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## **Annual report 2010**

Operating Room of the Future (FOR), Department of Surgery, St. Olavs Hospital and the Medical Faculty, Department of Circulation and Medical Imaging, NTNU.

**”The patients of today – the technology of tomorrow”**

**”A multidisciplinary arena for clinical research and development of medical technology”**

## **Summary**

The Operating Room of the Future (FOR) is a collaboration between St. Olavs Hospital HF, University Hospital of Trondheim and the Norwegian University of Science and Technology (NTNU), Trondheim, Norway. The management of the facility is a responsibility shared between Department of Surgery and the Department of Circulation and Medical Imaging, the Medical Faculty, NTNU. The Operating Room of the Future is an arena for research and development with the operating rooms as workshops designed to develop, test and apply new technology and new treatment modalities. The tasks of the University Hospital is defined in the specialist Health Care Act and include treatment of patients, teaching of patients and their relatives as well as research and teaching of health care personnel. The aim of FOR is to fulfill all these goals. According to National Plan for the Norwegian Health Authorities, Trondheim has a particular responsibility for research within the field of medical technology.

The core activity of FOR is research to provide safer and better treatment, a more efficient logistics and flexible architecture in the construction of new operating rooms. FOR has also become a centre of competence for construction of operating rooms outside St. Olavs Hospital. An agreement with our industrial partners has made it possible for the Health Care Trust of central Norway, St. Olavs Hospital and NTNU, to promote research and development in central Norway. FOR has a close collaboration with National Centre for Advanced Laparoscopic Surgery (NSALK), SINTEF and National Centre of Competence – 3D Ultrasound. In 2010 FOR was placed on the national roadmap for research infrastructures in connection with the norMIT cooperation with the Interventional Centre at the National Hospital, Oslo.

FOR is a multidisciplinary project and an arena for clinical research and development with focus on medical technology. Prototypes can be developed and tested in safe and controlled environments. FOR is set up to promote a close collaboration between clinicians, technologists, researchers and industrial partners. State-of-the-art equipment is available at FOR. The operating rooms are equipped for image-guided minimally invasive therapy.

During the first years the main focus was keyhole surgery of the abdomen (laparoscopic surgery) and endovascular therapy for diseases of the blood vessels. The principle of minimally invasive therapy is now used in all surgical disciplines. Minimally invasive therapy is less traumatic than traditional open surgery and will become more and more important in the future.

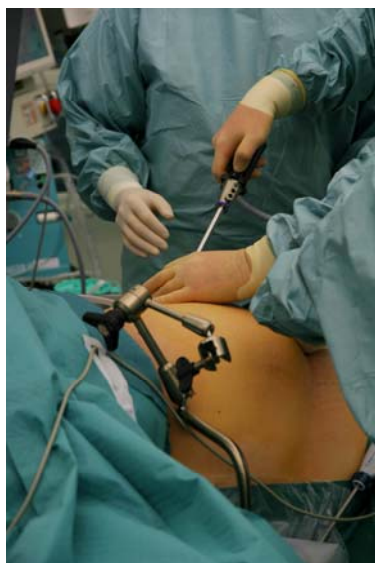
The "old" FOR was in May 2010 dismantled and moved to Røros Hospital to be used as a unit for day care surgery. 2010 has been a year with several changes and reorganisation of FOR. This has taken both time and resources.

FOR has its basis in 6 operating rooms at the new St. Olavs Hospital; one at each of the operating departments. The FOR concept demonstrates synergy effects in letting various disciplines and medical specialists use equipment, areas and competence together.

FOR has excellent facilities for research and projects based on a multidisciplinary approach. Investigations are performed by PhD-candidates, scientists, students and clinicians. FOR with its technical equipment and design is perfect for teaching and education of students, doctors and nurses.

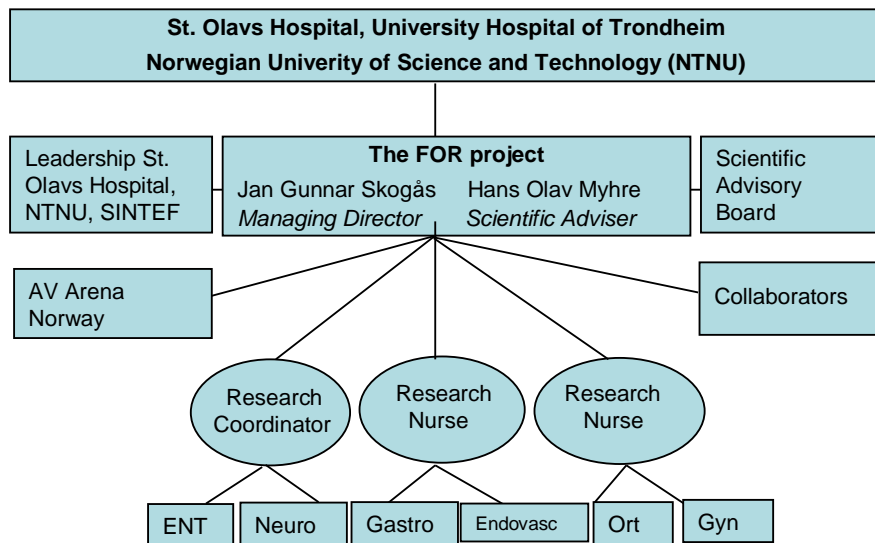
New methods for teaching have been tested and transmission of images from the operating rooms to the lecture room with two-way communication has been used on several occasions. This adds value to the teaching process and it is the intention to develop this part of the project further. At FOR and NSALK several postgraduate courses for medical students are arranged annually. Our facility with the integrated surgical lecture room is an excellent supplement to the teaching program used at such courses.

FOR is taking part in the development of visualisation and communication, which may be beneficial for diagnosis and treatment as well as for organisation of hospital units. Lecturing on the application of electromedical equipment has been an increasingly more important task for FOR.



Minimally invasive image guided treatment

# Organisation



## The staff at FOR



Hans Olav Myhre  
Emeritus Professor of Surgery  
Scientific adviser



Jan Gunnar Skogås  
Biomedical Engineer  
Managing director



Ketil Thorvik  
Bachelor of Arts  
Project Leader AV-Arena



Anne Karin Wik  
Operating Room Nurse  
Research Collaborator  
Gastro and Vascular



Therese Marken  
Operating Room Nurse  
Research Collaborator  
Othopaedic and Gynecology



Marianne Haugvold  
Bachelor of Science  
Research Coordinator  
ENT, Neuro

## **AV Arena Norway**

AV Arena is a resource network within medicine and media technology. It is financed through a network with the focus on projects designed to obtain medical and organisational benefits in the health care sector.

### **Background**

The resource network was established during the autumn 2010 to form a bridge between an IT-based competence within media technology and the health care system. Operating Room of the Future, St. Olavs Hospital, took the initiative to form this "bridge" because we feel that digital media will be of great importance for the many challenges faced in the attempts to improve quality in health care. Teaching of employees is important for patient safety and quality. Teaching as well as cooperation with the patient also has high priority. This process includes the improved flow of information and improved logistics. These focus areas have high priority at St. Olavs Hospital's program for better service during the years 2011-2016. By establishing this resource network we have attracted new collaborators with a strong interest in media technology and ideas, experience and tools from oil and gas industry. FOR has also established collaboration with Yonsei Hospital, South-Korea, and together we have developed pilot projects.

### **Main goals**

The main goal is to establish a leading international arena for innovation within medicine and media technology, for medical and organisational benefit of the health care sector. This main goal will be realised through pilot projects in national and international settings.

### **Methods**

The resource network is using pilot projects for testing new applications of digital media technology. The network will bring ideas to concrete projects. FOR is acting as a hub in this network and is monitoring all projects from our members. FOR will organize good processes for developing and building networks to improve our members' ability to properly design applications.

### **Result**

The result of our network will be finished projects. The success of this project will be of major importance for further activity within the network in a national and international perspective.

