *in vitro* and animal training provide a more objective evaluation of the training process?
- What are the ideal characteristics of a training program?
  - Model? Length?
  - Intensity? Level of supervision?
- How can we measure objectively the typical endoscopic skills?

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Training in Gynaecological Surgery

The paradigm for training in surgery is the
apprentice-tutor model

- Trainee first observes then assists and finally operates.
- The presence of the tutor is permanently required
- Insufficient amount of procedures and mentors to train laparoscopic gynaecological surgery.

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Training in Laparoscopy

- **In vitro models:**
  - Relatively cheap , Relaxed and controlled environment
  - **Pelvi-trainers:** learning curves for stitching, knot-tying, cutting, dissection
  - **Virtual-reality:** more objective evaluation of the learning process
- **Animal models:**
  - Usually in large animals, such as pigs
  - Simulation of the clinical scenario, e.g. anaesthesia, pulsating vessels, pneumoperitoneum.
  - Very expensive and therefore not widely and routinely used
  - Short training period, not appropriate for basic skill training

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Maximal Learning effect: trainingsession duration

G. Dewin, unpublished data

stitching and knot tying

6 training sessions of 1.5h

160 students

6 groups with different distribution of training sessions

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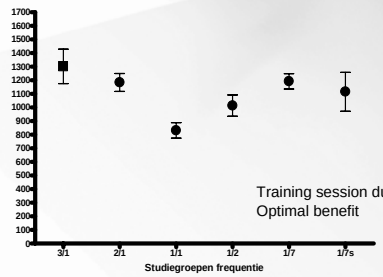
Maximal Learning effect: trainingsession duration

Mean and SEM

G. Dewin, unpublished data



Training session duration of 1.5h daily: Optimal benefit

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Skill Assessment: Possible Goals

- To define someone's **laparoscopic or psychomotor** skill level
- To guide trainees to the right training courses
- To help mentors and training centers to differentiate different skill levels of trainees
- To define the cut off for entering a one to one clinical teaching program.
- To evaluate someone's **surgical** skills
- To establish minimal standard for surgical licence .

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Skill assessment: Systems

- Quantitative and Qualitative
- Time
- Observations
  - checklists
  - Global Rating Scale

    eg. OSATS, GOALS,....
- Motion trackers
- Virtual reality

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Global Rating OSATS; example

	1	2	3	4	5
Respect for the tissue	Frequently used unnecessary force or caused damage by inappropriate use of instruments		Careful handling of tissue but occasionally cause inadvertent tissue damage		Consistently handled tissues appropriately within minimal damage
Time and Motion	Many unnecessary movements		Efficient time/motion but some unnecessary movements		Clear economy of movement and maximum efficiency
Instrument Handling	Repeatedly makes tentative awkward or inappropriate moves with instruments		Competent use of instruments but occasionally stiff or awkward		Fluid moves with instruments and awkwardness
Knowledge of instruments	Frequently asked for wrong instrument or used inappropriate instrument		Know names of most instruments and uses appropriate tool for task		Obvious familiar with the instruments and their names
Flow of operation	Frequently stopped operating and seemed unsure of next move		Demonstrated some forward planning with reasonable progression of procedure		Planned course of operation effort from one move to next
Use of assistants	Failed to use assistants		Appropriate use of assistants most of the time		Strategically used assistants to the best advantage at all times
Knowledge of specific procedure	Required specific instruction at most steps		Knew all important steps of the operation		Familiar with all aspects of the operation
Overall performance	Unable to perform operation independently		Competent, could perform operation with mini mal teaching assistance		Clearly superior, able to perform operation independently with confidence

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Skill Assessment: Motion Tracking

Time, Path length, Number of movements

Promis™

Imperial College Surgical Assessment Device:
Patriot System + Rovimas Software

Skill Assessment: Virtual Trainers

Assessment Systems: Summary

	Objective	Accuracy	Easy Available	Endoscopic Dimension Only	Price	Easy to detect progression	Evaluation self difined skills
Time	√	χ	√	√	√	√	√
OSATS and GOALS	χ	√	√	χ	√	χ	√χ
Motion Tracking	√	√	χ	√	χ	√	χ
Virtual Reality	√	√	χ	√	χ	√	χ

Skill assessment: Systems

- Quantitative and Qualitative
- **Correct exercise time**
- Observations
  - checklists
  - Global Rating Scale
    eg. OSATS, GOALS,....
- Motion trackers
- Virtual reality

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Skill assessment
Important Considerations

- Reliability
- Validity
  1) Construct Validity
  2) Predictive Validity
  3) Concurrent Validity
  4) Content Validity
  5) Face Validity

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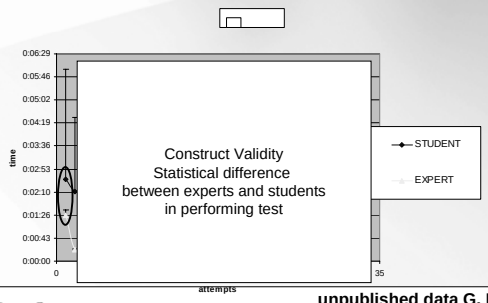
Proving construct validity, Remark



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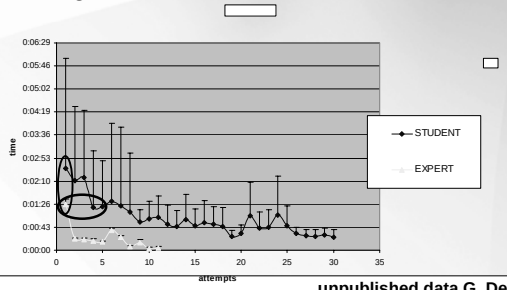
unpublished data G. Dewin

Proving construct validity, Remark

- Learning curve of assessment-test is essential;



unpublished data G. Dewin

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Project
From Anatomy to Endoscopic surgery

- **Gather scientific evidence to:**
  - define the necessary Laparoscopic Psychomotor Skills (LPS) for laparoscopic surgery,
  - provide a scoring system to test the individual student's ability in this field,
  - provide a training program for in house training that give the students the opportunity to master and acquire the psychomotor skills.

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Project
From Anatomy to Endoscopic surgery

- **Redifine the educational levels of Gynaecological endoscopic training:**
  - Within the Standing Committee on Training and Assessment (SCTA) of the European Board and College of Obstetrics and Gynaecology (EBCOG), a project is started with all European parties involved to define 3 educational levels in the training of an endoscopic surgeon.

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Project
From Anatomy to Endoscopic surgery

- **First educational platform in gynaecological endoscopic surgery**

Aim

- Preclinical training to acquire basic theoretical knowledge of surgical principles
- full endoscopic psychomotor skills (EPS)
- basic theoretical knowledge of instrumentation and OR functioning

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Project
From Anatomy to Endoscopic surgery

- **First educational platform in gynaecological endoscopic surgery**

Target audience

- Preclinical phase of education for all trainees aiming at an abdominal surgical discipline.

Content and Teaching strategy: Patient free environment

- Theoretical lectures
- Practical sessions in pelvic trainer (dry exercises)

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Project
From Anatomy to Endoscopic surgery

- **Second educational platform in gynaecological endoscopic surgery**
  - Board certified Gynaecologist
- **Third educational platform in gynaecological endoscopic surgery**
  - Special modules of surgical skills (training centers)

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Project
From Anatomy to Endoscopic surgery

- **New design of training programs for endoscopic surgery:**
  - The scientific evidence gathered by theAcademy research programs has inspired the experts of the Academy to work on a new design of training programs. It is a global concept with the aim to transfer the knowledge to mentors and provide them the necessary tools to be able to start in house training and evaluation.

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Pilot study LASTT
Laparoscopic Skill Trainer and Tester

- **General Objective:**
  - To develop a system for training and evaluation of LPS
- **Methodology:**
  - 12 exercises where tested on novices, gynaecologists and expert surgeons
  - Time of successful performance is used as the objective outcome parameter.
- **Result**
  - Feasibility and Construct validity was proven for 3 laparoscopic psychomotor exercises.

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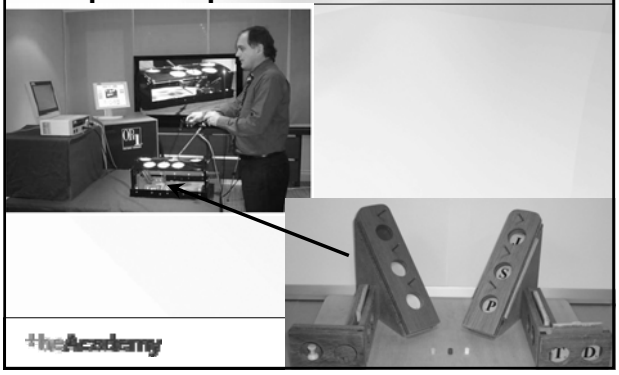
Pilot study LASTT
Laparoscopic Skill Trainer and Tester



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Exercise 1: Camera Navigation

Find Big Number 1

Zoom in at the small character next to 1

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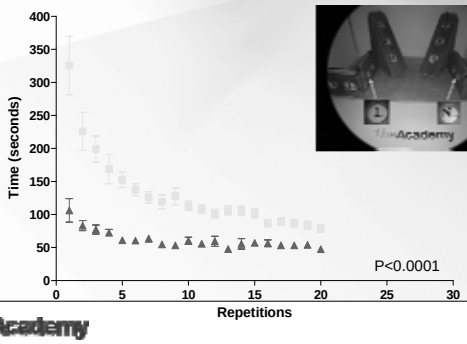
Exercise 1: Camera Navigation



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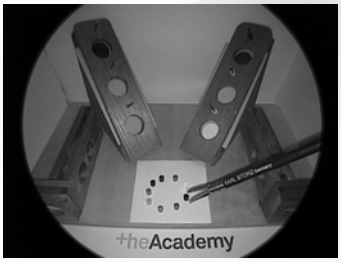
Exercise 2: Camera Navigation, Instrument Navigation & Grasping



Exercise 2:

Instrument navigation, camera handling and grasping

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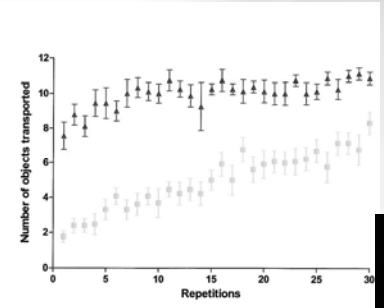
Exercise 2: Camera Navigation, Instrument Navigation & Grasping



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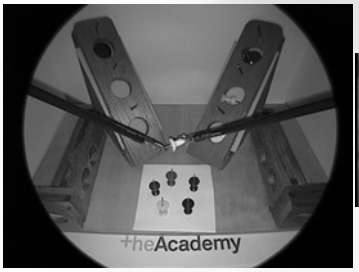
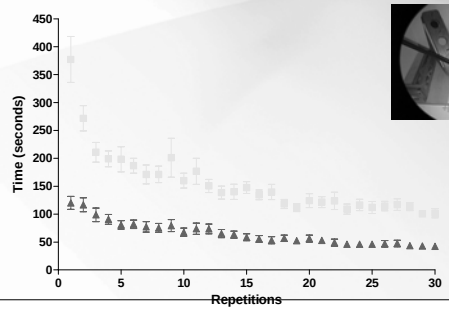
Exercise 3: Instrument handling and bimanual coordination



Exercise 3: Instrument handling and bimanual coordination



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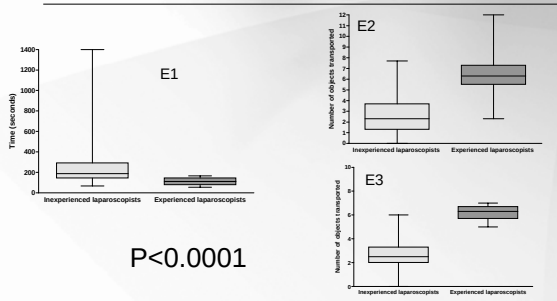
Construct validity testing of E 1-3 on 283 Individuals



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Conclusion

- Our data demonstrate that a simple inanimate model is feasible for both testing and training laparoscopic Psychomotor skills.
- The data also indicate that systematic repetitions of simple tasks, even without any tutor's feedback have a major impact in the learning process.
- The learning curves demonstrate that experts have better skills than novices, proving the construct validity of the model.
- In conclusion, our study demonstrate that a simple, cost friendly and reproducible inanimate model, with proven construct validity, is suitable for both testing and training laparoscopic skills

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Final Study LASTT

- Evaluation of the learning curve of a basic psychomotor skill versus a more complex exercise

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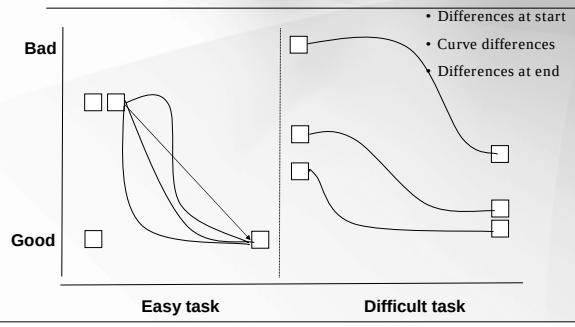
Hypothesis



