



Microsurgery training for 3R

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3R in microsurgery training

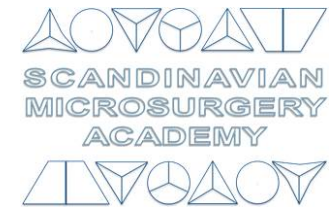
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Scandinavian Microsurgery Academy

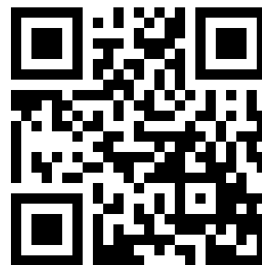
Started in 2013 as a collaboration between



UNIVERSITY OF GOTHENBURG



REGION
VÄSTRA GÖTALAND
SAHLGRENKA UNIVERSITY HOSPITAL



<http://microsurgery.se/>

The team behind (in alphabetic order)

- **Michael Axelsson**, Professor, Dept. of Biological and Environmental Sciences, University of Gothenburg.
- **Peter Axelsson**, MD. Senior consultant at the department of Hand- and Plastic surgery. Sahlgrenska University hospital, Gothenburg
- **Johan Berg**, MD. Hand surgery unit, Sahlgrenska University Hospital, Gothenburg
- **Lars Ewaldsson**, DVM, PhD. Laboratory for Experimental Biomedicine, University of Gothenburg
- **Mats Hellström**, MSc, PhD. Laboratory for Transplantation and Regenerative Medicine, Sahlgrenska Academy, University of Gothenburg.
- **Mihai Oltean**, MD, PhD. The Transplant Institute. Sahlgrenska University Hospital, Gothenburg.
- **Anders G. Nilsson**, MD, PhD, Hand surgeon, Hand surgery unit, Sahlgrenska University Hospital, Gothenburg
- **Mattias Liden**, MD, PhD. Head of Plastic Surgery Clinic, Department of Hand and Plastic Surgery. Sahlgrenska University Hospital, Gothenburg.
- **Paolo Sassu**, MD, PhD. Coordinator of the Hand Transplant Program, Sahlgrenska University Hospital, Gothenburg.
- **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

Markus Spingler, President & CEO ,S&T AG, Zollstrasse 91, CH-8212 Neuhausen, Switzerland

Myers, Simon, Professor, Centre for Cutaneous Research, Blizard Institute, Barts and The London School of Medicine and Dentistry, Blizard Building, United Kingdom

Ghanem, Ali, MD PhD, Centre for Cutaneous Research, Blizard Institute – Barts and The London School of Medicine, United Kingdom

Antonio di Cataldo, Professor, General Surgery, Faculty of Medicine and Surgery, University of Catania, Catania, Italy

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

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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 (**REFINEMENT**) 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

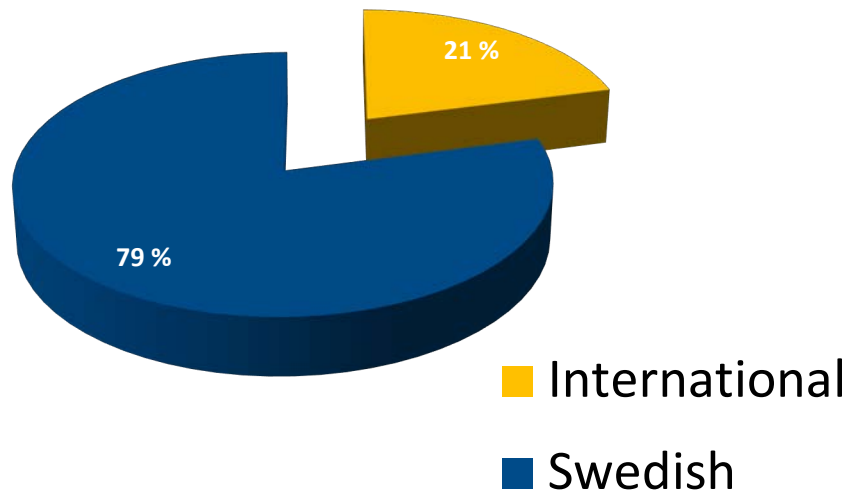
Evaluations tools:

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

Two courses

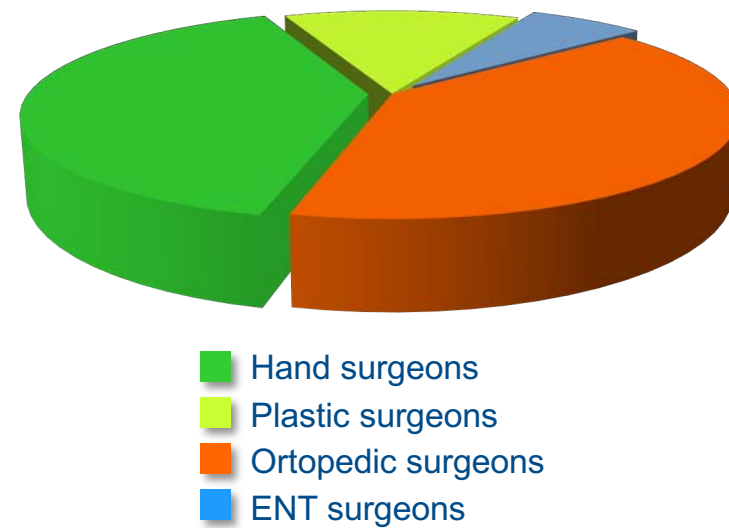
Experimental microsurgery

10 courses completed



Microsurgical techniques

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

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

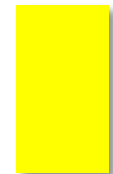
Animal work, day 3-5

Cannulation of neck vessels in rats, Jugular and carotid artery

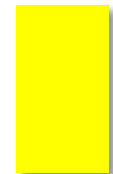
Groin Dissection & Cannulation, Femoral artery, vein and nerve

Femoral anastomosis

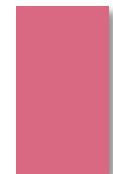
Abdominal opening/closing, dissection of abdominal aorta



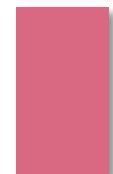
Day 1



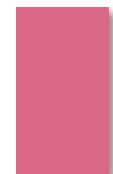
Day 2



Day 3



Day 4



Day 5

Microsurgical techniques

– clinically active surgeons

Microsurgical training on non-living model, day 1

Sun-Lee rings - latex membrane, suturing under microscope
Chicken thigh, tissue dissection and vessel anastomosis

Microsurgical training, day 2-5

End-to-end anastomosis of femoral artery
End-to-end anastomosis of carotid artery
End-to-end anastomosis of femoral vein
End-to-side anastomosis of femoral artery-vein
Nerve suturing, sciatic nerve
Vein grafts on either artery or vein



The reef knot and surgical knot basics

Bean bags and two-colored rope





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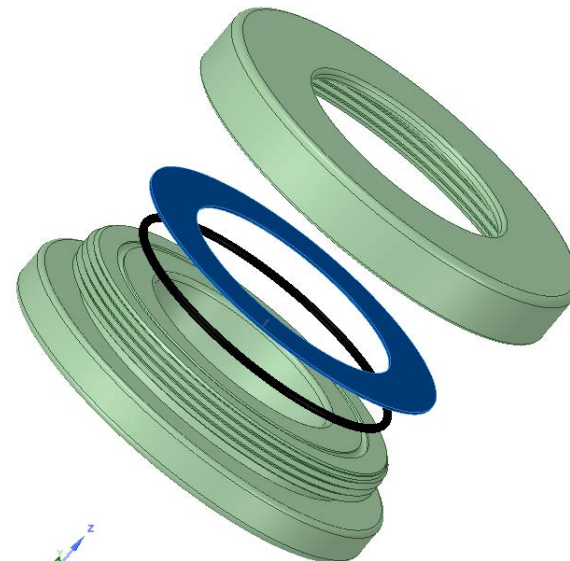
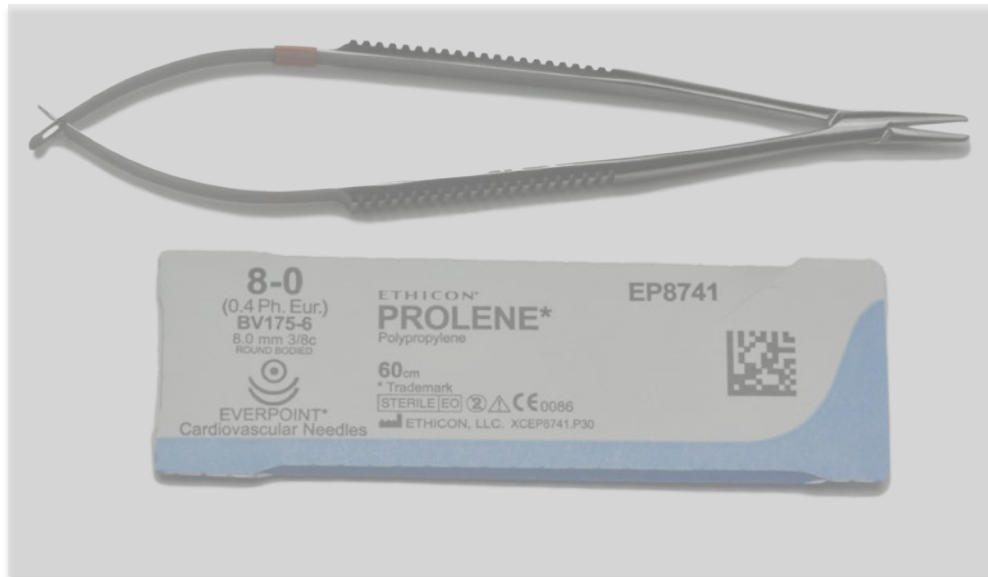
First instrument suturing