### **Members**

The partners in the network by the 1st of March 2011 are Nord-Trøndelag Elektrisitetsverk, Hospitality, Incita, Røros E-verk, Operating Room of the Future (FOR), St. Olavs Hospital, iBruk, T-vips, Uninett and At Work Systems.

## Pilot projects within three important focus areas

In the starting phase the resource network has identified three focus-areas;

- Digital teaching network
- Digital teaching modalities
- Digital cooperation with the patient

After the starting phase 6 pilot projects have been initiated by the members of the network, two within each focus area. All the members of the network are active in working groups with at least one of the projects. All the pilot projects fit well into the vision of FOR on the necessity of establishing a medical teaching platform in close collaboration with the quality management at St. Olavs Hospital.



AV Arena Norway is also exploring the possibilities for medical innovation outside the operating rooms. Digital programs are available for patients to learn about their particular disorder, the hospital and related subjects.

## **Department of Surgery**

In 2010 the big “box” on the west side of the main building at St. Olavs Hospital was removed. For many years this has been a high-tech department as a joint venture between St. Olavs Hospital and NTNU. FOR has now expanded to 6 centres with one operating room in each centre.

FOR has become an organisation more than the physical operating rooms. Thus, since 2010 we have developed a decentralised organisational model of FOR. When planning the new hospital, different ways of developing FOR was discussed. We are happy with the resulting decentralised way of running the facility, seeing this as a significant improvement. We hope that the FOR organisation can continue to coordinate the collaborative efforts with our industrial partners. St. Olavs Hospital is today collaborating with about 20 Norwegian entities within health technology through FOR. In addition we have projects with international companies and close collaboration with international hospitals and universities like Massachusetts General Hospital, Boston, New York Medical Centre, Technical University of Munich and Yonsei University Hospital, Seoul.

With the close cooperation with NTNU and industrial partners, St. Olavs Hospital has used FOR as a showcase for technological development within surgical therapy. Our intention is to employ the FOR facilities for research and development in at least 50 % of available time.

Ola D. Sæther, MD  
Professor of Surgery  
Head of Department of Surgery  
St. Olavs Hospital



## **Clinical activity**

### ***Laparoscopic / endoscopic treatment***

In 2010 St. Olavs Hospital phase 2 was finished and the laparoscopic FOR operating room was established at the Centre for gastrointestinal diseases. Experience from research projects in phase 1 at FOR formed the basis for the new operating room, this being one of the most modern in the world. In cooperation with Olympus and health authorities of Central Norway, completely new materials and logistics have been used. Glass walls with customised ceiling-suspended light fixtures and Olympus EndoAlpha/EndoBase will optimise endoscopic surgery.

The technical infrastructure of the facility is integrated, allowing the application of laparoscopic technique as well as operation by flexible instruments from inside the lumen of the gastrointestinal tract. The two methods can also be combined whenever necessary. Laparoscopic/endoscopic operating modalities are advantageous for the patient as well as fiscally beneficial since the stay in hospital and the recovery time is reduced. However, there may be challenges for the surgeons regarding identification of tumours, blood vessels and lymph nodes. Cooperation with SINTEF and Centre of competence 3D-ultrasound has made it possible to apply navigation and 3D-ultrasound to address these problems. One of our fellows has developed an experimental tumour model making it possible by ultrasound navigation to identify an intra-hepatic tumour with great accuracy. CustusX is a navigation tool developed by SINTEF. It is today used in different surgical settings, including laparoscopic treatment of the adrenal glands and tumours of the posterior abdominal wall. This is part of a multicentre study together with Mesos Medical Centre, Utrecht, The Netherlands.

The FOR operating room has also been used for the development and testing of a new laparoscopic instrument in cooperation with the University of Tübingen. The instrument has an ergonomic design, which is of great importance in minimally invasive surgery. FOR has also been taking part in a multicentre study testing a new operative technique for the treatment of morbid obesity. Electrodes have been attached to stimulate the vagus nerve (VBLOC) and the inclusion of patients is now completed. We look forward to results of the three-year follow-up.

In cooperation with the Regional Centre for Morbid Obesity (RSSO) FOR has since 2005 been part of a study comparing surgery with lifestyle modification in the treatment of morbid obesity.

In cooperation with SINTEF, Ronald Mårvik has been medical advisor for the EU project VECTOR, where an advanced wireless endoscopic capsule makes therapy of localised disease

processes possible from inside the gastrointestinal lumen. This device can also be navigated from the surface of the body.

Several surgeons from Norway, Denmark, Japan, The Netherlands and Germany have visited FOR in 2010. An excellent synergy between the training facilities at NSALK and the interactive lecture room at FOR has been established. The candidates who are attending courses can use simulators for practicing new laparoscopic and endoscopic procedures.

In 2010, 137 operations have been performed in the FOR operating rooms and 93 of these have been for morbid obesity. We have also performed endoluminal procedures through flexible endoscopes where tumours have been removed from inside the bowel.

<b>Operative activity, laparoscopic surgery</b>		
Gastroenterology	Laparoscopic fundoplication	8
	“ cholecystectomy	3
	“ gastric bypass	86
	“ gastric sleeve	7
	“ hernia of the abdominal wall	11
	“ hepatic resection	4
	“ resection of pancreatic tail	2
	“ splenectomy	6
	Endoscopic mucosal resection	1
Endocrine surgery	Laparoscopic adrenalectomy	9
<b>Total</b>		<b>137</b>





### ***Endovascular treatment***

Several changes have been taking place at FOR in 2010 after the decommissioning of the original FOR building. The new FOR operating room in the Centre for cardiovascular diseases opened 12<sup>th</sup> of May. This new operating room is a hybrid operating room where open and interventional therapy can be carried out. The operating room is equipped with the angiography unit “Artis Zeego” from Siemens and this unit has attracted the attention of several visiting surgeons and radiologists.

Altogether 80 procedures for vascular diseases have been performed at the FOR operating room in 2010. 36 of these were performed for aneurysms (aortoiliac and thoracic), while 40 were combined procedures for other arterial diseases. Two patients with complex aortic aneurysm received special stent-grafts with fenestration permitting blood flow to kidneys and bowel while repairing a suprarenal aortic aneurysm. Cardiac surgeons and cardiologists have been implanting 10 aortic valves by minimally invasive techniques at the FOR operating room in 2010.

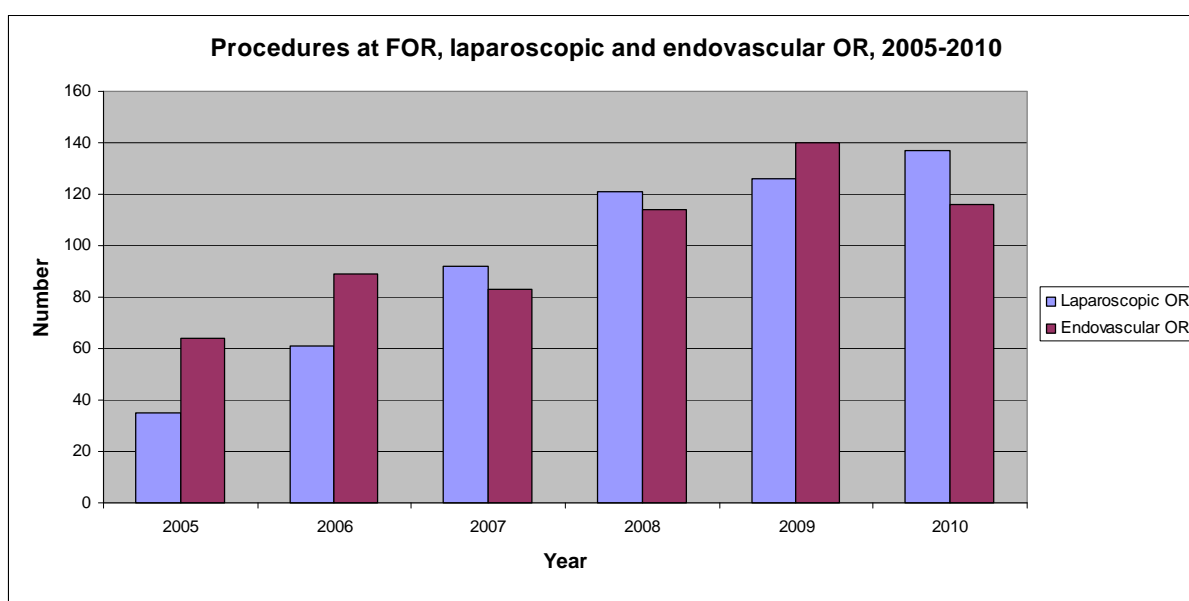
Stable patients with suspicion of ruptured abdominal aortic aneurysm are now also investigated with CT-scan to explore whether they can be treated with endovascular technique at the FOR operating room. For traumatic transection of the thoracic aorta stent-grafting is now our first choice, and the results of our first 9 procedures were presented at the annual winter meeting of the Norwegian Society for Vascular Surgery in March 2010.