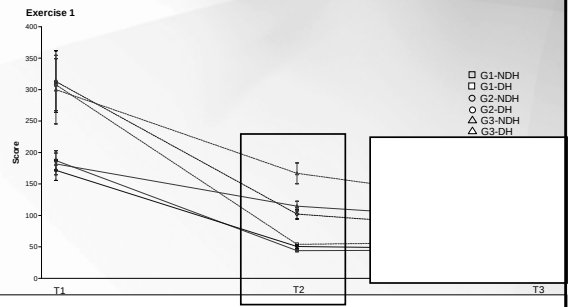
Study characteristics

- **Subjects**
  - 60 gynaecologists 25-50 years old
  - Gynaecologists with little or no experience in laparoscopy
- **Laparoscopic exercises**
  - E1: basic laparoscopic skill (stereotaxis). Dominant hand (DH) and non-dominant hand (NDH) separately
  - E2: intermediate laparoscopic skill (intracorporeal knot-tying). Dominant and non-dominant hands together
- **Experimental design:**
  - 5 phases
  - 3 groups (n=20)

Experimental design

Phase 1 Test	Phase 2 Training E1	Phase 3 Test	Phase 4 Training E2	Phase 5 Test
• G1: – E1-DH – E1-NDH – E2 • G2: – E1-DH – E1-NDH – E2 • G3: – E1-DH – E1-NDH	■ G1: ■ E1-DH ■ E1-NDH ■ G2: ■ E1-DH ■ --- ■ G3: ■ --- ■ ---	■ G1: ■ E1-DH ■ E1-NDH ■ E2 ■ G2: ■ E1-DH ■ E1-NDH ■ E2 ■ G3: ■ E1-DH ■ E1-NDH ■ E2	■ G1: ■ E2 ■ G2: ■ E2 ■ G3: ■ E2	■ G1: ■ E1-DH ■ E1-NDH ■ E2 ■ G2: ■ E1-DH ■ E1-NDH ■ E2 ■ G3: ■ E1-DH ■ E1-NDH ■ E2

Results after psychomotor training



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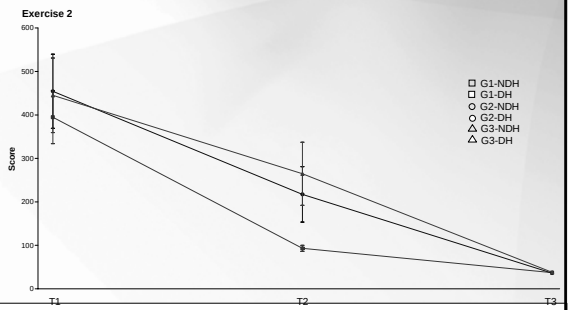
Results after intracorporeal knot-tying training



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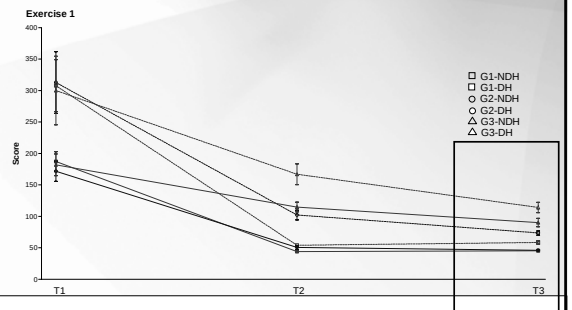
Final Results



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Conclusion

- Training of intracorporeal knot-tying only does not provide full skill acquisition.
- Also specific psychomotor skills exercises are necessary.
- Training and Testing can be done in a simple model suitable for in house training.
- Instrumentation setup is cheap and easy movable, multifunctional use is possible
- OR or Animal training should only start when full acquisition of EPS has been achieved.

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Conclusion

- Within the Standing Committee on Training and Assessment (SCTA) of the European Board and College of Obstetrics and Gynaecology (EBCOG), a project is started with all European parties involved to define **3 educational levels** in the training of an endoscopic surgeon.
- The same scientific evidence has inspired the experts of the Academy to work on a new design of training programs. It is a global concept with the aim to transfer the knowledge to mentors and provide them the necessary tools to be able to start in house training and evaluation.

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More info on the special training programs in endoscopic surgery

+heAcademy @ ESGE.ORG

(How) Does preclinical lab training influence the surgical learning curve in residents?

Gunter De Win
Dirk De Ridder
Marc Miserez
Centre Surgical Technologies
KU Leuven
Belgium

Barcelona
July 2008

See One, Do One, Teach One?

Training in Endoscopic Surgery

long and steep learning curve

different way of teaching

medicolegal aspects

time constraints

Simulation

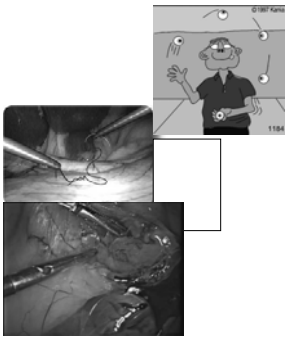
Structured training program needed; from simulation in the lab to real operations in theatre room

- Trainee: central
- Repetitivity
- Standardized
- No stress
- Critical situations
- Availability

Different Models

Different Curricula

- Psychomotor skills
- Suturing and Knot Tying
- Tissue Handling, Coagulation, Dissection



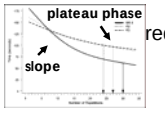
Training in laparoscopic surgery

to develop specific laparoscopic skills pregraduate

↓

to help clinicians along the learning curve quickly and safely

↓



reducing complication rates & shortening of operation time

↓

increased cost-effectiveness

laparoscopic ~ minimally invasive surgery

Scientific Evidence? : What Study we need?

- Experimental group: Structured preclinical Training and Standard Residentship
- Control Group: Standard Residentship
- Real Clinical Transferstudy on learning curve

No single publication

Scientific Evidence??

- Dozens of validation studies on different models
- Few studies on training transfer to theatre room
- Recent RCT's on training curricula

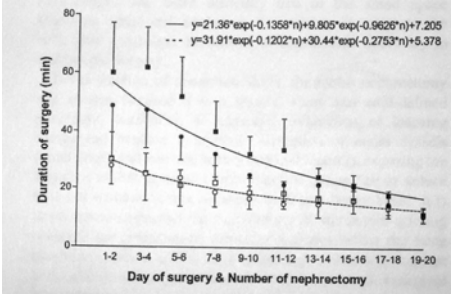
Training Transfer?

Training Transfer

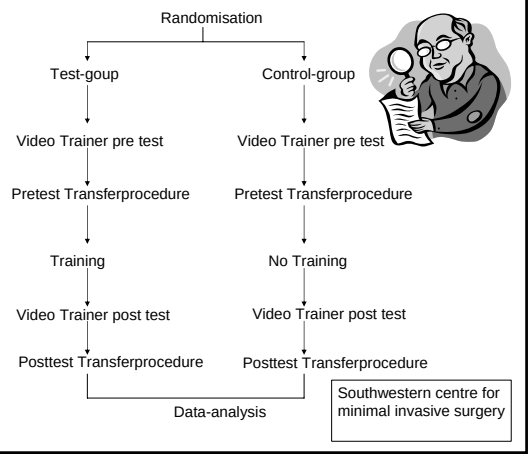
- Proficiency ?
- Automaticity?
- Proficiency Maintenance …

Stimulating peformance during training?

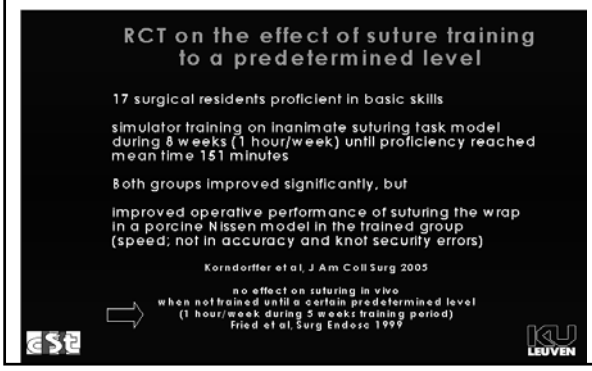
Amount of Training?



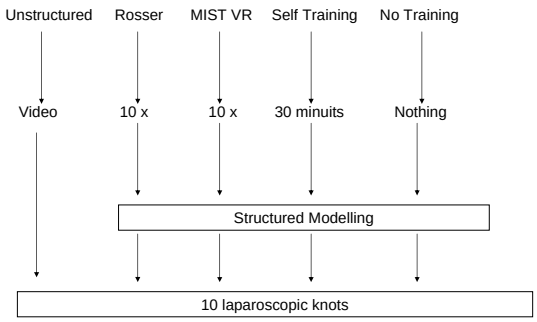
20 days 8 hours ←→ Short Term Courses



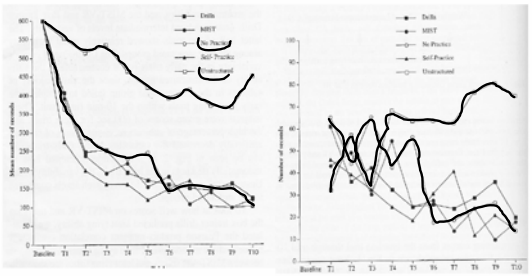
Training To Predetermined level



Pre-test laparoscopic knot after short demonstration

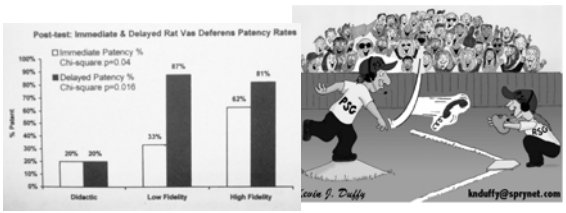


Structured Training needed



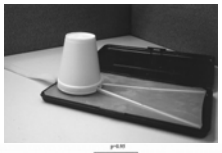
Pearson; 2002

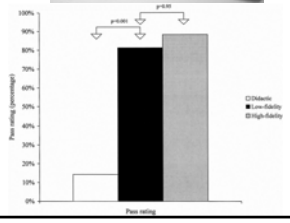
Fidelity



Grober 2004

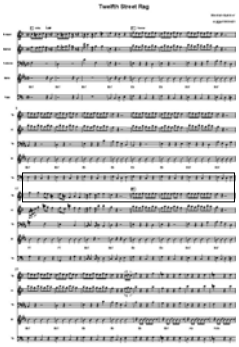
Fidelity





Matsumuto, 2002

Experts: Concentrated Exercise & Critical steps



Optimal Frequency of Skill Labs ?

Laparoscopic Intracorporal Suturing

- Difficult Surgical Procedure, Important in the clinic
- Fine motoric movements and 2D-3D interpretation
- Not enough time to exercise in real life

Which is the optimal distribution of training sessions to teach laparoscopic skills?

Randomisation

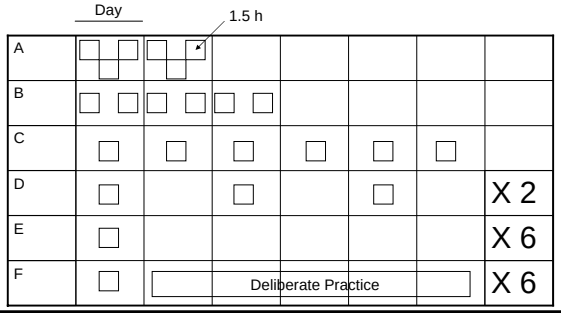
- 145 students (novices, 18-23 years) randomized into 6 comparable groups with respect to:
- Spatial Ability: Schlaufigurentest
- Ambidexterity: Oldfield Questionnaire
- Laparoscopic Skills: Southwestern drills

- Motivation
- Age and Sex

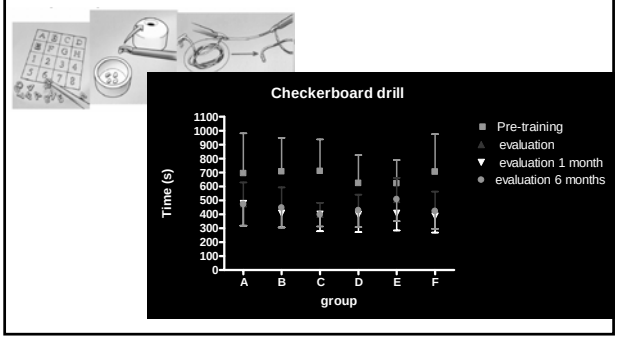
Scott DJ, Bergen PC, Rege RV, Laycock R, Tesfay ST, Valentine RJ et al. Laparoscopic training on bench models: better and more cost effective than operating room experience? J Am Coll Surg 2000; 191(3):272-283.