Banana peel is useful



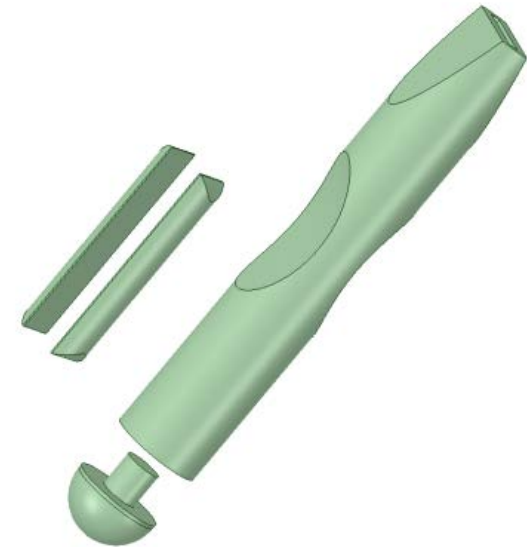
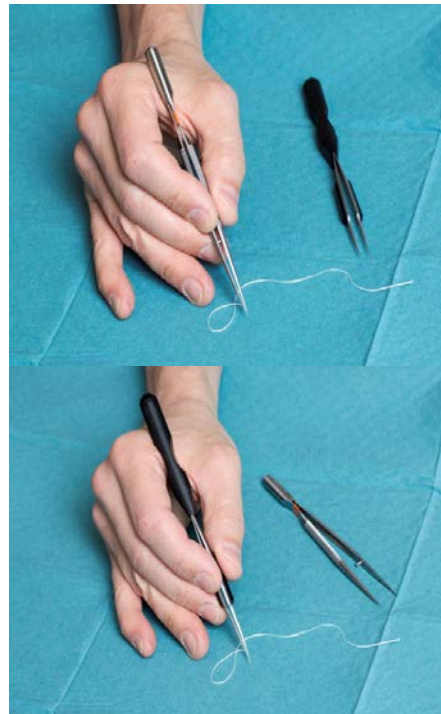
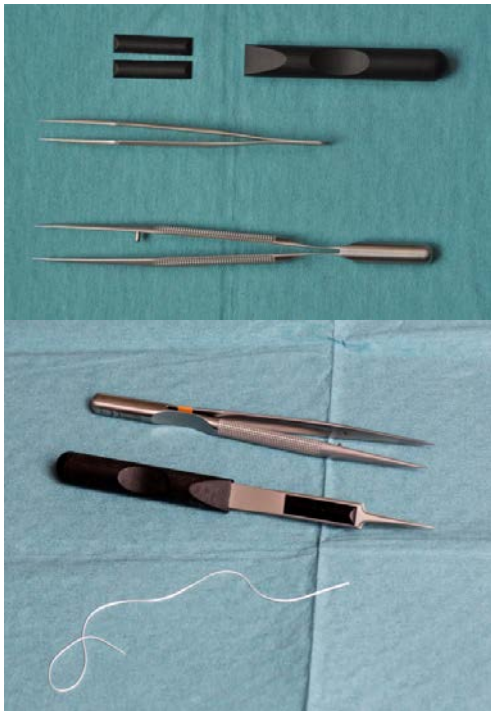
Sun-Lee disk in a modern 3D printed design