Two PhD-candidates have finished inclusion of patients in scientific studies applying rotational angiography (DynaCT) in 2010. In addition 10 experimental operations applying navigation during stent-graft implantation have been performed. Furthermore, the FOR operating room has been used for 13 gastroenterologic procedures.



The FOR operating room for vascular and endovascular therapy with the ArtisZeego angiography unit.

<b>Clinical activity, endovascular operating room</b>		
Vascular surgery / intervention	Stent-grafting thoracic aorta	5
	Stent-grafting abdominal aorta	30
	Procedures of the abdominal aorta for other conditions	4
	Combined procedures for atherosclerosis. Open surgery combined with balloon angioplasty	40
Gastroenterology	Electrode for sacral nerve stimulation (SNS)	13
Cardiac surgery / cardiology	Transapical implantation of aortic valve	10
Anaesthesiology	Deployment of tracheal stent	1
	Removal of CVP catheter	1
	Stent mesenteric arteries	1
Experimental surgery		10
<b>Total</b>		<b>116</b>



## **Department of ear, nose and throat diseases, oral surgery and eye diseases**

In 2010 the cooperation between our department and FOR was intensified and we have signed an agreement with FOR regarding research and development. The scientific advisory board has accepted several research projects from our department and PhD-candidates have started their scientific work. We have one operating room dedicated to FOR activity and in addition we have two FOR nurses at the Department of ENT diseases and oral surgery. One research coordinator has the responsibility to work with our department regarding FOR related activities.

One of the strategic goals of the ENT department is to be in front professionally and scientifically. We want to strengthen the collaboration between the technological research groups at SINTEF and NTNU including Operating Rooms of the Future (FOR). Together with the Department of oral surgery we plan to establish a national centre for minimally invasive endoscopy within our fields.

As a department of ENT at one of our university hospitals, benchmarking with other university departments nationally as well as internationally is important. Proximity of the Technological campus at NTNU is a good starting point. The Clinic of ENT diseases and Oral Surgery aim to be at a high level in the development and clinical testing of new technology for diagnoses and treatment within our specialities. We feel that the collaboration with FOR is essential to fulfil our goals.

I hope that all specialities at our department will benefit from closer cooperation with FOR.

Mette Bratt  
Head of Department  
Clinic of ENT diseases, oral and eye diseases

## Department of neurosurgery

The Department of Neurosurgery has one of the FOR operating room facilitating a high scientific activity. Professor Geirmund Unsgård is chief of the clinic of neurosurgery, St. Olavs Hospital and is leading the research activity within neurosurgery.. The most important research profile of the department is the application of ultrasound within image-guided minimally invasive neurosurgery. This technology in combination with navigation has been applied in several areas including surgery of the pituitary gland, neuroendoscopic methods as well for the operation of spinal and brain tumours. Several of our research projects are exploring the potential of navigation within this field. Our research has background in clinical needs and through a multidisciplinary approach combining technological and clinical research, less traumatic and safer treatment modalities are developed. The research at Department of Neurosurgery is carried out in closed cooperation with SINTEF and NTNU. Centre of competence 3D-ultrasound is a very important platform for our research activity.

Geirmund Unsgård  
Chief of the Neuro Clinic



## **Department of women and children's diseases**

At the Department of women and children's diseases we've initiated a close collaboration with FOR in 2010 and hope to expand this further in 2011. Since the establishment of the new clinic in 2006 we have had plans for a separate FOR operating room at our department, but so far this has not been sufficiently equipped. However, in March 2011 we will have infrastructure at our FOR operating room including EndoAlpha and high-definition camera allowing live transmission of operating procedures.

In 2010 robotic surgery was started at our department and the first operation was performed in November. We will apply robotic technology both for general gynaecological surgery as well as in cancer operations. Thus, we will get a sufficient experience with this particular operating modality. Robotic surgery is today performed in closed collaboration with the Department of urology. We think that this activity fits in well with the FOR concept: it is high-tech, innovative and has a great potential for the future. It is our goal to have our own daVinci robot at our FOR operating room, but so far we've enjoyed the good cooperation between surgeons, anaesthesiologists and operating room personnel at the Department of Surgery. Robotic surgery will in the near future be one of our important research fields.

FOR has been extremely useful in the training and certification of our personnel in the application of electromedical equipment. We think this is an important service to the operating clinics. In this way the criteria for such competence is similar all over the hospital. We are extremely pleased with the close collaboration with FOR and look forward to contribute with an increasing number of scientific projects.

Runa Heimstad  
Head of the department  
Clinic for women and children's diseases

## **Clinic for orthopaedic and rheumatologic diseases**

The cooperation between Department of Orthopaedic surgery and Rheumatologic diseases and FOR started in 2010. FOR has a long tradition in clinical and technological research, innovation and development. We feel that the cooperation with FOR might be of special advantage for our National Centre for Orthopaedic Implants (NKSOI). The main goal of this unit is to provide good facilities for research within the field of orthopaedic implants.

So far the main activity at the FOR operating room has been innovation regarding "fast track" surgery for joint replacement. We have established a quality register measuring patient related outcome measures and data which are relevant for the logistics in the operating room.

The FOR operating room has an excellent infrastructure including HD-camera allowing live transmission from the operating room. This has been used extensively during courses and in the continuing education of our personnel.

FOR is also giving advice regarding cooperation with industrial partners. Furthermore, FOR is taking care of the compulsory training program in the use of electro-medical equipment and in hospital hygienics. For our clinic it is of utmost importance that FOR is supervising and recording this activity.

Vigleik Jessen

Head of the clinic

Clinic for Orthopaedic and Rheumatologic diseases



Concept for orthopaedic operating room

## **Developing and testing of medical technology**

In addition to clinical activity the operating rooms at FOR have been used for experimental investigations as well as laboratory studies. Altogether 10 animal experiments have been carried out. We have applied navigation for the deployment of stent-grafts with side-branches in an experimental model. This work was finished in 2010. Furthermore, we have used navigation in laparoscopic surgery as part of a PhD-project. A completely new treatment modality for abdominal aortic aneurysm has been tested out in an experimental setting. So far this method has not been applied in patients.

SINTEF and various PhD-candidates have used the FOR operating rooms 35 days for calibration, testing and mounting of navigational equipment. 14 weeks have been spent on FOR for testing technological systems, quality control, safety control and upgrading as well as validation of medical technology. So far our experience with the angiography unit ArtisZeego (Siemens) is indicating an excellent image quality and a larger field of view than the older DynaCT unit.

## **Resource centre for new hospitals**

FOR is a resource centre for integrating operating rooms, in-hospital structure and for implementing new technology and equipment. FOR has been used by several departments at St. Olavs Hospital. The hospital development project for central Norway has used knowledge from FOR both in phase 1 and 2, especially during planning and construction of new operating departments at our new integrated university hospital. In 2010 special focus has been on infrastructure in phase 2, AV-ICT structure and technology at the operating rooms.