Different Groups

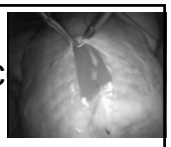
9 hours of training in each group



Evaluation: Basic Skills

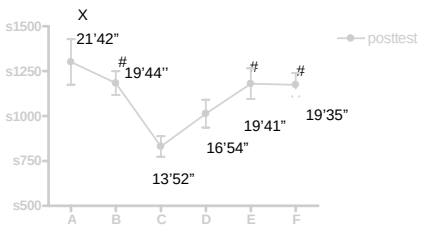


Evaluation: Advanc



AFTER training

Chicken Skin

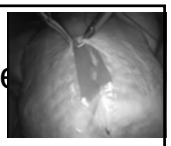


ANOVA;
P= 0.003

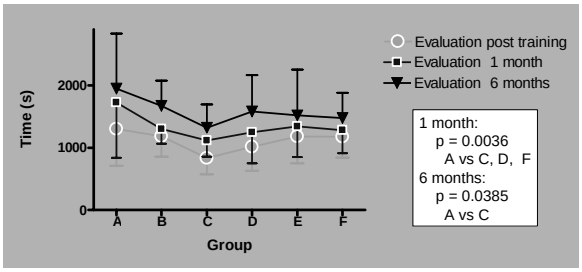
Statistical Difference with C
X: P < 0.01
#: P< 0.05

C once a day

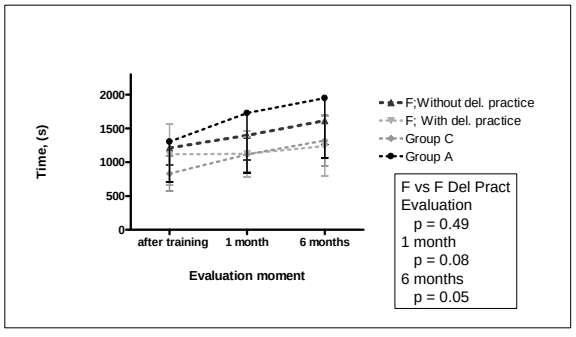
Evaluation: Advance



RETENTION

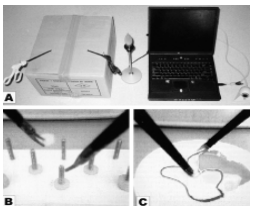


Deliberate Practice

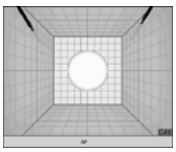


Short Daily Training

- Promote Local Training Centers
- Selftraining: Webcam



Virtual reality (VR) simulators



Mist VR

LAP Mentor

LapSim

Xitact LS 500

Consensus guidelines for validation of virtual reality surgical simulators
Carter et al, Surg Endosc 2005

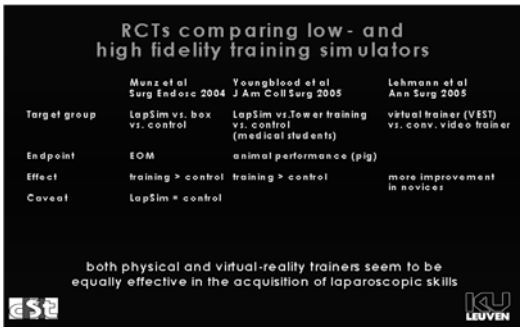
RCT's

The effect of training basic laparoscopic skills with virtual reality simulators on operating room performance: RCTs

	Seymour 2002	Hyltander 2002	Ahlberg 2002	Hamilton 2002	Grantcharov 2004
Target group	surgical residents	medical students	medical students	junior surgical residents	surgeons with limited laparoscopic experience
Training	standard training +/- MIST VR	LapSim	MIST VR	MIST VR or video-trainer	MIST VR
	3-8 sessions	2hrs/week (5 weeks)	3 hrs	2 weeks (10x30 min)	10x6 exercices
Surgical Performance	lap CCE human	basic skills pig	"lap app" pig	lap CCE human	lap CCE human
Interval	< 2weeks	?	?	1 week(?)	< 2weeks
Effect	yes	yes	no	yes	yes

long-term retention of training?
optimal training frequency?

RCT's



Comment on RCT's

- Only Psychomotor skills Trained
- No comparison virtual dissection and real dissection
- Maybe better because of:
  - → cognitive modelling
  - → inherent feedback

Link Motor learning

Cognitive training: Modelling

Critical steps

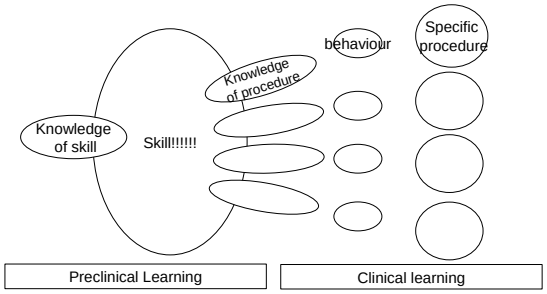
Repetitive Concentrated Exercise

Level

Feedback of performance

Retention & transfer of learned skills

Operative Skills



Knowledge of Procedure

- Mimics…

Setting Up a Multi-center Clinical Anatomy & Surgical Skills Training Program

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USA

Disclosures

None

Learning Objectives

Participant should be able to:

- Discuss advantages to multi-center, multidisciplinary collaboration.
- List strategies to build educational programs with other centers or departments.
- Be familiar with one multi-center, multidisciplinary program.

Chicago

- 5 Large Academic Medical Centers
- 6 Medical Schools
- 13 Residency Programs

Optimizing “Limitations”

- Less time spent in the OR
  - Limited work hours
  - Decreased surgical volume
  - Patient safety concerns
- Maximize time & teaching in OR
  - Need to come to OR with more knowledge and skills
- Universal to surgical residents
  - Ob/Gyn, Urology, General Surgery

Resources

- Faculty time
  - Most valuable
- Facilities
- Trainers, instruments
- Cadavers

Principles

- Teamwork & collaboration
- Think of “unique” or “non-traditional” teams
  - Female Pelvic Medicine & Reconstructive Surgery
- “Make sure you get at least 2 uses of each academic effort”
  - Dr Linda Brubaker

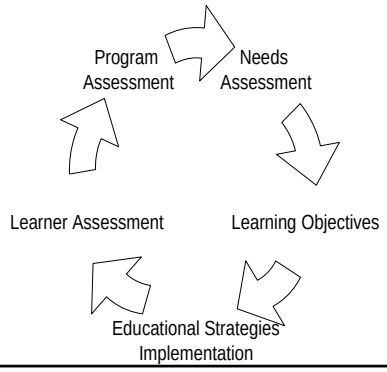
How Maximize Time & Resources?

- Multiple Disciplines
  - FPMRS: Gyn & Urology
- Multiple Centers
  - Faculty
  - Facilities
  - Resources

Clinical Anatomy and Surgical Skills Training

- Aim:
  - To develop a multicenter, multidisciplinary anatomy and surgical skills training program
- Methods
  - 4 Residency Programs
    - 3 Ob/Gyn Program
    - 1 Urology Program

Curricular Development



Needs Assessment

	Knowledge		
	Excellent	*Adequate*	*Marginal/Poor*
Surgical Knots	7%	68%	25%
Suture Properties	0%	25%	75%
Abdominal Wall Anatomy	0%	46%	54%
Pelvic Anatomy	0%	39%	61%
Hysterectomy	0%	7%	93%
3rd & 4th Degree Laceration	0%	7%	93%

Needs Assessment

- 100% - benefit from more formal basic surgical skills training
- 86% - prosected cadavers increase anatomy knowledge
- PGY2 more likely than PGY1s to
  - Rate knot tying skills as excellent or adequate (p=0.009)
- Urology more likely than Gynecology to
  - Rate knowledge of pelvic anatomy as poor (p=.001)
  - Rate knowledge of hysterectomy as poor (p=.012)

Pretest

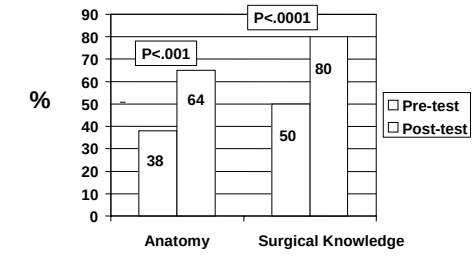
- 40% knew difference between 1-4^{O} laceration
- 27% identify 3 branches of pudendal nerve
- 10% knew 3 most common sites of ureteral injury during TAH

Curriculum

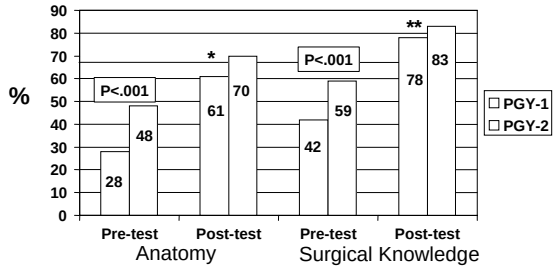
- 5, 3 hour sessions
  - Knot tying & instrumentation
  - Abdominal wall anatomy
  - Opening and closing the abdomen
  - Pelvic & neural anatomy and TAH
  - Repairing perineal lacerations
- 1st hour – didactics
  - 13 didactics/10 faculty
- 2nd-3rd hours – gross anatomy or surgical skills labs
- 2-3 learning objectives per session

Learner Assessment

Pre & post test data available for 28/32



Learner Assessment



*P=.107

**P=.216

Learner Assessment

Urology vs Gynecology

- Gyn residents scored higher in anatomy and surgical skills on pre-test
  - P=.03 & P=.002
- No DIF in post-test scores
  - Anatomy, P=.11
  - Surgical skills knowledge, P=.82

Program Assessment

Residents	Excellent/ Helpful	Marginal	Waste of Time
Knot Tying	78%	22%	0
Abdominal Wall	96%	4%	0
Opening & Closing	92%	8%	0
Pelvic & Neural Anatomy	96%	4%	0
Repairing Lacerations	87%	10%	3%

- Faculty
  - Multicenter collaboration lessened individual burden
  - Multidisciplinary collaboration heightened educational benefit for residents

Program Assessment

Residents	Excellent/ Helpful	Marginal	Waste of Time
Knot Tying	78%	22%	0
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- Faculty
  - Multicenter collaboration lessened individual burden
  - Multidisciplinary collaboration heightened educational benefit for residents

Costs

Formal Cost Analysis not done *a priori*

- Faculty time NOT included
  - Biggest cost
- 1 site (6 residents): $1700 per resident
- 4 sites (32 residents): $800 per resident
- 45% start-up costs
  - ~ half next time

CASST Sr

- Similar program for senior residents
- Included 1 additional program (N=5)
- Similar process of curricular development

CASST Sr

- FACULTY
  - General Gynecology (9)
  - Urogynecology (3)
  - Urology (3)
  - Gynecologic Oncology (1)
  - Program Directors (3)
  - Endourology and Urogyn fellows (2)
- RESIDENTS
  - Ob/Gyne (34)
  - Urology (6)

Curriculum

4 sessions (3 hours)

- 1 hour: didactics
- 2 hours: workshops
  - round table discussions
  - prosected cadavers
  - bench models

Curriculum

- Urogyn and Endoscopy
  - Clinically relevant anatomy
  - Advanced surgical skills
- Ethics of Surgical Innovation
- Problem-Solving in the OR
- Surgical Complications: Identification &Treatment
- Enhancing Communication

Conclusions

- Multicenter, multidisciplinary approach to surgical education is
  - Feasible
  - Cost effective
  - Maximizes faculty time & effort
  - Perceived as beneficial by residents
- Expands education for residents & faculty
- Think outside the box for potential collaborators

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Clinical anatomy and surgical skills training (CASST): Development of a multicenter, multidisciplinary program

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KEY WORDS
Surgical skills
Technical skills
Surgical education
Resident education
Urology

Objective: The aim of this program was to develop a multicenter, multidisciplinary anatomy and surgical skills training program for junior residents in obstetrics and gynecology and urology.
Study design: After administering a needs assessment, we developed a collaborative clinical anatomy and surgical skills training program for junior residents in obstetrics and gynecology and urology at 3 academic medical centers in Chicago.
Results: Thirty-two residents participated in the program. Needs assessment results indicated that all residents felt they could benefit by more formal training in basic surgical skills. Learning objectives were developed for each of the 5 3-hour sessions that dealt with basic surgical skills, anterior abdominal wall anatomy, opening and closing the abdomen, female pelvic anatomy, and perineal anatomy and laceration repair. The cost of training each of the residents was approximately $600. Forty-five percent of the costs were one-time "start-up" costs for abdominal trainers and surgical instruments.
Conclusion: By including multiple centers and disciplines, we were able to reduce costs of teaching basic surgical skills and anatomy and maximize faculty teaching time and effort.

