



Microsurgery training for 3R

3R in microsurgery training

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Scandinavian Microsurgery Academy

Started in 2013 as a collaboration between







http://microsurgery.se/



The team behind (in alphabetic order)

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- Johan Berg, MD. Hand surgery unit, Sahlgrenska University Hospital, Gothenburg
- Lars Ewaldsson, DVM, PhD. Laboratory for Experimental Biomedicine, University of Gothenburg
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- Andri Thorarinsson, MD. Head of Center for Microsurgery, Department of Hand and Plastic Surgery, Sahlgrenska University Hospital, Gothenburg.











Guest lecturers and inspirators

Norbert Nemeth, M.D., Ph.D, Department of Operative Techniques and Surgical Research, University of Debrecen, Hungary

Roberto Puxeddu, Associate professor, Department of Otorhinolaryngology, University of Cagliari, Italy

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GOTHENBURG

Mihai Ionac, Division of Vascular Surgery and Reconstructive Microsurgery, Clinic of Vascular Surgery, Victor Babes University, Timisoara, Romania.

Andres Rodrigues-Lorenzo, Consultant In Plastic Surgery, Director of Microsurgery at Akademiska Hospital, Uppsala, Sweden

Ron de Bruin, Associate Professor, Erasmus Medical Center, Erasmus University Rotterdam, The Netherlands

Mikael Wiberg, Consultant in hand surgery and plastic surgery, Norrlands University Hospital, Umeå, Sweden

Aleksandra McGrath, MD, PhD. Dept of Hand Surgery University of Umeå **Martin Halle**, MD, PhD. Dept of Plastic Surgery, Karolinska Institute, Sweden **Birgit Ewaldsson**, DVM, PhD., AstraZeneca, Sweden

















Microsurgery training for 3R

The use of surgical procedures in rodents is increasing in biomedical research, legislation both within in EU and other countries stipulates that personnel should have adequate training to perform these procedures.

Surgical training will lead to refinement for the animals in experiments (**REFINMENT**) and high quality, standardized training will contribute to improved data that can reduce the number of animals used in experiments (**REDUCTION**)



3R in microsurgery training"

In the case of experimental microsurgery training a full replacement of animals is implausible but a carefully designed course curriculum can lead to a reduction of the animals used in training.

Innante models used:

- Ropes
- Bananas
- Woven compresses
- 3D printed version of Sun-Lee rings
- Chicken thigh

Ergonomy improvments (impacts the outcome):

- Bean bags
- Handles for short (11cm and cheaper) microforceps

Evaluations tools:

- 3D printed version of Sun-Lee rings
- Micro-TRACK



Two courses

Experimental microsurgery

Microsurgical techniques

10 courses completed

10 courses completed





Experimental microsurgery – preclinical personnel

Basic surgical training in non-living models, day 1 and 2 Basic knotting, rope training, surgical knot with variations	Day 1
Instruments suturing using banana peels Woven compress, hand – eye coordination under the microscope Sun-Lee discs- latex membrane, suturing under microscope Chicken thigh, tissue dissection and vessel anastomosis	Day 2
Animal work, day 3-5	Day 3
Cannulation of neck vessels in rats, Jugular and carotid artery Groin Dissection & Cannulation, Femoral artery, vein and nerve Femoral anastomosis Abdominal opening/closing, dissection of abdominal aorta	Day 4
	Day 5



Microsurgical techniques – clinically active surgeons

Microsurgical training on non-living model, day 1 Day 1 Sun-Lee rings - latex membrane, suturing under microscope Chicken thigh, tissue dissection and vessel anastomosis Day 2 Microsurgical training, day 2-5 End-to-end anastomosis of femoral artery End-to-end anastomosis of carotid artery Day 3 End-to-end anastomosis of femoral vein End-to-side anastomosis of femoral artery-vein Nerve suturing, sciatic nerve Day 4 Vein grafts on either artery or vein Day 5



The reef knot and surgical knot basics Bean bags and two-colored rope





First instrument suturing Banana peel is useful





Sun-Lee disk in a modern 3D printed design Suturing in latex membrane







SUN LEE, MD, and WARD J. COPPERSMITH, BS MICROSURGERY 4~67-69 1983



The ergonomy affects the outcome Cheap forceps improved







S&T balanced, FRS-15 RM-8 costs around 400 EU Dumond, model 5H costs around 40 EU 3D printed reusable handle, Spaceclaim 3D Modeling Software



Evaluation of skills aquisition

Sun-Lee disk, based on Queen Mary University London Microsurgery Global Rating Scale (QMUL Micro GRS)





Evaluation of skills aquisition Micro-TRACK

Three 9-axis sensors per hand plus video capture





Sensor Bosch - BNO055

triaxial 16bit gyroscope triaxial 14bit accelerometer Triaxial geomagnetic sensor

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Mads, Movement Estimation Left (fine) - LeftArm:

Mads, Movement Estimation Right (fine) - RightArm:

Mats, Movement Estimation Left (fine) - LeftArm:

Mats, Movement Estimation Right (fine) - RightArm:





Summary

Practical training is not only mandatory for everybody working with research animals after 2013 with EU (Directive 2010/63/EU) and in many other countries **BUT** it also lead to **REFINMENT** and **REDUCTION**

A well structured course curriculum using innate training tools before the introduction of live animals will lead to **REDUCTION**

It is important to apply skills evaluation protocol and grade the participants based on their skill level at the end of the course according to Article 23 of the Directive 2010/63/EU.