## **Use of the “old” Operating Rooms of the Future**

The old facilities at FOR had to be deconstructed in connection with the establishment of our new university hospital. For future use, it was decided to move the construction to Røros Hospital. This was achieved in autumn 2010. This made it possible to upgrade the facilities at Røros, both with regard to areas and equipment. In the first floor we will establish an out-patient clinic while the second floor is going to be a modern operating department which will replace the old one. We will then have two operating rooms with modern technology and an excellent operating room logistic giving a more effective operative activity. The building will be placed just above the department of physio-therapy. The city of Røros is funding the relocating expenses of about 11 million NOK, while St. Olavs Hospital is covering the running costs through a 10-year leasing agreement with Røros County.

### ***Day care surgery***

In September 2010 orthopaedic implant surgery was moved to St. Olavs Hospital and Røros hospital will perform day care surgery exclusively. Today we are covering orthopaedic surgery, gynaecology and ear/nose/throat surgery. Increased activity at Røros Hospital is important for patients who do not get surgical treatment within the time-limit decided by the health authorities at hospitals in central Norway. According to hospital CEO Nils Kvernmo the activity at Røros Hospital is important to fulfil this agreement on surgical treatment in central Norway. In addition there was a need for upgrading of surgical facilities at Røros Hospital.

Deconstruction of "old" FOR



# Teaching

## *Staff*

- Medical personnel affiliated to FOR is going through annual certification in compliance with national regulations on the use of maintenance of electro-medical equipment.
- All surgeons at St. Olavs Hospital are going through courses on an annual basis regarding electro-medical equipment.
- The personnel at FOR is contributing to training of personnel from other departments at St. Olavs Hospital as well as personnel from other institutions focusing on clinical procedures, research and application of medical technology.
- FOR has visitors from other hospitals and organisation and design of operating rooms has been one of the important focus areas.
- During a course in simulator training arranged by the National Centre for Advanced Laparoscopic Surgery, FOR has been used as an arena for transmission of operative procedures and for dissemination of information about integration of new equipment applied during these procedures.
- The personnel at FOR has during 2010 attended courses within leadership and research organisation.



Teaching of operating room personnel

## *Students*

- On a regular basis operative procedures have been transmitted from the operating rooms to the lecture room in connection with teaching of medical students, nurses and radiography students as well as other professional groups at St. Olavs Hospital, Sør-Trøndelag University College and NTNU.

- Operating room nurses and anaesthesia nurses have been taking part in this educational and tutorial activity.
- Master students as well as PhD-students at St. Olavs Hospital / NTNU / SINTEF have a good opportunity to experience new medical technology and operations from the interactive surgical lecture room at FOR.

### ***Conferences using live transmission 2010***

On a regular basis we have used live transmissions, especially from vascular and gastroenterologic procedures:

- The SMIT conference, September 3<sup>rd</sup> 2010, Trondheim
- Expo-Shanghai 2010, Nordic Lighthouse, September 15<sup>th</sup>
- Visit by deans and the advisory board for medical technology, October 12<sup>th</sup>
- Visit at NSALK and transmission of operations from FOR
- Visitors from Centre of Competence 3D-ultrasound at the new integrated university hospital (Centre for GI diseases)
- Course regarding treatment of hernias, November 5<sup>th</sup>
- Course in urology for specialist candidates, November 10-12<sup>th</sup>



Medical students are following a laparoscopic procedure transmitted to the lecture room at FOR

### ***Courses***

- Sør-Trøndelag University College. Course for specialists nurses regarding endoscopy and HF surgery, January 19<sup>th</sup>
- Workshop COSTT-project, February 10<sup>th</sup>
- IT-camp, NTNU, February 15<sup>th</sup>

- NSALK, basic course in laparoscopy for specialist candidates. Endoscopic technology and HF-surgery, April 15<sup>th</sup>
- NSALK, Thoracoscopy, endoscopic and HF-surgery, May 15<sup>th</sup>
- Sony course for “super users”: Operating room nurses, June 16<sup>th</sup>
- Sony “super users” for doctors and operating room nurses, November 17<sup>th</sup>
- NSALK, Basic course in laparoscopy for specialist candidates. Endoscopic technology and HF-surgery, November 18<sup>th</sup>

## ***Electro-medical equipment (EMU)***

### **Courses in the use of electro-medical equipment**

On behalf of the operating clinics FOR is conducting compulsory courses in the use of electro-medical equipment. In 1999 a new regulation regarding “use and maintenance of electro-medical equipment” was passed. This regulation has its background in law on medical equipment from 1995. Personnel who are going to use electro-medical equipment must have training and instruction in the application of such equipment. It is important that they know side-effects connected to the application of electro-medical instruments, and know how to prevent them. This training program, including documentation, is now established on all operating clinics at St. Olavs Hospital. All surgeons, including surgeons in training, as well as staff surgeons, are getting invitation to these courses as a part of the continuing medical education.

The positive response we have from the various clinics has inspired us to improve this concept. We want to design new courses using digital based learning. This tool can be used by the candidate on their own as a supplement to regular courses. We also want to develop new systems for monitoring and recording of participants in the courses as well as reporting to the head of the clinic. Thus, we are obtaining an automatisisation of several work processes saving time. Simultaneously we are getting better reports regarding participation in the various activities.

### **Plans for courses in the use of electro-medical equipment for surgeons at St. Olavs Hospital**

Course 1: High-energy equipment

- Surgical cautery
- Ultrasound cutting

Course 2: Endoscopic equipment including:

- Rigid and flexible endoscopes
- Camera systems, light sources, insufflators and racks

- Navigation tools, microscopy

Course 3: Imaging technology

- Irradiation protection
- C-arm x-ray
- Ultrasound machines

In 2010 we have arranged the following courses:

Course 1: High-energy equipment

- January 20<sup>th</sup> March 3<sup>rd</sup>
- September 22<sup>nd</sup>
- November 11<sup>th</sup>

Course 2: Endoscopy

- August 25<sup>th</sup>
- September 21<sup>st</sup>
- November 10<sup>th</sup>

Course 3: Protection against irradiation

- October 6<sup>th</sup>
- December 8<sup>th</sup>

Hospital hygienics

- September 8<sup>th</sup>



Course in hospital hygienics and patient safety

## ***Visitors***

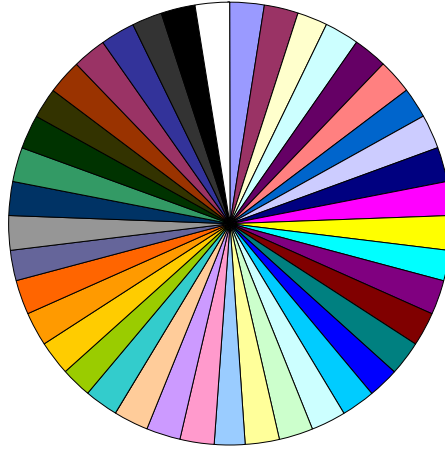
In 2010 several national and international groups have visited FOR. This year FOR was reorganised and the activity is now decentralised to 6 operating departments. During the reorganisation process it was not possible to receive visitors during the period medio April – medio June. In the new FOR organisation one research collaborator/coordinator has the responsibility for each of the participating clinics. Thus, the cooperation between various operative units and FOR has been strengthened. In 2010 altogether 40 groups visited FOR totalling 350 visitors. The visits have been arranged as guided tours, lectures, meetings and courses with live transmission of operations. The groups have consisted of health care professionals, hospital planners, administrators, members of the Norwegian Parliament, state department employees, representatives from the industry, scientists and journalists. In addition, FOR has received several groups internally from St. Olavs Hospital and from the hospital development project of Central Norway, as well as SINTEF and NTNU.



Visit at FOR operating room at the Gastro centre for participants in an international course for surgeons October 2010.