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Resident surgical training is increasingly challenging because of limited resident work hours, decreased surgical volume, concerns for patient safety, and increasing clinical demands of academic faculty.[1,2] As a result, much basic surgical education has moved outside the operating room and into structured surgical skills laboratories. Multiple authors have demonstrated that structured surgical skills laboratories can be used to reliably

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train and evaluate resident surgical skills.[3-5] In a survey of 199 obstetric and gynecology residency programs about their surgical education curriculum, only 58 programs (30%) had developed formal curricula.[6] Of the programs without formal curricula, 100% used direct observation in the operating room, while only 61% had bench laboratories. The relatively low rate of technical skills laboratories is likely a result of limited faculty time and limited resources. As a result, new, innovative, cost-effective programs must be developed to teach junior residents anatomy and basic surgical skills. Junior residents from all surgical disciplines need to master the same basic technical skills and clinical anatomy. By collaborating with other departments and institutions teaching similar concepts and skills, we may be able to increase teaching efficacy, decrease faculty burden, and reduce costs.

The aim of our program was to develop a multicenter, multidisciplinary anatomy and surgical skills training program for junior residents in obstetrics and gynecology and urology. We will describe how we developed and assessed our clinical anatomy and surgical skills training (CASST) program.

Material and methods

Program directors from 3 obstetric and gynecology residency programs and 1 urology residency program agreed to develop a joint clinical anatomy and surgical skills training program. We followed a basic 5-step process for developing the CASST curriculum.[7]

Needs assessment

We administered a needs assessment questionnaire on knowledge of basic surgical skills and clinical anatomy to first and second year residents from 4 residency training programs in the Chicago area.

Learning objectives

Clearly defined objectives were developed based on the consensus opinion[8,9] of the faculty and the results of the needs assessment. Faculty opinions were derived from personal experience and consulting with national experts in surgical education. Specific objectives were written for each session and distributed to the residents at session one.

Educational strategies and implementation

We used results of the needs assessment to develop 5 3-hour workshops, including 13 short didactics, surgical skills laboratories, and prosected cadaver dissections to teach basic surgical skills and anatomy.

Table I Needs assessment results–resident responses (n = 32)

	Knowledge			
	Excellent	Adequate	Marginal	Poor
Suture properties	0%	25%	57%	18%
Surgical knots	7%	68%	25%	0%
Anterior abdominal wall anatomy	0%	46%	39%	14%
Pelvic anatomy	0%	39%	43%	18%
Hysterectomy anatomy and skills	0%	7%	46%	46%
Third and fourth degree lacerations	0%	7%	29%	64%

Assessment of learners

A short answer, fill-in the blank, pretest was given before the first session to assess baseline knowledge. The same test was administered at the conclusion of the fifth session and will be given again at the end of the academic year to assess the resident's short- and long-term knowledge retention.

Program evaluation

We used 2 methods to assess the CASST program: all residents completed a course evaluation after the final session and faculty met to formally discuss and evaluate what they thought of the program.

The needs assessment, learning objectives, and program evaluation results are presented here. We also describe the start-up and on-going costs of the program.

SPSS (Version 13, Chicago, Ill) was used for data entry and analysis. Chi-square test of association was used for nominal data. Data were considered significant at the .05 level.

Results

Thirty-two residents participated in the program. Faculty included physicians from gynecology (n = 7) and urology (n = 3) from 3 different academic medical centers.

Educational outcomes

Needs assessment

Ninety-three percent of participants preferred hands-on surgical models or cadavers to didactic lectures. One hundred percent of participants agreed or strongly agreed that they would benefit from more formal training in basic surgical skills before entering the operating room, and 86% thought that prosected cadavers would increase their knowledge of anatomy. Table I demonstrates participants' assessment of their current knowledge regarding anatomy and surgical skills. Over half

Table II Resident learning objectives

Session 1: Basic surgical skills
Choose appropriate surgical instruments and suture based on biomechanics and tissue, suture, and healing properties.
Demonstrate how to tie surgical knots, including 1-handed, 2-handed, and instrument.
Place a tie using a passer and free hand.
Session 2: Abdominal wall anatomy
Discuss the muscular and fascial layers and vasculature of the abdominal wall.
Compare common surgical incisions used in gynecology and urology and identify specific instances in which each is beneficial.
Session 3: Opening and closing the abdomen
Select appropriate instruments (eg, smooth vs toothed pick-ups) and suture for the different layers of an abdominal closure.
Demonstrate how to create and close an abdominal incision.
Demonstrate how to first assist opening and closing an incision.
Session 4: Pelvic anatomy
Identify clinically important anatomic structures in the pelvis and apply anatomic relationships to clinical scenarios.
Demonstrate how to position a patient in stir-ups and place a self-retaining retractor to prevent pelvic nerve injury.
Discuss steps of abdominal hysterectomy and identify common sites of ureteral injury.
Session 5: Perineal anatomy and laceration repair
Define the anatomic structures involved in the 4 degrees of perineal lacerations.
Demonstrate how to repair a fourth-degree laceration on a beef tongue model,[10] including repairing all layers and choosing appropriate suture types for each layer.

of residents thought their knowledge and/or skills in all areas surveyed (except knot tying) were marginal or poor. A significantly higher percentage of second year residents felt their knot tying skills were excellent or adequate ($P = .009$). Urology residents were significantly more likely to report that their knowledge of pelvic anatomy and hysterectomy was poor compared to gynecology residents ($P = .001$ and $P = .012$, respectively).

Pretest results further emphasized the need for the CASST program. Twenty-seven percent of residents could correctly identify all 3 branches of the pudendal nerve, and less than half (40%) accurately described differences between first- and fourth-degree perineal lacerations. Only 10% knew the 3 most common sites of ureteral injury during hysterectomy, while another 33% could name 2 sites. Only 50% of residents selected an appropriate suture type to close fascia, subcutaneous tissues, and skin.

Learning objectives

The objectives for each session included cognitive and psychomotor components. Table II contains the objectives for each session.

Educational strategies and implementation

We developed 5 sessions, each containing 2 or 3 short didactics followed by a 'hands-on' workshop in either the surgical skills or gross anatomy laboratories. The following briefly describes the curricular content of each session, including the didactic and laboratory portions.

Session 1: Basic surgical skills

The first hour contained 3 didactics: (1) Introduction to the operating room, specifically how to position patients, lights, check equipment; (2) reviewing common surgical instruments used in obstetrics and gynecology and suture properties and types; (3) knot tying principals. The laboratory session consisted of 6 stations, where residents practiced knot tying (1-handed, 2-handed, and instrument), passing with a free tie and instrument, and reviewing the names and purpose of various surgical instruments.

Table III Residents' ratings of 5 CASST sessions (n = 32)

	Excellent	Helpful	Marginal	Waste of time
Knot tying	26%	52%	22%	0
Abdominal wall anatomy	36%	60%	4%	0
Opening and closing	56%	36%	8%	0
Pelvic and neural anatomy	50%	46%	4%	0
Repairing perineal lacerations	56%	31%	10%	3%

Session 2: Clinical anatomy of the anterior abdominal wall

Didactics were given on the layers and anatomy of the anterior abdominal wall, on common incision types, including midline, paramedian, Pfanenstiel, Maylard, Gibson, and Cherney, and on laparoscopic port placement for various procedures. We spent the remainder of the time in the gross anatomy laboratory. Four prosected cadavers were used to review layers, musculature, vessels, and innervation of the abdominal wall. We demonstrated where different incisions would be placed and important nearby structures by presenting clinical scenarios for the groups to discuss. We also repeated the knot tying and instrument naming stations from the first session.

Table IV Program costs budgeted versus actual

Item	Budgeted cost	Actual cost	Start-up or ongoing	$/resident actual
Abdominal trainers	$1452	$3494	Start-up	$109
Instruments	$11,792	$5241	Start-up	$164
Pads for trainers	$2816	$1747	On-going	$55
Cadavers	$2400	$4800	On-going	$150
Breakfast items	$0	$578	On-going	$18
Administrative support	$0	$500	On-going	$16
Meeting costs	$0	$1500	On-going	$47
Misc costs for supplies	$750	$1500	On-going	$47
Physician salaries	$0	$0	On-going	$0
Total	$19,200	$19,360		$605

Session 3: Opening and closing the abdomen

Two didactics were presented on opening and closing the abdomen emphasizing abdominal wall anatomy and basic surgical principles (traction and counter traction, how to hold knife, pick ups, needle driver). The residents spent the remainder of the time in groups of 2 practicing making and closing incisions using abdominal wall trainers and pig's feet.

Session 4: Pelvic anatomy

The didactic portion of this session was dedicated to a review of basic pelvic and retroperitoneal anatomy—broad and cardinal ligaments, uterus, ovaries, and tubes, vessels, the course of the ureter—steps of abdominal hysterectomy focusing on clinically relevant anatomic relationships, and important neural anatomy and injuries. Laboratory session included reviewing pelvic and retropubic anatomy on prosected cadavers, using clay models to practice the steps of abdominal hysterectomy, and case scenarios of common nerve injuries associated with pelvic surgery.

Session 5: Perineal anatomy and laceration repair

Three short didactics were presented at the beginning of this session: review of perineal anatomy, repairing episiotomies and second-degree lacerations, and repairing third- and fourth-degree lacerations. We used a beef tongue model[10] for repairing third- and fourth-degree lacerations during the laboratory session.

Program evaluation

Upon completion of the program, all (100%) residents strongly agreed or agreed that the CASST program was beneficial. Table III shows residents' evaluations of the 5 individual sessions. There were few differences in responses between residency year and program. First year residents were more likely to rate the session on opening and closing the abdomen as excellent, while second year residents only found it helpful ($P = .029$). Urology residents were significantly more likely than gynecology residents to rate the session on perineal lacerations as marginal ($P = .005$). Similarly, urology residents were more likely to remain neutral to the statement that the session on perineal lacerations was beneficial ($P < .0005$).

Faculty assessment of the program was positive. Faculty unanimously agreed that collaborating with other centers/programs lessened their individual burden, resulting in an educational benefit for their residents. Faculty also benefited from working with specialists from other institutions and disciplines, frequently stating that they learned from the program. We identified several areas for improvement. More surgical instruments and trainers would improve some sessions. Next time, we will divide residents by specialty for certain breakout sessions. We will incorporate a more formal mechanism to provide formative feedback during individual sessions.

Cost analysis

The budgeted and actual expenses of the program for 32 residents are shown in Table IV. The abdominal trainers and surgical instruments were a one-time purchase and can be reused at further training sessions. Approximately 45% of the costs were associated with start-up.

Disposable or on-going costs included pads for the trainers, cadavers, supplies, and administrative support. Faculty salaries and meeting room expenses were not included. Four cadavers were prosected by the faculty to illuminate specific teaching points. The number of cadavers was dependent on the learning objectives and not the number of resident participants. If we consider doing the same program with only 6 residents from a single program, the costs would increase by $800 per resident.

Conclusion

We have developed a unique multicenter, multidisciplinary program to train junior residents in clinical anatomy and surgical skills. By including multiple centers and disciplines, we were able to maximize faculty teaching time and effort, reduce costs to individual programs, and

establish collaborative relationships with specialists outside our departments.

As medical education and training change to meet the Accreditation Council for Graduate Medical Education's new requirements for resident duty hours, increasing clinical demands are being placed on academic faculty.[1,11] Experts predict that the clinical activity of academic surgeons will likely increase at the expense of their academic productivity (teaching and research).[12] By collaborating with other surgical residency programs, we decreased each individual faculty member's preparation, didactic, and teaching time. The CASST program included 13 short didactics, which complemented the 'hands-on' portion of each session. Each of the 10 faculty prepared at least 1 didactic session. Likewise, we shared preparation and cadaveric dissections. Most programs have a limited number of teaching faculty to participate in surgical skills programs, forcing a small number of faculty to develop, prepare, teach, evaluate, and assess their program. Our program maximized each program and faculty member's time.

Additional costs that were not included in the analysis were costs of faculty time, facilities fees, and actual administrative costs of the program. Our multicenter program allowed us to utilize each program's unique resource. For example, one program had new medical school facilities that could accommodate the didactic sessions and the anatomy breakout sessions.

Chicago is unique in having 5 university medical centers in addition to several strong community based medical centers in close geographic proximity, which lends to close working relationships with other centers. This certainly aided our efforts to assemble a team from multiple medical centers. However, we also successfully collaborated with our own urology department, demonstrating the potential for intrainstitutional collaboration within more remote medical centers. In fact, we hope to expand the program to include general surgery as well as urology and gynecology from other institutions. Our multidisciplinary collaboration provided several additional educational benefits: (1) the distinctive input and view-point of different specialties exposed residents and faculty to alternative ways of approaching a problem or task; (2) residents initiated professional relationships with future colleagues with whom they will collaborate clinically, and hopefully, academically; (3) residents witnessed professionalism and cooperation among surgical subspecialists.

Additionally, we believe the CASST program accomplished our major educational goals. We determined a need for an anatomy and technical skills program, developed concise, specific learning objectives, and put together a relevant curriculum. Program evaluations by residents and faculty judged the program to be beneficial. Final summative feedback will not be available until July 2006. Until that time we cannot comment on final assessment of resident's knowledge. However, most programs have subjectively acknowledged improvement in junior resident's knowledge and skill about objectives covered in CASST.