Suturing in latex membrane



The ergonomics affects the outcome

Cheap forceps improved



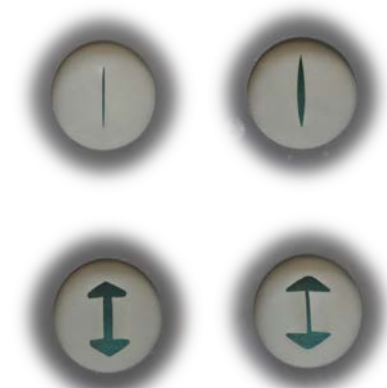
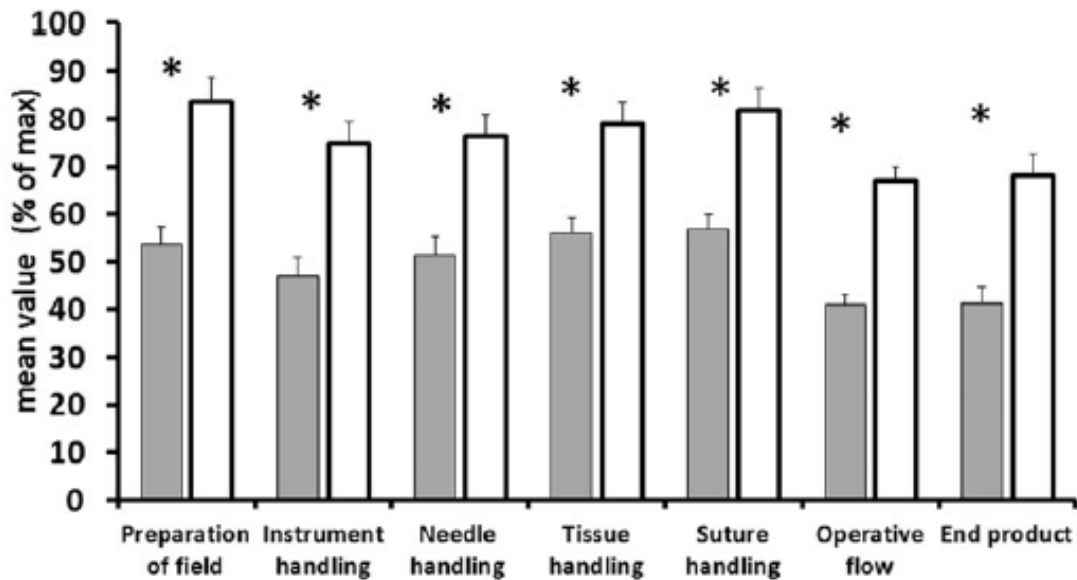
S&T balanced, FRS-15 RM-8 costs around 400 EU

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

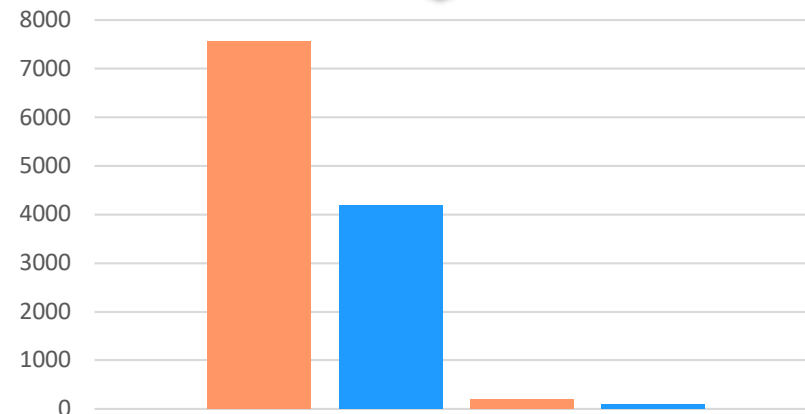
Three 9-axis sensors per hand plus video capture



Sensor Bosch - BNO055

- triaxial 16bit gyroscope
- triaxial 14bit accelerometer
- Triaxial geomagnetic sensor

T	Z	R	D	9	O	N	M	J	X	L	I	H	D	T	Y	B	O	C	B	A	L
...



- 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.