## Visitors at FOR 2006-2010

### 42 nationalities



Australia	Austria	Belgium	Bulgaria	Canada	China
Czech Republic	Denmark	Dubai	Egypt	Estonia	Finland
France	Germany	Greece	India	Irak	Iran
Iceland	Israel	Italy	Japan	Latvia	Lithuania
Malta	Mexico	Netherlands	Norway	Poland	Portugal
Russia	Serbia	Slovenia	Spain	Switzerland	Sweden
South Korea	Thailand	Turkey	United Kingdom	Ukraine	USA



## Medical technology, FOR 2010

In 2010 there has been further development of IP-based communication for tele-medicine via FOR, and new IP technology has been applied through the research net – Uninett. As an example this has been used in connection with communication to various destinations in Asia, Europe and USA in 2010. We have also further developed fibre-optic communication from several from the FOR operating rooms, making live transmission in full high-definition possible.

We are also working together with Department of Medical Technology and HEMIT regarding a new infrastructure giving the possibility for live transmission to several of the meeting rooms and lecture rooms at the new hospital. This infrastructure is also a part of the planning for the new Academic centre, which will be ready during the autumn 2013.

In collaboration with Covidien we have implemented a research-based platform for high energy medical equipment including cautery and an advanced technology for securing of blood vessels during surgery. This has been established in all 6 FOR operating rooms. The goal is to improve the safety during the application of high energy medical equipment.

Together with the partners of FOR, 2010 was used for implementing new technology in the new FOR operating rooms. The new technology consists of:

- New HD technology in all 6 FOR operating rooms for live transmission to lecture rooms, seminar rooms and to other hospitals.
- New integrated angiography laboratory at the FOR operating room in the Center for Vascular and Cardiac diseases. The robot assisted Artis Zeego unit has been established and is giving excellent image quality and faster image processing.
- New EndoAlpha system for laparoscopic procedures at the FOR operating room Gastro centre May 2010.
- In cooperation with Olympus a new operating room concept with focus on integration and improvement of work-flow was installed at the FOR operating room, GI surgery. It includes video routing, special lightening and glass walls, making sanitation simpler and easier.
- Gynaecology and laparoscopic procedures:  
A cooperation between Department of Urology, Gynaecology and Gastroenterology has been established. Both Department of Urology and Gynaecology have started using the technology; the daVinci robot, which is now used 3 and 2 days per week respectively. The interest for this technology is increasing and we are already short of capacity for application of this technology.

## Research and development

### *National and international committees*

Ronald Mårvik:

- Leader of the national task force responsible for the report “Workup and treatment of morbid obesity in secondary health care”.
- Committee member Technology Committee and NOTES – Committee in European Associations of Endoscopic Surgery.
- Member of Program Committee for EAES – Annual Congress in Torino
- Member of the board Norwegian Bariatric Association and Norwegian Thoracolumbaroscopic Union
- Member of the network Medical Technology, NTNU, Trondheim
- Editorial Board, Surgical Endoscopy

Torbjørn Dahl:

- Norwegian council member in ESVS; European Society for Vascular Surgery
- Norwegian council member in International Union of Angiology

Hans O. Myhre:

- European Society for Nanomedicine: Member of Executive Council
- Member of the Advisory Board of the CLINAM-foundation
- Member of the network (representative for FOR), Medical Technology, NTNU, Trondheim
- Chairman at the 3<sup>rd</sup> European Conference for Clinical Nanomedicine, Basel, May 10-12-, 2010
- Leader of the group evaluating research at the Medical Faculty, Örebro University, Sweden. The report is available in fulltext:  
<http://www.oru.se/Om-universitetet/Kvalitet/Forskningsutvardering-ORE2010/>
- Scientific adviser for FOR
- Supervising 4 PhD-candidates

## **PhD-theses, Master degrees, Bachelor degrees and other projects**

### ***Ongoing PhD-studies***

**Frode Manstad-Hulaas**, PhD, medicine/medical technology

“Endovascular stent-graft implantation using navigation technology”.

The project has developed a navigation system based on electro-magnetic positioning and 3D-imaging for application during endovascular treatment of complicated aortic aneurysm. This has been performed in an experimental model. The navigation system can visualise instruments in a 3D-image without the use of x-rays. The intention is to make it easier to treat patients with complicated aortic disease with image-guided minimally invasive therapy. The collection of data is finished. 3 papers have been published and the 4<sup>th</sup> is under preparation. The project will be finished in 2011.

**Kari Ravn Eide**, PhD, Health/medical technology

“Intraoperative DynaCT during implantation of stent-grafts for abdominal aortic aneurysm”.

DynaCT is a technology where a C-arm linked to an angiography laboratory rotates and give CT- like images during the intervention. The whole angiography laboratory was integrated with an operating table for treatment of vascular diseases at FOR. Two papers on the accuracy of DynaCT during AAA repair have been published and the 3<sup>rd</sup> paper regarding irradiation during the application of this equipment is under preparation. The PhD work will be submitted within 2011.

**Ole Vegard Solberg**, MSc, Medical technology

“3D ultrasound for improved diagnosis and surgical guidance – reconstruction and integration of preoperative image data”.

This work was performed in close cooperation with Centre of Competence – 3D-Ultrasound. Ole Vegard defended his thesis 8<sup>th</sup> of February 2011.

**Reidar Brekken**, PhD, Medical technology

“Strain measurements in evaluation of abdominal aortic aneurysm (AAA)”.

Strain in the aortic wall is investigated to evaluate the risk of rupture in these patients. One paper is discussing the methodology using ultrasound, while another one is evaluating strain before and after endovascular treatment of abdominal aortic aneurysm. A method for visualisation of strain in a 3D-anatomical model has been finished. Brekken’s PhD-thesis is a collaboration with FOR and Centre of Competence 3D-Ultrasound. He is planning to finish his work in 2011.

**Berit Brattheim**, MSc, Health/medical technology

“Aortic Aneurysm Network: Coordination support for trans-organizational care processes”.

The work is focusing on patients with abdominal aortic aneurysm. Part of the study is describing workflow when selecting patients for possible stent-grafting. The project is studying how new technology will change patient flow and course following treatment, which may give challenges for coordination of the hospital stay. The work is focusing on

patients with abdominal aortic aneurysm: selection of patients for EVAR treatment and postoperative follow-up after treatment. The need for ICT-based support is evaluated. The work is done on the Department of electronic patient records (NSEP) and is a part of the so-called COSTT-project. The candidate will finish her work in 2012.

**Anna Aasgaard Rethy**, PhD, Medical technology

“The role of navigation and intraoperative imaging in laparoscopic surgery”.

Two articles have been published and the PhD-work will be finished in 2012.

**Håkon Olav Leira**, PhD, Medicine

“The application of DynaCT for bronchoscopy and endobronchial procedures”.

The first part of this PhD investigation is experimental. The purpose is to apply navigation to increase the accuracy and safety with transbronchial procedures and endobronchial minimally invasive therapy. This work is organised by Department of Pulmonary medicine, St. Olavs Hospital.

**Conrad Lange**, PhD, Clinical medicine

“Endovascular treatment of aortic disease”.

This work includes investigations of endovascular treatment of so-called inflammatory aortic aneurysms and is also evaluating EVAR in elderly patients; above the age of 80. These works are based on the EUROSTAR vascular register. Clinical results and long-term results following endovascular treatment of abdominal and thoracic aneurysms is part of the study. Three papers have been published and the 4<sup>th</sup> is under preparation. The project will be finished in 2012.

**Camilla Berge**, PhD

“Time-trends and results following treatment of abdominal aortic aneurysm”.

This investigation includes papers on time-trends in the treatment of abdominal aortic aneurysm. Furthermore, she has studied the long-term results following open surgery as well as endovascular therapy. Finally, she is going to investigate AAA in female patients. There are relatively few female patients treated for AAA compared to men. Also, the mortality especially following rupture, is higher in women. Finally, AAA rupture at a lower diameter in women than in men. This project will be finished in 2012/2013.

**Geir Arne Tangen**, PhD, Medical technology

“Enhanced Minimally Invasive Therapy”.

The goal is to develop methods for application in navigation technology within endovascular procedures. Today these procedures are dependent on imaging technology like fluoroscopy for guiding and deployment of endovascular prosthesis. Provided navigation technology can be applied during these procedures one can receive more relevant information, and reduce the dose of x-ray irradiation and contrast material to the patient. This will improve the safety and reduce the complication rate. Geir Arne started his PhD during the autumn 2010.