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Validity of computer based methodology to evaluate surgical skill

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ESHRE, 2008

Validity of computer based methodology to evaluate surgical skill

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Greetings from KIEL in Germany

Learning objectives

1. Basic endoscopic training models are still essential for laparoscopic and hysteroscopic procedures
2. Computerized trainers offer better teaching possibilities
3. Virtual reality trainers are advantageous
4. Live animal surgery and human cadaver surgery should be performed when possible

Disclosure statement

- We have no commercial or financial relationship with manufacturers of any medical devices shown in this lecture.

Objectives

- **1. The intelligent hospital**
- Advances in computer graphics, robotics and virtual reality (VR) technology open up new possibilities in medicine. **Robots fit readily into the infrastructure of today's hospitals**. Users, as the new generation of computer literate physicians and patients recognize these potentials and benefits.

Objectives

- **2. Demographic change**
- In developed countries are more elderly people requiring hospital care and fewer working age people able to provide it.
  One solution is automation in health care.
- **Robotics is one example of modern techn. together with computer based surgical skill training before the actual surgery on the patient that helps to deliver effective surgical care**

Objectives

- **3. Telesurgery**
- Advances in telecommunications now routinely allow surgeons to view operations taking place in distant hospitals using video conference techniques.
  Adding a robot assistant to this set up allows
  a distant surgeon to participate directly in the operation, controlling the robot in exactly the same way as if they shared the same room.

Enhancing laparoscopic skills with the LTS3e: A computerized hybrid physical reality

- What are our study objectives?
- To determine the value of this interactive simulator in acquiring basic laparoscopic skills among its users and to evaluate the correlation between the frequency of trials/practice and the overall performance
- Accepted for publication in Fertility and Sterility 2008, Soyinka,A.,Meinhold,I, Schollmeyer,T. and L. Mettler

Design

- Cross-sectional study with paired analysis.

Setting

- The study was carried out at the Kiel School of Gynaecological Endoscopy and Reproductive Medicine

  Department Obste.Gynec.Christian Albrechts-University - **Campus Kiel**, Germany
- July 2006 and February 2007.

Subjects

- **Twenty-five** in-training gynaecological endoscopic surgeons from various parts of the and world and

  fifteen third-year medical students of the above institution.

Interventions

- Verbal explanation and video demonstration of a set of 10 laparoscopic skill takss, suitable for application in endoscopic surgery, was presented to participants before administration of a pre-test. Voluntary rounds of further trials were encouraged thereafter, based on self motivation.

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Interventions

- The post-tests were administered five days later once the participant was comfortable performing the tasks. Assessments were conducted by the same independent supervisor and recorded on the LTS3e simulator.

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Main outcome measures

- Improvements in overall scores and relative performance mean scores were measured using the independent t-test and comparison of various trial groups was performed by the ANOVA, an analysis of variance.

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Results

- **Significantly better post-test scores were achieved in all tasks for both groups compared to the pre-test scores p>0.0001.**

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Results

- There was no statistical difference between the overall relative training outcomes of both groups (when the numbers of trial rounds were taken into consideration) p=0.471.

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Results

- No significant difference in group mean scores between the group of trainees who performed five or more rounds of trials and those with two and three trials ($p<0.012$ and $p<0.018$ respectively) was detected.

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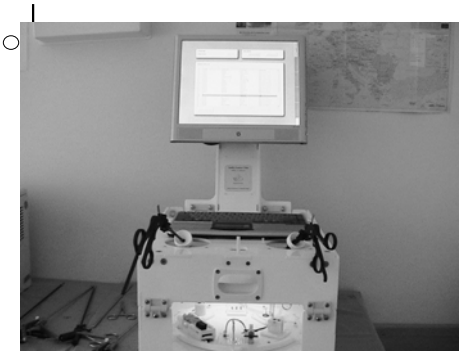

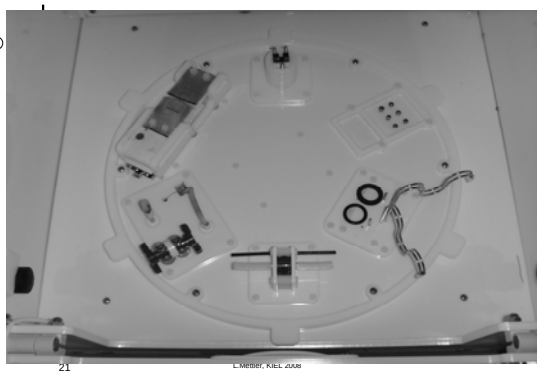

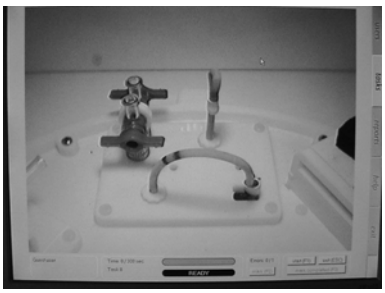

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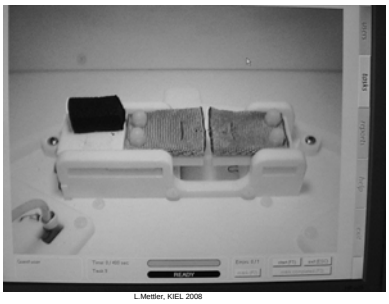

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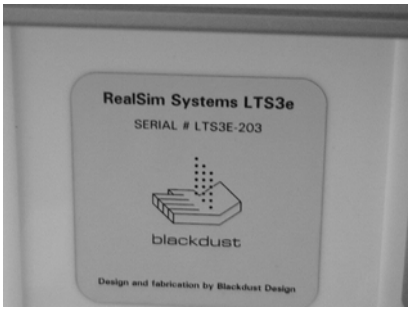

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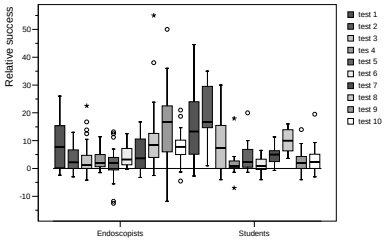
Fig. 3: Relative training success of both groups compared for each of the task and displayed in figure boxes.



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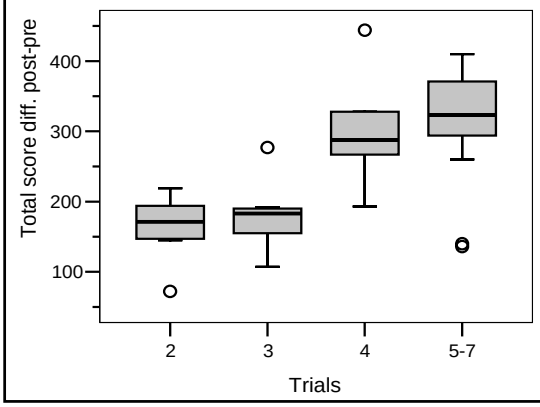

Conclusions

- The LTS3e simulator device substantially contributes to the acquisition of laparoscopic skills in the less experienced or novice trainee surgeon. Performance improves progressively with practice.

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Simulators

- **Mechanical simulators, also called box trainers or conventional trainers, have long been used to teach laparoscopic skills. Box trainers are a popular alternative to animal and cadaver models, because they are less expensive and more convenient**
- **Computer-based virtual reality simulators are relatively new to surgical education but are growing in popularity**
- **Virtual reality simulators allow more independent instruction and objective feedback.**

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Box trainers

- **Commenly using for practicing or assessing laparoscopic skills**
- **Most box trainer simulators use actual laparoscopic equipment**
- **The trainee performs the laparoscopic tasks under direct guidance of an experienced mentor for instruction and feedback**
- **Scott et al., 2000**

randomized surgical residents to a box trainer group or to a no training group. Using a global assessment tool for laparoscopic cholecystectomy on an actual patient the investigators found that the training group demonstrated significantly greater improvement

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Virtual reality

- **Can virtual reality training improve operating room performance?**

Grantcharov et al., Br J Surg 2004;91:146– 50
randomized, blinded, control trial
assessed surgical residents during a laparoscopic cholecystectomy (on an actual patient) using a global assessment scale

- **Residents were randomly assigned to additional MIST-VR training or no simulator training**
- **They found that significantly shorter operating times, fewer errors, and better economy of motion in the group with VR training**
- **Schijven M, Surg Endosc 2005**
  Similar results
- **Ahlberg G, Surg Endosc 2002**
  No difference

Virtual reality trainers versus box trainers

- **Hamilton E, Surg Endosc 2002;16:406– 11.**
  randomized 50 surgery residents to box training or virtual reality training
  After the designated training, participants had their technical skills assessed during an actual laparoscopic cholecystectomy
- **The virtual reality training significantly improved resident performance during operating room case, whereas training with a box trainer did ony improve performance slightly**
  The authors concluded that virtual reality training is superior

- **Youngblood P, J Am Coll Surg 2005;200:546– 51.**
  In that study, performance was assessed in an animal model.
  Again, investigators found that the virtual reality trainer was superior

VR training in the Endoscopy School at the Dpt. Obstet. Gynec. In Kiel

- Education model project at our 3 months courses
- 1. group conventional training
- 2. group VR training (LapSim, VR1, LAP-Mentor)
  - 2 hours per week VR training
- Both groups receive 10 hours of didactical education
- After 8 week education technical skills are assessed during an actual timed exam and best at home with an easy surgery, like tubal ligation

- (LapSim)
- Ectopic pregnancy

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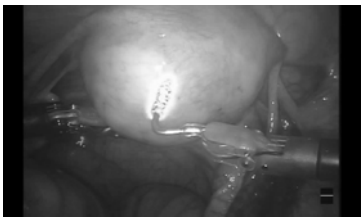

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Virtual Reality Trainers

- One such system,
the **VR Pelviscopy Trainer ,VSOne,**
consists of two main components.
The 3-D interaction
to guide the surgical instruments
and the 2-D user interface
for visual feedback
and control of training session.

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- To provide the virtual environment,
  a realistic 3-D representation
  of the anatomic situs
  is derived from 2-D medical image data
  using imaging algorithms
  and visualisation techniques.

VEST Applications

Arthroscopy
Logan et al. (1996), Univ. of Hull, UK
Ziegler, Müller et al. (1995), FhG-IGD, D

Bronchoscopy
Bro-Nielsen et al. (1999), HT-Medical, USA

Cardiac-Surgery / Anastomosis
Playter et al. (1997), BDI, USA

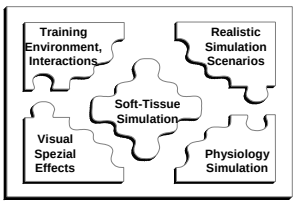
Craniofacial Surgery
Keeve (1996), Uni-Erlangen, D

Eye-Surgery
Sinclair et al. (1998), Georgia-Tech, USA

Gynaecology
Szekely et al. (1998), ETH-Zürich, CH
Kühnapfel et al. (1998), FZK, D

Laparoscopy
Cover et al. (1993), Georgia-Tech, USA
Kühnapfel et al. (1995), FZK, D

Trauma Surgery (mil.)
Basdogan et al. (1997), Musculographics, USA

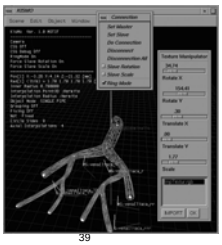


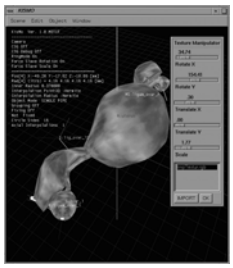
VEST-System Requirements

- ➲ **Limited surgical Interactions**
- ➲ **Limited anatomical „Realism“**
- ➲ **Limited modelling of „Physiology“**

Modelling-Tool *KisMo* (KISMET-Modeller)

Implementation of the Software-Tool *KisMo* for elastodynamical Objects





Surgical Simulation Scene

Application 1
Cholecystectomy

Clinical partner
Universitätsklinik Tübingen
Prof. Buess (since 1995)

Technical Details
Objects: 2
Knots: 325
Springs: 1317
Performance: 24 fps (SGI OnyxIR2, 2 CPU)
17 fps (SGI OctaneMXE, 2 CPU)
15 fps (SGI VPC-320, 2 CPU)
9 fps (Intergraph PC, 2 CPU)

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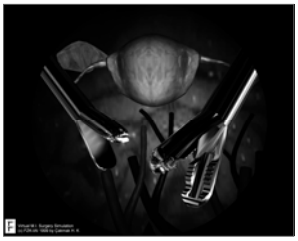
Surgical Simulation Scene

Application 2
Gynaecology

Clinical partner
Universitäts-Frauenklinik Kiel
Mrs. Prof. L. Mettler (since 1997)

Technical Details
Objects: 21
Knots: 2.847
Springs: 11.326
Performance: 12 fps (SGI Octane, 2 CPU)
9 fps (SGI VPC-320, 2 CPU)
6 fps (Intergraph PC, 2 CPU)