**Tor Erik Evjemo**, PhD, Sociology

“An ethnographic research design used in studies for identifying work – related activities in areas of collaboration and communication”.

The work is focusing on modes of collaboration in technologically complex environments. A part of this study is focusing on video recording of communication / use of information in a high-tech setting. Employees have been interviewed and a paper from this work has been published. Tor Erik Evjemo will defend his thesis in 2011. It will be published as a monography and papers will be published later on.

## **Clinic for ENT diseases, Oral Surgery and Eye Diseases**

### **Nils Petter Fosslad, PhD**

”Chronic rhinosinusits. Etiology and pathogenesis with a focus on superantigen stimulation and wound healing”.

This is an investigation focusing on healing of nasal mucosa following endoscopic surgery. Immunohistochemical differences between various types of chronic rhinosinusits will be investigated. The research protocol has been approved and the project is approved by REK (Regional Ethics Committee). Planned as a PhD-project.

### **Wenche Moe Thorstensen, PhD**

“Symptoms from nose and sinuses in patients with asthma – United airways”.

The investigation is focusing on nasal symptoms in patients with asthma and on the effect on these symptoms when treating pulmonary function. Approved by REK. Planned as a PhD-project.

### **Daniel Bratbak, PhD**

“Endoscopic resection of the sphenopalatine ganglion in chronic cluster headache”.

This is a new operating method for cluster headache. It is developed from the established radioware (thermic) destruction of the spehnopalatine ganglion with infratemporal approach using fluoroscopy. By endoscopic transnasal surgery, one will try a direct approach to the ganglion in the pterygopalatine fossa to the posterior wall of the maxillary sinus for direct visual control during the procedure. Planned as a PhD-project.

“Intranasal and intraoral ultrasound-guided surgery”.

The intention is to explore the role of ultrasound endoprobes for navigation during ENT surgery. A similar approach is used at Department of Neurosurgery.

“Sialoscopy in the diagnosis of salivary gland tumours”.

Sialoscopy is a term used for inspection of the salivary ducts by a thin flexible instrument. The project will evaluate the use of this method in the diagnosis of sialolithiasis, tumours and other conditions in the salivary glands. It is also the plan to compare sialoscopy with other diagnostic modalities like MRI.

## **Neuroclinic**

### **Aud Sissel Hoel, PhD**

The research project “Picturing the Brain: Perspectives on Neuroimaging” is exploring new methods for imaging and visualisation of the brain, focusing on the role that these methods may have as images of visual tools within medicine and science. The goal is to improve the understanding how images will improve our knowledge about the brain by serving as a research tool, surgical tool or an important rhetoric instrument. The project is multidisciplinary and includes collaboration between scientists with background in media science, philosophy, media technology, medical imaging, neuroscience as well as artists. The project consists of 3 work packages focusing on how the new imaging tools will work within the areas of knowledge, surgery and rhetoric. A 4<sup>th</sup> work pack will function as a project laboratory for testing of the various ways of integrating science, technology and society through artistic intervention. The project has been financed by Norwegian Research Council and will be carried out during the period September 1<sup>st</sup> 2010 – December 31<sup>st</sup> 2013.

Project leader: Assistant professor Aud Sissel Hoel, Institute of arts- and media science, NTNU. Her team is consisting of professor Andrew Perkis (NTNU), assistant professor Liv Hausken (University of Oslo), senior researcher Annamaria Carusi (Oxford University), PhD-student Jordi Puig (NTNU) and one more PhD-student.

Cooperating partners are Centre for Quantifiable Quality of Service in communication systems (NTNU), Operating Room of The Future (St. Olavs Hospital), SINTEF, Medical Imaging Lab (NTNU) and TEKS – Trondheim Electronic Art centre.

### **Master degrees**

Jenny Kristin Aasland defended her master thesis 24th of August 2010, “Vascular Surgery in Norway – An investigation based on the Norwegian Vascular Register (NorKar)”.

Anne Karin Wik has planned the completion of a master degree in 2011, “Health related quality of life and results following sacral nerve stimulation in patients with anal incontinence”.

## ***Studies / projects / national and international collaborators***

### **Collaborators**

- Today there is a good cooperation with our most important industrial collaborators, SONY, Siemens, Olympus and Covidien.
- FOR has also a close collaboration with HIST (University College of Sør-Trøndelag), DMF (The Medical Faculty) at NTNU, NSALK (National Centre for Advanced Laparoscopic Surgery), SINTEF – Department of Medical Technology and National Centre of Competence 3D-Ultrasound.

### **Ongoing projects**

- **Cooperation Support Through Transparency (COSTT)**. This is a 4-year research project organised by Norwegian Centre for Electronic Patient Records where FOR is a cooperating partner. The project is financed by the VERDIKT-program financed by the Norwegian Research Council. The goal of the COSTT project is to develop ICT based technologies supporting cooperation and coordination by giving an automated real-time view regarding status and on-going activities for relevant resources and patient courses. The project is running from September 2008 to September 2012. It has 4 PhD-candidates and 2 post.docs. For more information about COSTT, see [www.costt.no](http://www.costt.no) In 2010 COSTT started a project to realise automatic communication of the activity at the gastro and vascular operating rooms at FOR. All the activities in the operating rooms are generating a lot of data from ICT systems and other technologies. These data will indicate when relevant events are occurring and the data will be used for further analysis. A next step can be to develop technology which is forming the basis of an infrastructure for future ICT systems for process and decision support.
- Navigation and use of DynaCT during operations for anal incontinence. The main study started in 2008. Patients are still included.
- Evaluation of electromagnetic navigation during bronchoscopy. Ongoing PhD investigation.
- Investigating the accuracy of electromagnetic navigation in the operating room setting.
- Evaluation of algorithm for image to image recording (software) is being developed and application in clinical endovascular therapy is planned during the spring 2011.
- ArtisZeego: Data are collected to the investigation “Respiratory movements”. Two manuscripts are under preparation.
- Electromagnetic positioning in the operating room. Data have been collected at the new FOR, Centre for Cardiac- and vascular surgery, to investigate the accuracy and

robustness of electromagnetic positioning with C-arm in various positions. We have applied a phantom from a cooperating partner in the United States. This phantom has a ringed field generator making it possible to do x-ray analysis in the centre.

- Clinical investigation regarding accuracy of optical- and electromagnetic navigation during stent-grafting for arterial disease.
- Animal model to investigate the accuracy and feasibility of electromagnetic navigation during implantation of stent-graft with side-branches to the renal and visceral arteries.
- The project “Endovascular stent-graft implantation during image-guided navigation technology” has been performed by a PhD-candidate Frode Manstad-Hulaas. This work will be continued by engineer Geir Arne Tangen, who is a fellow at NTNU, through the eMIT-project. The project will further develop electromagnetic navigation for endovascular procedures.

Stefanie Demirci from Chair for Computer Aided Medical Procedures & Augmented Reality, Technische Universität München, has been a visitor at FOR, Trondheim, in 2010-2011.

- “The effect of exercise before gastric bypass”. Tissue samples are retrieved pre- and intra-operatively to estimate whether the gene expression in the tissue is changed in patients as a consequence of preoperative physical training. The intra-operative sample is taken in connection with gastric bypass procedures, which are performed at FOR. This is a collaboration between NTNU and Centre for Morbid Obesity at St. Olavs Hospital, University Hospital of Trondheim.
- Prospective study comparing surgery (gastric bypass) with lifestyle modification in morbid obesity. This is a 5-year study being run by Centre for Morbid Obesity at St. Olavs Hospital. Patients included for operative treatment are operated at FOR.
- The application of navigation in laparoscopy is a cooperation with Mesos Medical Centre, Utrecht, The Netherlands. The protocol has been signed and this investigation will be carried out as a multicentre study.
- High-definition video in laparoscopy. This is a comparative study aimed at evaluating the clinical significance of high-definition versus standard definition images. The images will be acquired from the same trocar opening where both types of scopes will be pointing towards the same point. The images will then be compared by an independent observer.
- Olympus has developed a prototype for new operating light-source replacing traditional light. This is a collaboration between FOR and Olympus.
- Collaboration with the University of Tübingen concerning development of an ergonomic grip for laparoscopic instruments.

- Collaboration with the University Hospital, Barcelona, regarding the evaluation of the use of Olympus data technology in the operating room.
- EAES (European Association of Endoscopic Surgery). The Trondheim group has members in one of the NOTES committees.
- 3D-Ultrasound in laparoscopy. A solution based on micro-positioning and flexible ultrasound probe to be integrated in the navigation system CustusX is being developed. The ultrasound application has so far been tested under laboratory conditions to evaluate the degree of position. This work will be continued as laboratory experiments, primarily by comparing acquired ultrasound images with corresponding images acquired through DynaCT scans. The project will be included in two master degrees and one PhD-thesis.
- IIOS (Integrated Interventional Imaging Operating System) is an EU project, Marie Curie ITN project. Two fellows and one post.doc. position will be available for the Trondheim group. One PhD is going to work with ultrasound-guided laparoscopic surgery using FOR as arena for the investigation.
- The EU project VECTOR (Versatile Endoscopic Capsule for gastrointestinal Tumour recognition and therapy) is a large EU project with altogether 18 participants, including SINTEF and clinicians at St. Olavs Hospital through SMIT (Society for Medical Innovation and Technology). The project is focusing on the use of micro-technology for early detection and treatment of cancer in the gastrointestinal tract. The project was initiated in September 2006 and will run out 2010. FOR is the arena for testing prototypes within this project.
- NSALK is represented through Ronald Mårvik as member in the technology committee EAES, which is responsible for a European symposium each year. Through this work FOR is used as an arena to demonstrate new concepts as well as to establish procedures.
- Collaborative effort has been established in Sony Corporation; M. Kano, V. Liverød and J.G. Skogås, to investigate the application of holograms and 3D displays in operating rooms.
- “Micro-biological investigation of mobile equipment at operating departments”. This is a collaboration between St. Olavs Hospital, Department of hospital hygienics, Sør-Trøndelag University College and FOR. Measurement of the quality has been carried out in our new operating rooms at St. Olavs Hospital and compared to facilities in the old operating department. We have also compared operating rooms from phase 1 with phase 2 at the new hospital.
- A collaboration has been established with Massachusetts General Hospital (MGH) in Boston in the field of logistics. One of our PhD-candidates (Andreas Seim finished his thesis in 2009) has been visiting MGH and we are planning to continue this

collaboration with Warren Sandberg, MD, Department of Anaesthesiology, Vanderbilt University School of Medicine, Nashville, TN. He has been employed as professor II at Department of Circulation and Medical Imaging, NTNU.

- Suhail A, Mårvik R, Kuhry E.  
Safe Access and closure in trans-gastric natural orifice endoscopic surgery (NOTES). Project period 2009-2014.
- Kuhry E.  
Adhesion formation after laparoscopic and open surgery. A research protocol has been approved by the scientific advisory board FOR and has been sent to REK. Project period 2009-2014.
- Mårvik R, Våpenstad C.  
Evaluation of the modules “Lifting and grasping” and “fine dissection” on VR simulator. Project period 2008-2009.
- Mårvik R, Våpenstad C.  
Predictive validity of the LapSim VR simulator. Project period 2008-2010.
- Mårvik R, Våpenstad C.  
Analogue simulator with electromagnetic tracking. Development of electromagnetic tracking equipment. Project period 2008-2011.
- Mårvik R, Nielsen M.  
Video conference network within laparoscopic surgery (Yonsei Univeristy Hospital, Korea). Project period 2008-2010.
- The research project based on the NTNU game “World of NTNU, WoN”, by Q2S is working on a conceptual platform to integrating three research fields, medias in network, QoS mechanisms for dynamic net and quality measurements”.  
The platform has a main goal to define integrating research activity in all three research fields by developing a main architecture based on serious games. The development phase for WoN is based on the architecture and is following a cyclic process where each stadium in the development is dependent on and is influencing the previous one. The process has been chosen to explore new projects in various fields from architecture to medicine. In 2010 we have worked with making a model of the FOR operating room at the Gastro centre. The intention is to develop further a scenario for advanced surgery. The model is finished and will be implanted in the near future.
- Department of Thoracic Surgery and Cardiology as well as Departments of Anaesthesia and Medical Imaging have together started a new treatment for patients with aortic stenosis. This treatment, TAVI (Transcatheter Aortic Valve Implantation), is an alternative to open surgical valve replacement in aortic stenosis of high-risk patients. The operative trauma is less than conventional surgery. The valve is

implanted either via the femoral artery in the groin or through a mini-thoracotomy and further through the apex of the heart.



Aortic valves used for TAVI in patients with aortic stenosis.

## **Publications**

### ***Vascular / endovascular therapy***

#### **Articles in international journals with peer review**

Seternes A, Myhre HO, Dahl T. Early results after treatment of open abdominal after aortic surgery with mesh traction and vacuum-assisted wound closure. *Eur J Vasc Endovasc Surg.* 2010; 40: 60-64.

ACST collaborative group, Europe; Halliday, Alison; Dahl, Torbjørn et al. 10-years stroke prevention after successful carotid endarterectomy for asymptomatic stenosis (ACST-1) a multicenter randomised trial. *The Lancet* 2010, volume 376: p 1074-1084 (Myhre and Dahl were collaborators in this multicenter study).

Brattheim B, Faxvaag A, Tjora A. Getting the aorta pants in place: A “community of guidance” in the evolving practice of vascular implant surgery. *Health (London)*. 2010 Dec 15. (Epub ahead of print).

Manstad-Hulaas F, Demirci S, Pfister M, Lydersen S, Tangen GA, Hernes TAN. Endovascular Image-Guided Navigation – Validation of Two Volume – Volume Registration Algorithms. In press, *Minim Invasive Ther Allied Technol (MITAT)*, 2010.

Manstad-Hulaas F, Tangen GA, Gruionu LG, Aadahl P, Hernes TAN. Three-dimensional endovascular navigation with electromagnetic tracking – Ex Vivo and In Vivo Accuracy. *J Endovasc Ther*, accepted.

Bø LE, Gjerald SU, Brekken R, Tangen GA, Hernes TAN. Efficiency of ultrasound training simulators: Method for assessing image realism. *MITAT. Minimally invasive therapy & allied technologies*, 2010; 19: (2)69-74.

Gjerald S, Brekken R, Hernes TAN. Realtime simulation for low cost training simulators. *SPIE Medical Imaging*, San Diego, California, February 2010.

Leira HO, Amundsen T, Tangen GA, Bø LE, Manstad-Hulaas F, Langø T. A novel research platform for electromagnetic navigated bronchoscopy using cone beam CT imaging and an animal model. *Minim Invasive Ther Allied Technol.* 2011 Jan;20(1): 30-41. Epub 2010 Sept 27. PMID: 20874055 (PubMed – in process).

#### **Presentations at international conferences**

Myhre HO, Skogås JG, Hernes TAN, Wik AK. Operating Room of the Future. *SMIT*; 2010-09-02 – 2010-09-04.

## **Presentations at national conferences**

Aasland JK, Dahl T: “Challenges by using data from the Norwegian Vascular Registry (NorKar). Annual meeting of the Norwegian Surgical Society, Oslo, Oct 2010.

Aasland JK, Dahl T: “Abdominal aortic aneurysm in the Norwegian Vascular Registry (NorKar) 1997-2006”. Annual meeting of the Norwegian Surgical Society, Oslo, Oct 2010.

## **Presentations at national courses and conferences**

Skogås JG. Project Operating Room of the Future, AV/ICT. University Hospital of Århus. January 28<sup>th</sup>, 2010.

Myhre HO. Operating Room of the Future. (Ministry of Health and Care Services), February 16<sup>th</sup>, 2010.