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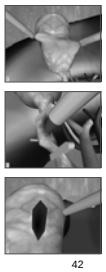
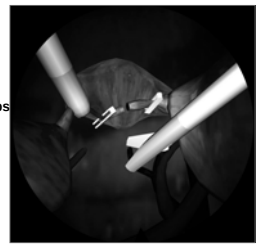
Basic Surgical Interactions



Grasping

Application of clips
Coagulation

Cutting



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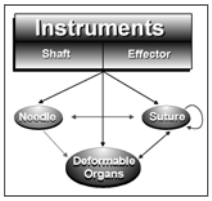
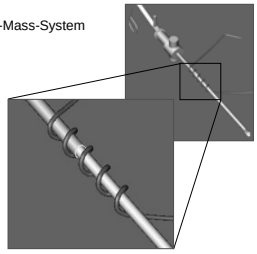
Simulation of Suturing

- Suture material modelled as Spring-Mass-System
- Collision **management**





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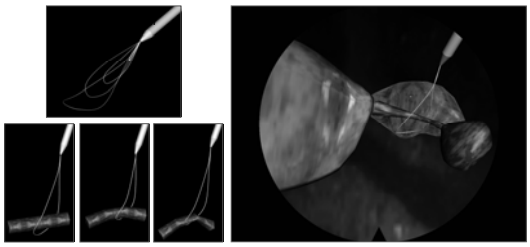
Sling Mechanism and Interaction



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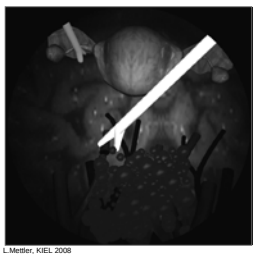
Arterial Bleeding

- Particle System Simulation
- Coupled with Pulse Simulation
- Application of clips to stop bleeding
- Accumulation of blood
- Parameters: Blood loss per vessel
  Rendering settings



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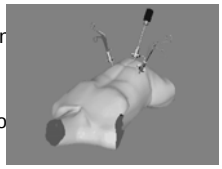
Virtual Reality Trainer VSOne

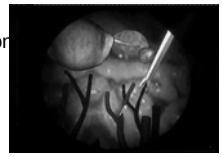
VSOne

- **Model Overview**
- Camera introduction
- Placement of clips
- Coagulation
- Suction and irrigatio
- Suture



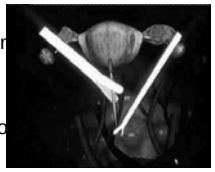
VSOne

- Model Overview
- Camera introduction
- Placement of clips
- Coagulation
- **Suction and irrigation**
- Suture



VSOne

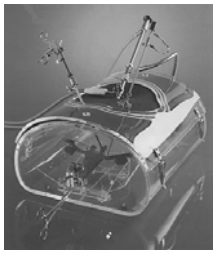
- Model Overview
- Camera introduction
- Placement of clips
- Coagulation
- Suction and irrigation
- **Suture**

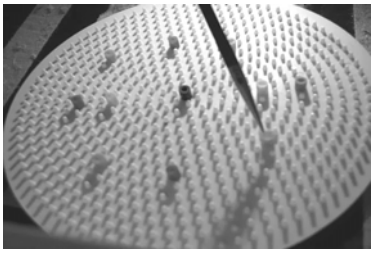


Old training models meet computerized technology

1. Basic training on the pelvi-trainer, „popp trainer“, LTS-1 with simple exercises on models or organic tissue - specially advisable to practice suturing
2. Computerized trainers
3. Virtual reality trainers
4. Animal organs
5. Animal live situation training

„Pelvi-Trainer“





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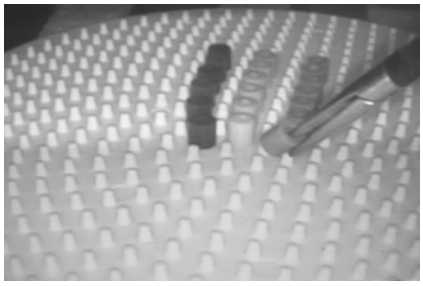

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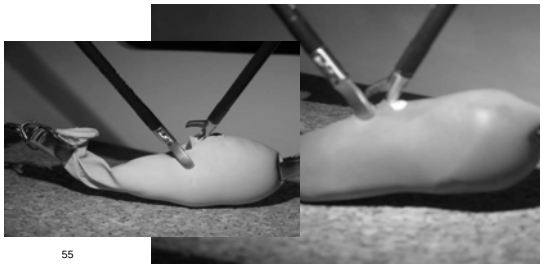

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Role and value of laparoscopic training devices in assesing nondominant and two handed dexterity

- Mettler et al. Gynecol.Surg (2006) 3: 110-114

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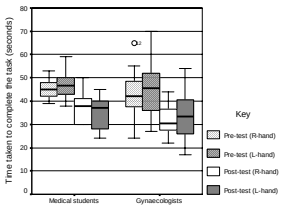

Fig. 2 (a) Individual hand's precise touching ability

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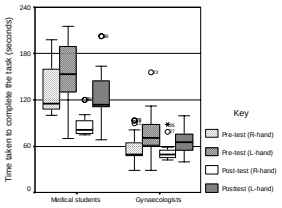

Fig. 2 (b) Individual hand's precise pulling ability

58

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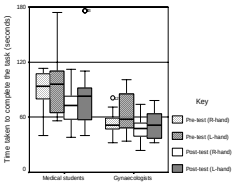

Fig.2 (c) Individual hand's precise putting ability

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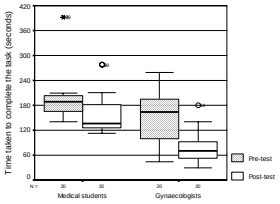

Fig.2 (d) Both hands' coordination for manuvering ability

60

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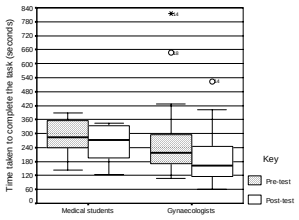

Fig.2 (e) Both hands' coordination for I.C. suturing ability

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Robotics

- **AESOP ™**

(automated endoscopic system for optimal positioning)
was the robot of the year 2000
in medical application.
It enables a tremor-free
voice-commanded movement
of the camera holding arm
during laparoscopic surgery.

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AESOP

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Methods

- **Zeus** uses 3 robots,
  one for the camera movement
  and 2 for robotic instrumentation.

Methods

- **Intelligent operation rooms**
- 2. The integration and the central steering of different operation room components are realised in the **OR1 of Storz**.
  This technology allows a completely new operation room management:
  central control of all room components, processing, capturing and mailing of all patient data for data exchange between clinics, doctors and health care staff;
  efficiency increase.

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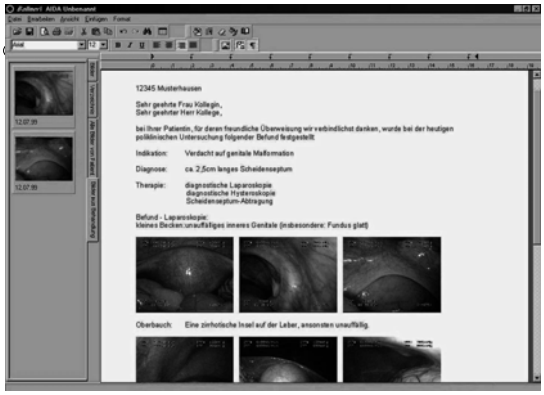
12345 Musterhausen
Sehr geehrte Frau Kollegin,
Sehr geehrter Herr Kollege,
Indikation: Verdacht auf genitale Malformation
Diagnose: ca. 2,5cm langes Scheidenseptum
Therapie: diagnostische Laparoskopie
diagnostische Hysteroskopie
Scheidenseptum-Abtragung
Befund - Laparoskopie:
Oberbauch: Eine zirrhotische Insel auf der Leber, ansonsten unauffällig.

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- Using the **da Vinci M Surgical System**, it is possible to operate with the look and feel of open surgery, performing complex surgical manoeuvres through 1cm ports in a sitting position with a so-called **Surgical Immersion™** Technology.

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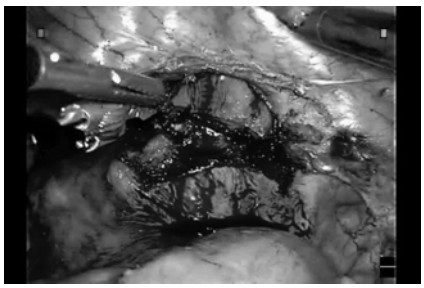
- **"da Vinci M Surgical System"**
- **MIS** becomes second nature. The eyes and hands of the surgeon are completely immersed in the patient. True-to-life, 3-D vision and instinctive operative control make complex MIS procedures feel like open surgery.

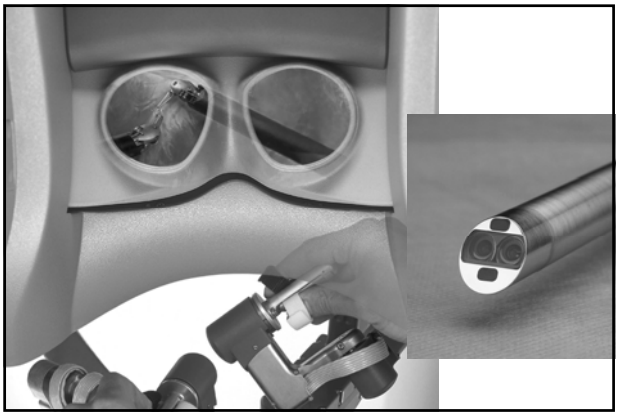
71 L.Mettler, KIEL 2008

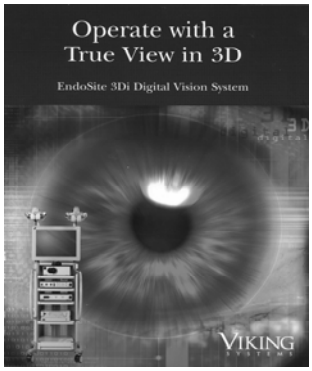
72 L.Mettler, KIEL 2008

73 L.Mettler, KIEL 2008

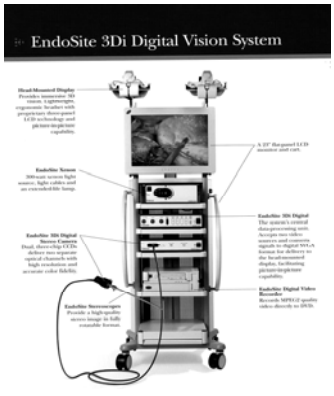


75 L.Mettler, KIEL 2008

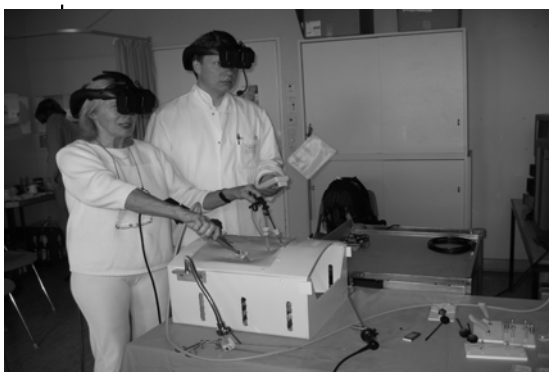



Operate with a
True View in 3D
EndoSite 3Di Digital Vision System
VIKING

77


EndoSite 3Di Digital Vision System

78



Other robotic tools are:

HUMPHRY
as robotic uterine manipulator for LAVH etc.

82 L.Mettler, KIEL 2008

Results

- A comprehensive finite element framework to enable simulation of patient specific biomechanics gives new possibilities for diagnosis and surgical planning as well as training **before** the individual case.

83 L.Mettler, KIEL 2008

Results

- The **VSOne** advanced training system was applied by 71 doctors for intensive training prior to surgery on the patient.
- **LTS 3e**. our real simulation system can be used as a screening mechanism for advanced laparoscopic surgeons. It also showed its **teaching effects** evaluation 50 doctors and medical students.

84 L.Mettler, KIEL 2008

Results

- **AESOP™** was used in comparison to assistant-held laparoscopic surgery in a group of 132 patients.
- The length of surgery, the skill of surgery and the outcome proved to be superior in those cases where the camera was held and moved by AESOP™ compared to human assistance.

Results

- **AESOP™** used in 132 laparoscopic gynaecological cases

		operation time			
		with assistant camera holder		with roboticarm (voice control)	
Surgical procedure	n	n	time/*	n	time/*
ovarian cysts	55	25	90	30	60
myomectomies	62	24	95	38	60
hysterectomies	25	15	80	10	40

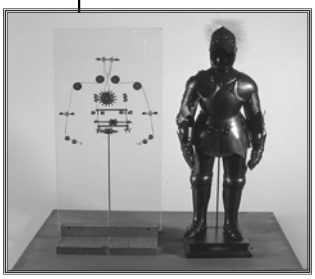
- * times are rounded up to 5 and 10'.

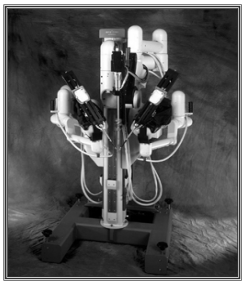
Results

- The surgical revolution initiated by the **da Vinci™ Surgical System** enables surgery to be performed with unprecedented precision and control. The immersion in the patient by looking into the da Vinci™ is now practised in many centers around the world. Results on patients are fascinating and comparative studies to laparoscopic conventional surgery are running .

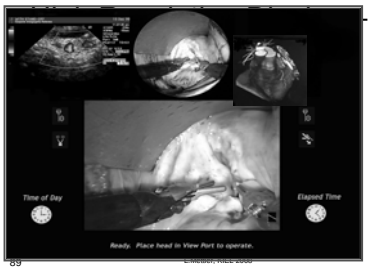
Past

Present

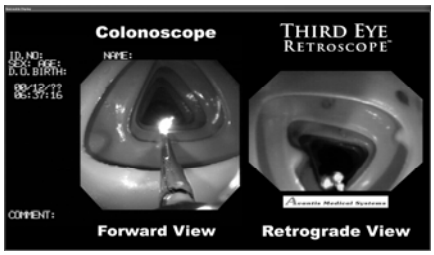




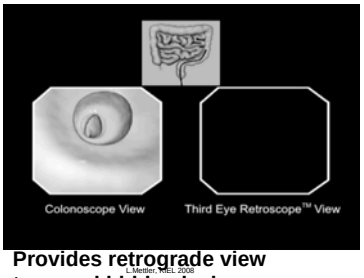
The Future of Robotic Surgery



The Future of Surgery



Avantis Third Eye Retroscope™



Provides retrograde view to reveal hidden lesions

91 L.Mettler, KIEL 2008

The Future of Surgery

Instruments

- Additional types of instruments
- Reusable instruments
- Use of the CO2 laser

Robotic Needle holder

92 L.Mettler, KIEL 2008

Conclusions and future aspects in gyne. surgery

1. Surgical skills have to be **trained computerized** today.
2. 90% of all surg. interventions will be performed by **laparoscopy or hysteroscopy**
3. Natural orifice surgery
4. Robotics with 3 dimensional surgery, high definition optics
5. A combination of **molecular genetic early disease detection** and **endoscopic, minimal invasive surgery** will hopefully induce less trauma to our patients in the future.

93 L.Mettler, KIEL 2008

Conclusions

- With the **da Vinci™** Surgical System the future of surgery is at your fingertips.
- We are able to take surgical precision and technique beyond the limits of the human hand.

Conclusions

- Benefits of the Intelligent Operating Room
  are at hand: “OR1” - “Hermes”, Alpha Image track, High definition cameras Olympus, Storz
  - » improved ergonomics
  - » better data management
  - » more efficient personal utilisation
  - » enabling new procedures and tools: HDTV
  - » optimised surgeon control

Conclusions

- Robotic surgical instruments give the surgeon:
  - » telesurgery chances
  - » image guided positioning
  - » image augmented dexterity
  - » sensor guided positioning of instruments with multiple degrees of liberty
  - » data preservation
  - » sensor guided dexterity
  - » task specific end-effectors
  - » increased manual dexterity

Thank you for your attention

Is there still a need for a reproductive surgeon

Stephan Gordts M.D.

Leuven Institute for Fertility and Embryology

YES !

RESTORATION NORMAL ANATOMY

TREATMENT DISEASE

OFFERING POTENTIAL FOR SPONTANEOUS CONCEPTION

OPTIMALIZATION RESULTS IVF

Investigation

uterine pathology congenital

acquired

tubal pathology

endometriosis

Hysteroscopic Findings in Subfertile Patients

	No	%
Total	530	100
Normal	370	69.8
No diagnosis	9	1.7
Abnormal	151	28.5

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Hysteroscopic findings in patients with repeated IVF failure

Nb patients with 2 IVF failures and nl. HSG n=55

SUBMUCOUS LEYOMYOMA	**2**
POLYPS	**10**
ADHESIONS	**6**
ENDOMETRITIS	**7**
	45%

Oliveira et al. Fertil Steril, 80, 2004

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Hysteroscopy and IVF outcome

Tarek El- Thouki RBM online 2008, 16

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UTERINE SEPTUM

Pre - and Post-operative Pregnancy Outcome

No.	Pre-operative	Post-operative
Patients	43	31
Pregnancies	117	37
• abortions	*104 (88.9%)	*5 (13.5%)
• premature	6 (5.1%)	5 (13.5%)
• at term	7 (6.0%)	27 (73%)
• children alive	*12 (10.2%)	*32 (86.5%)

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Septated Uterus and Implantation after IVF

	uteroplasty	control
Pregn.rate	20%	12.5%
Impl. Rate	10.5%	4.6%

Lavergne et al.Eur.J.Obstet.Gynec. 68,1996

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Septated uterus

	Small n= 125		Large n= 54	
	before	after	before	after
Time	22.44	6.6	20.88	4.98
Pregn	109	97	38	42
Deliv	16.5%	90.7%	18.4%	88.1%
Abort.	78%	8.2%	71.1%	11.9%
Ectop.	5.5%	1.1%	10.5%	

Gergolet et al, subm. Fertil Steril

Laparoscopic findings in 92 oligo-ovulatory infertile patients after 4 failed cycles

	No	%
Normal	33	35.9
Endometriosis	37	40.2%
Endometrioma 8	8,7%	Pelvic adhesions 30
	32.6%	
Tubal disease	1	1,1%

CAPELLO ET AL. FERTIL STERIL, 80, 2004

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IUI RESULTS IN PATIENTS WITH UNEXPLAINED INFERTILITY VERSUS MINIMAL ENDOMETRIOSIS

	Unexplained	minimal endometriosis
No. Patients	119	49
Pregnancy rate	33.6%*	16.3%*
Implantation rate	43.6%*	18.3%*

* $p < 0.005$

Omland et al., Hum Reprod 13, 9, 1998

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Uterine Leiomyoma Classification

Based on the concept that fibroids are primarily interstitial and gradually forced outwards or inwards:

- **Intramural**
- **Submucosal**
- **Subserosal**

EPIDEMIOLOGY

- **20-40% of women of reproductive age are affected by leiomyomas**
- **Myomas are associated directly or indirectly with 5-10% of cases of infertility**

Size **Location** **Number** **Type**

20 – 50% with symptoms

Menorrhagia **Dysmenorrhoea** **Infertility**

American Fertility Society. Guidelines for practice: myomas and reproductive dysfunction. 1992

Uterine Leiomyoma Clinical Manifestations

- **Bleeding**
- **Pain and pressure**
- **Urinary symptoms**
- **Pregnancy**
  - **Infertility**
  - **Recurrent spontaneous abortion**
  - **Obstetrical complications**

Impact of Intramural Myomas on Fertility

Greater distance for sperm travel
Encroachment on tubal ostium-occlusion
Distortion of uterine cavity
Vascular changes
Interfere with normal rhythmic uterine contractions
Impaired implantation
Abnormal endometrial maturation
Alteration on oxytocinase activity

Hunt J. 1974 Clin.Obstet.Gynecol.
Iosif C. 1983 Acta Obstet.Gynecol.Scand
Vercellini, P. 1992 Fertil Steril
Verkauf B fertil Steril 1992
Wallach, E.E. 1995 Obstet.Gynecol.Clin.N.Am.

Mechanism of Impaired Fertility in Case of Intramural-submucosal Myoma

Richards et al.(Hum Reprod Upd;1998,4)

- The numbers of *caveolae* in host myometrium and fibromyomata are conceivably *decreased* compared with normal myometra.
- This specific structural abnormality may affect calcium metabolism by causing a decrease in calcium extrusion and thus *raising the intracellular calcium*.
- *Increased* intracellular calcium produces *myometrial irritability* and hyperactivity.
- Results in disruption of rhythmic contractions of the junctional zone.

Mechanism of Impaired Fertility in Case of Intramural-submucosal Myoma

Subendometrial tumors:

- Causing endometrial erosion with subsequent inflammation altering the nature of the intrauterine fluid, resulting in a hostile environment.
- Disrupt the endometrial blood supply, affecting nidation and maintenance of early embryo

Fahri et al 1995

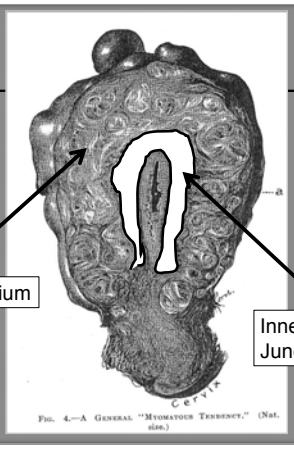


Fig. 4.—A General "Myomatous Tendency." (Nat. size.)

Outer myometrium

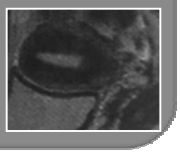
Inner myometrium
Junctional zone

Brosens et al.

Junctional Zone Myometrium

Functionally important entity in reproduction

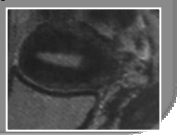
- **Ontogenetically related to endometrium**
- **Cyclic changes in SSH receptors**
- **Role in gamete transport and implantation**



Myometrial Junctional Zone Important Role in Reproduction

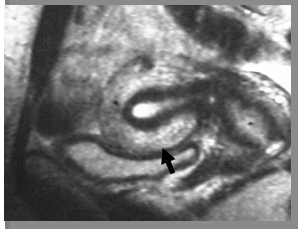
Functionally important entity in reproduction

- **Early changes from time of implantation**
- **Decidualization and trophoblast invasion**
- **Defective transformation of JZ spiral arteries in spectrum of pregnancy complications**



THE OUTER MYOMETRIUM

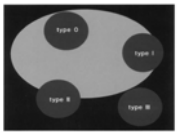
Less important role in reproduction



Muscle contractions during delivery

Proposal of Classification

- ***Submucosal (JZ) fibroid***
  - **type 0, I, II (European Society for Hysteroscopy criteria, 1994)**
  - **type III : abutting the endometrium**
- ***"Outer myometrium" fibroid***
  - **type IV: intramural**
  - **type V, VI: subserosal, pedunculated**



Impact of Intramural Myomas on *In Vitro* Fertilization

Myomectomy efficacy allows pregnancy in 60% of the patients with unexplained infertility in the first year following surgery

Vercellini P.1998 Hum.Reprod.

Impact of Intramural Myomas on *In Vitro* Fertilization

The decision to proceed with myomectomy in an asymptomatic patient with unexplained infertility remains controversial. Current data suggest surgical treatment for patients who have uterine cavity distortion.

Klatsky P et al 2007

Submucosal Myoma and Infertility in IVF (Pritts EA 2001)

	n Studies	Cycles	RR*	95% C.I.
Pregnancy	2	510	0.321	0.130 - 0.697
Implantation	1	541	0.277	0.096 - 0.720

AFTER RESECTION

	n Studies	Cycles	RR*	95% C.I.
Pregnancy	2	157	1.719	1.134 - 2.582
Implantation	1	55	0.980	0.453 - 2.409

* Referent is infertile control without LM

Intramural Leiomyoma

Pregnancy Rate after IVF

	Subjects	PR	Controls	PR
Hart	106	23%*	322	34%
Stovall (cycles)	91	37%*	91	53%
Eldar-Geva	46	16%*	249	30%
Khalaf Y	122	24%*	322	33%

Intramural Leiomyoma

Pregnancy Rate after IVF

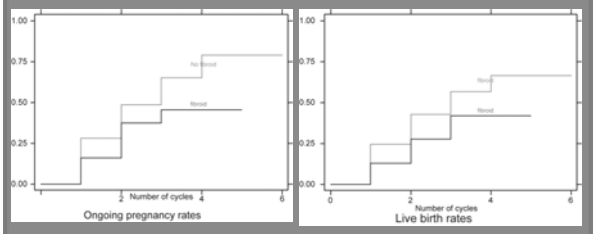
	Subjects	PR	Controls	PR
Surrey	73	51%	316	60%
Check	61	34%	61	48%
Ramzy	39	38%	367	34%
Oliveira	130	48%	245	45%
Klatsky	94	47%	275	54%

Intramural Leiomyoma

Miscarriage Rate After IVF

	Subjects	MR	Controls	MR
Eldar-Geva	46	33%	249	30%
Check	61	34%	61	20%
Ramzy	39	20%	367	15%
Oliveira	130	27%	245	29%
Gianaroli	129	40%*	129	19%*

Intramural Fibroids and Cumulative Outcome Assisted Conception



Khalaf HumReprod 2006

Material and Methods

•Retrospective case-control study

	Group 1 (N=75 patients with myomas)	Group 2 (N=127 patients without myomas)
N.of transferred cycles	129	129
Age (M ± SD)	35.8 ± 4.9	35.7 ± 4.8
Mean Oestradiol	1205 ± 874	1395 ±821
% fertilized oocytes	67	56
No of fibroids	2.46 ± 2.8	/

Gianaroli *et al.*

Results (I)

	Group 1 (N=75 patients with myomas)	Group 2 (N=127 patients without myomas)
# of embryos/ET (M ± SD)	2.02 ± 0.4	2.14 ± 0.6
# of clinical pregnancies (%)	45 (34.9%)	53 (41.1%)
Implantation rate %	48/267 (18%) *	63/238 (26.5%) *
# of abortions (%)	18 (40%)*	10 (18.9%)*

*X^2=4.34 p<0.05

Uterine Myoma and Pregnancy
Washington State Birth Records

- Retrospective population-based study 1987-1983
  - 2,065 singletons
  - Comparison group selected randomly; matched by birth year
  - No match by age, parity, or race/ethnicity

Coronado et al. 2000

Uterine Myoma and Pregnancy
Washington State Birth Records

- Abruptio placentae OR: 3.87 95% CI: 1.63, 9.17
- 1st Trimester bleeding OR: 1.82 95% CI: 1.05, 3.20
- Dysfunctional labor OR: 1.85 95% CI: 1.26, 2.27
- Breech presentation OR: 3.98 95% CI: 3.07, 5.16
- Caesarean delivery OR: 6.39 95% CI:5.46, 7.50

Coronado et al. 2000

Uterine Myoma and Pregnancy

Israeli Population-based Study

- **- Virtually all singleton deliveries of southern Israel occur at Soroka University Medical Center**
  - Period 1988-1999 (n=105909) (0.65% myomas, n= 690)
- **UM independently associated with:**
  - Caesarean delivery OR: 6.7 95%*CI:5.5,8.1*
  - Placental abruptio OR: 2.6 95%*CI:1.6,4.2*
  - <36 weeks gestation OR: 1.34 95%*CI:0.7,2.8*

Sheiner et al 2004

Myomectomy Surgical Technique

Submucous myoma: hysteroscopic myomectomy

-diameter ≤ 5 cm

-partially protruding in cavity

-2-step procedure can be necessary

-in case of larger myomas a pre-treatment with GnRHa can reduce the diameter

Myomectomy Surgical Technique

Intramural myoma: laparoscopic myomectomy

- diameter 6-7cm
- number max. 4
- no pre-treatment with GnRHa

Mini laparotomy with exteriorization of uterus

Myoma and Reproduction

Conclusions I

Infertility: retrospective IVF cohorts with controls
- **impaired fertility submucosal myoma**
- **possible negative impact of intramural myoma**
- **negative effect seems to be correlated with size and numbers**

Myoma and Reproduction

Conclusions II

Recurrent miscarriage:

- **not clearly established link**
- **prospective studies needed**
- **increased risk of abortion in presence of several myoma**
- **increased risk with involvement of JZ**

Myoma and Reproduction

Conclusions III

Obstetric outcome: retrospective population based cohorts
increased risk of
- **abruptio placentae**
- **Caesarean section**
- **pre-term delivery**
- **breech presentation**

Leiomyomas and Infertility

- **It is rarely probable that they cause infertility but it has been described:**
  - **Longer time to conception (Hasan et al. 1990)**
  - **Reduction of the success of ART (Stovall et al. 1998; Khalaf et al. 2006)**
  - **Relation to spontaneous abortion (Muhieddine et al. 1992) (Matsunaga et al. 1980)**
  - **A similar probability of pregnancy after myomectomy compared with patients with no uterine pathology (Buttram & Reiter 1981)**

Leiomyomas and Infertility

Consensus on the benefits of treating submucous leiomyomas

No consensus on the treatment of smaller intramural leiomyomas

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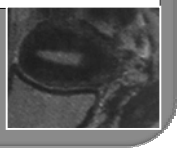
Junctional Zone Myometrium

Functional important entity in reproduction

- **Ontogenetically related to endometrium**
- **Cyclic changes in SSH receptors**
- **Role in gamete transport and implantation**



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T2-weighed NMR imaging in adenomyosis

NMR visualises the distortion of the myometrial architecture

- Accurate soft tissue contrast
- Non invasive
- Differentiates focal and diffuse adenomyosis

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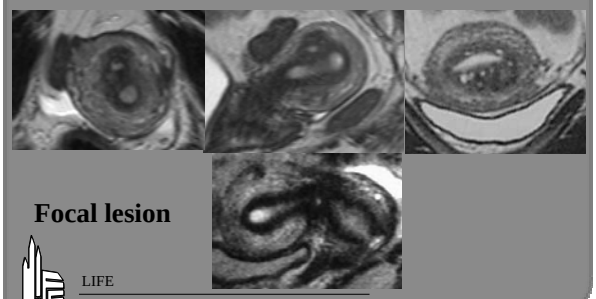
NMR is an accurate technique to detect uterine adenomyosis



Focal lesion

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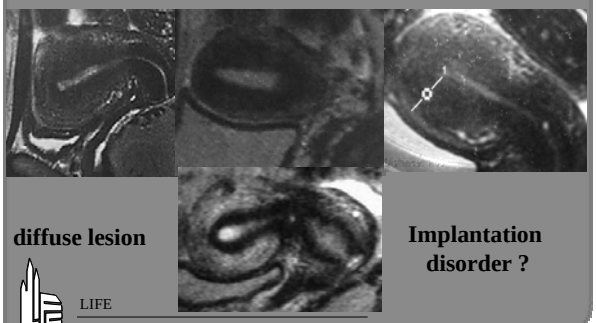
NMR is an accurate technique to detect uterine adenomyosis



diffuse lesion

Implantation disorder ?

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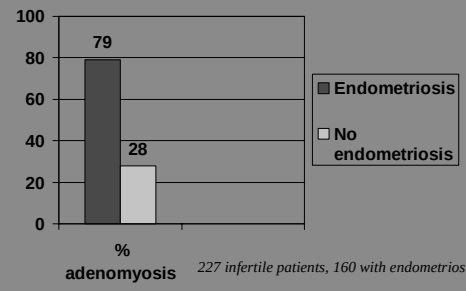
Infertility:Adenomyosis and endometriosis (MRI)



227 infertile patients, 160 with endometriosis

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Kunz, Human Reprod 2005

ADENOMYOSIS AND TREATMENT

No RCT
No EBM
No large series

??????

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ADENOMYOSIS AND TREATMENT

Surgery

Best treatment option?

Exact localization?

Laparoscopy/laparotomy?

Pre-treatment GnRha?

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ADENOMYOSIS AND TREATMENT

Surgery *clinical aspects*:

darker color, less firm consistency
no well defined cleavage plane
dichotomous disease
-disruption JZ
-secund.infiltr. myometrium
more difficult wound apposition

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ADENOMYOSIS AND TREATMENT

Reductive surgery: difference with myomectomy

no obvious plane of cleavage

adenomyosis infiltrates normal myometrium

⇩

excision of diseased area substracts
myometrial mass from the total uterine volume

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ADENOMYOSIS AND TREATMENT

Reduction in myometrial capacity:

↑ abortion
premature labour
uterine rupture
incidence C-section

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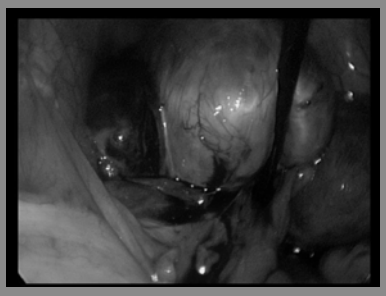
ENDOMETRIOSIS



Endometriosis as a Pleiotropic Reproductive Disorder

- Endometriotic lesions
- Peritoneal inflammatory microenvironment
- Subtle ovarian dysfunctions
- Aberrant endometrial SSH response
- Myometrial JZ hyperplasia and dysfunction

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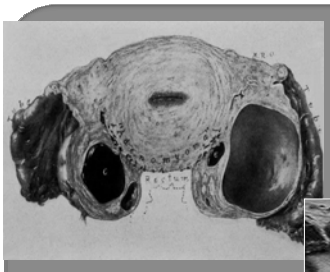
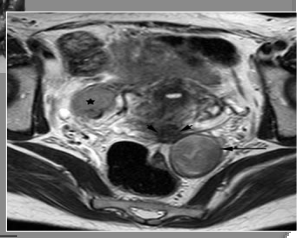


J.A. Sampson 1927

MRI 2004



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ENDOMETRIOSIS-Associated INFERTILITY

Randomized, controlled multicenter trial of laparoscopic surgery in minimal/mild disease
(Marcoux et al, NEJM 1997)

	No	MF	CPP (36w)
•Untreated	169	2.4%	18
•Treated	172	4.6%	31

•Conclusion: " …factors other than the
• endometriosis interfere with infertility."

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ENDOMETRIOSIS-Associated INFERTILITY

Comparison of Pregnancy Rates
(Adamson, Sem Reprod Endocrin 1997)

	Stage of disease	
	Mini/Mild	Severe
• Expectant	37,4%	3,1%
• Surgical	51,7%	41,3%

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ENDOMETRIOSIS- Associated CPP

Prospective, randomized, double-blind trial of laser laparoscopy *(Sutton, Fertil Steril 1994)*

Relief	rAFS 1	rAFS 2-3
• Placebo	25%	20%
• Laser	46%	74%

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Endometriosis
Conservative surgery

- Elimination of implants and adhesions
- Effective in infertility and CPP, but more in severe than mild disease

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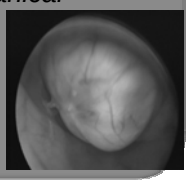
Tubal surgery

- Distal occlusion
- Proximal occlusion

  infectious / mechanical
- Ectopic



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HYDROSALPINX AND IVF OUTCOME

Prospective studies

	Hydros. Pos.	Hydros. Neg
Strandell et al. 1999	**23.9%**	**36.6%**
Dechaud et al. 1998	**18.7%**	**34.2%**

HYDROSALPINX AND IVF OUTCOME

	Hydrosalpinx positive %	negative %
pregnancy rate	19.67	31.2
implantation rate	8.53	13.68
delivery rate	13.40	23.44
early pregn. loss	43.65	31.11

E. Camus Hum Reprod 14, 5; 1999

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HYDROSALPINX AND IVF OUTCOME

Mechanism of impairment

Receptivity: - lower concentration integrin αvβ3
- out of phase histological maturation
Meyer et al. 1997

Mechanical: - fluid interface
- washing out ***Sharara et al. 1999***

Treatment options:

Correction of endometrial αvβ3		Pr/ET (%)	IR (%)
Salpingectomy	92.3% (n=13)	39	18.8
Neosalpingostomy	33.3% (n=3)	36.2	16.7
Proximal occlusion	66.7% (n=3)	60	27.3
Transvaginal aspiration	0% (n=1)		

Meyer et al. 1997 Hum Reprod 12:1393-98

HYDROSALPINX AND IVF OUTCOME

Treatment options

~~Should a hydrosalpinx been removed before IVF??~~

Which surgical correction should be performed before IVF??

Salpingostomy

Microsurgery

	Year	Nb	IUP %	E.P %
Leuven	1980	333	21	6
Winston	1980	241	24.5	9.5
Verhoeven	1983	143	23.7	2
Boer Meisel	1986	108	28.7	17.5
Gomel	1978	89	31	9
Dubuisson	1985	76	36	22

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Salpingostomy

Laparoscopy

	Year	Nb	IUP %	E.P %
Dubuisson	1990	65	27.7	4
Donnez	1994	85	27	
Filippini	1996	104	32.5	4.8
Canis	1991	87	33.3	6.9
Audebert	1992	142	20.4	

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Salpingostomy

Laparoscopy >< microsurgery

Pregnancy rates

grade	I	II	III	IV
laparoscopy	50	32.4	8.3	0
microsurgery	66.6	36.6	14.3	7.7

Canis et al. 1991

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Tubal surgery

- Distal occlusion
- Proximal occlusion

  infectious / mechanical
- Ectopic

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Tubal microsurgical anastomosis

Reversals

	Year	Nb	IUP %	E.P %
Winston	1980	126	60.4	2.4
Gomel	1980	118	82.5	1.7
Rock	1982	125	65.0	4.0
Schlösser	1983	119	60.5	2.5
Dubuisson	1995	206	69.9	-
Boeckx	1986	63	69.8	5
Gordts	2008	261	72.5	-

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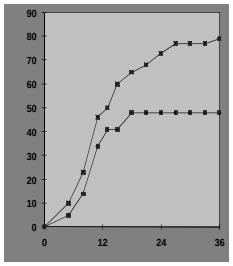
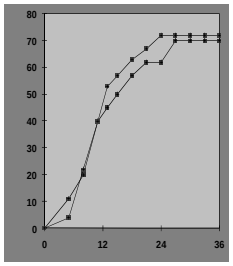
PROXIMAL TUBAL OCCLUSION



Cumulative intrauterine pregnancy rates according to age



Cumulative intrauterine pregnancy rates according to histology: fibrosis versus Salpingitis Isthmica Nodosa

Dubuisson, 1997 Hum. Reprod.

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CONCLUSION

YES WE NEED REPRODUCTIVE SURGEONS

integrated in each unit of reproductive medicine

urgent need specific training