Skogås JG. Operating Room of the Future. (Ministry of Health and Care Services), February 16<sup>th</sup>, 2010.

Myhre HO, Stranden E, Seternes A, Slagsvold CE. Chronich mesenteric ischaemia (CMI). Diagnosis. Bergqvist Symposium, Uppsala, March 15<sup>th</sup>, 2010. (invited speaker).

Myhre HO. Operating Room of the Future. Video conference Covidien, March 16<sup>th</sup>, 2010.

Skogås JG. Operating Room of the Future. Video conference Covidien, March 16<sup>th</sup>, 2010.

Brattheim B. Aortic Aneurysm Network (AAN): Process support for trans-institutional treatment plans. Presentation in EPJ forum, National ICT, March 18<sup>th</sup>, 2010.

Skogås JG. Operating Room of the Future as an infrastructure for R&D and modern AV/ICT, Ullevål University Hospital, April 19<sup>th</sup>, 2010.

Skogås JG. Operating Room of the Future and minimally invasive methods using modern medical technology. National Anaesthesia Conference, Fredrikstad, September 28<sup>th</sup>, 2010.

Myhre HO, Farup P. How to make good research protocols? Presentation at Course University Hospital of Oslo, October 26<sup>th</sup>, 2010.

Leira HO, Amundsen T. Use of navigation in bronchoscopy. Pulmonary Forum of Central-Norway, 2010.

Leira HO, Amundsen T. Navigation in bronchoscopy, St. Olavs Hospital, (plenum), 2010.

## **Abstracts**

Brekken R, Hernes TAN, Myhre HO. Ultrasound strain estimation in abdominal aortic aneurysm. 6<sup>th</sup> World Congress in Biomechanics, Singapore, August 1-6, 2010.

Skogås JG, Hernes TAN, Wik AK, Myhre HO. Operating Room of the Future. SMIT conference. Trondheim, September 2-4, 2010.

Eide KR, Ødegård A, Hatlinghus S, Haraldseth O, Myhre HO. Evaluation of cross sectional imaging (DynaCT) in patients undergoing endovascular repair of AAA. ESVS – European Society for Vascular Surgery, Amsterdam, September 16-19, 2010.

## **Proceedings**

Manstad-Hulaas F, Tangen GA. Initial experiences – Electromagnetic navigation technology implemented in endovascular procedures SMIT 2010, Trondheim, Conference Proceeding.

## **Popular Science**

Myhre HO, Wikander JA, Benum P: Marius Nygaard Smith-Petersen. One of the great pioneers within orthopaedic surgery. Medlemskrift. Selskapet for Grimstad bys vel, 2010.

Brattheim B. “Aortic Aneurysm Network”: Process support in ICT system for treatment plans crossing the hospital borders. Hold Pusten no 5/2010.

## **Book chapters**

Myhre HO. Vascular surgery in Norway. Chapter in Haffner J & Gerner T (Eds) Surgery in Norway. Norwegian Surgical Society 100 years.

Myhre HO, Wesche J, Nyheim T. Norwegian Society for Vascular Surgery. Chapter in: Haffner J & Gerner T (Eds) Surgery in Norway. Norwegian Surgical Society 100 years.

Mårvik R, Myhre HO, Unsgård G. Experimental Surgery in Trondheim. Chapter in: Haffner J & Gerner T (Eds.). Surgery in Norway. Norwegian Surgical Society 100 years.

## ***Endoscopic-/laparoscopic surgery***

### **Articles in international journals with peer review**

Rethy A, Langø T, Aasland J, Mårvik R. Development of a multimodal tumour model for porcine liver. *J Gastrointest Surg*, 2010; 14: (12) 1969-73.

Våpenstad C, Rethy A, Langø T, Selbekk T, Ystgaard B, Hernes TAN, Mårvik R. Laparoscopic ultrasound: A survey of its current and future use, requirements and integration with navigation technology. *Surg Endosc* 2010; 24: 2944-53.

Martins C, Strømme M, Stavne OA, Nossum R, Mårvik R, Kulseng B. Bariatric Surgery versus lifestyle interventions for morbid obesity – changes in body weight, risk factors and comorbidities at 1 year. *Obes Surg* 2010, April 9<sup>th</sup>

Büchel D, Mårvik R, Hallabin B, Matern U. Ergonomics of disposable handles for minimally invasive surgery. *Surg Endosc*. 2010; 5: 992-1004.

Müller S, Langø T, Brekken R, Ystgaard B. Degrees of bowel adhesion after repair of ventral incisional hernias: an ultrasound method. In press *JLS*, 2011.

### **Presentations at international scientific conferences**

Langø T. Live video conference with presentation of the Future OR project in laparoscopic surgery and the R&D group in Trondheim in medical technology. Two-way conference between SMIT 2010 and SLS 2010. SLS is the Society of Laparoendoscopic Surgeons (SA), conference venue: New York. SMIT is the Society for Medical Innovation and Technology, conference venue Trondheim, September 2-4, 2010.

Langø T. Live video demonstration via video-conference from the Future OR for laparoscopic surgery in Trondheim, to the World Expo in Shanghai, September 15<sup>th</sup>, 2010.

Våpenstad C, Bø LE, Langø T, Mårvik R. Construct validity of two modules on a virtual reality laparoscopic training simulator. *Minimally Invasive Therapy and Allied Technologies (MITAT)*, 19 Suppl. 1, 2010.

Langø T et al. Navigated Ultrasound in Laparoscopic Surgery. *Minimally Invasive Therapy and Allied Technologies (MITAT)*, 19 Suppl. 1, 2010.

Hernes TAN et al. Ultrasound and image guided surgery – A collaboration between SINTEF, St. Olavs Hospital and NTNU in Trondheim. Presentation at the 22<sup>nd</sup> Annual SMIT (Society for Medical Innovation and Technology) congress, Trondheim, Norway, September 2-4, 2010.

Langø T. Ultrasound and navigation in laparoscopic surgery. Training in 3D Ultrasound and Neuronavigation, Trondheim, August 31<sup>st</sup> – September 1<sup>st</sup>, 2010.

Langø T. Navitation – Tha basis of personalized procedures. Invited talk at pHealth 2010, Berlin, Germany, May 26-28, 2010.

Langø T, Bø LE, Gjelsvik T, Johansen T. Ultrasound based localisation of wireless endoscopic capsule. Oral presentation based on 2-page proceeding paper, at pHealth 2010, Berlin, Germany, May 26-28, 2010.

Mårvik R. Education in laparoscopic surgery, the Operating Room of the Future, Navigation in laparoscopic surgery. Egypt Surgical Society, January 20-23, 2010.

Mårvik R. Navigation in laparoscopic surgery, Vagal Blocking in Bariatric Surgery, EAES, June 16-19, 2010.

Mårvik R. Complications in antireflux surgery. Norwegian Thoraco-Laparoscopic Forum, September 22-23, 2010.

Mårvik R. Navigation in laparoscopic surgery. The Future Operating Room in Endoscopic Surgery. Endoscopic Surgical Summit, Coastal Steamer, September 29-30. The Norwegian Surgical Society, Bariatric Symposium, October 26, 2010. Lifestyle therapy.

Mårvik R. Pneumoperitoneum. Risk-factors in laparoscopic surgery. Complications in lap cholecystectomy. Course in basal laparoscopy, NSALK, November 17-19, 2010.

Mårvik R. Advances in surgery. Audit of intelligent OR. Barcelona, December 9-20, 2010.

## ***General FOR***

### **Presentations at international conferences**

Skogås JG. The project “Operating Rooms of the Future”, Expo-Shanghai 2010, Nordic Lighthouse, September 13-15, 2010.

Ødegård A. Endovascular therapy. The hybride operating room. Expo-Shanghai 2010, Nordic Lighthouse, September 13-15, 2010.

Mårvik R. Education in endoscopic surgery. The Future Operating Room for Endoscopic Surgery. Expo-Shanghai 2010, Nordic Lighthouse, September 13-15, 2010.

Mårvik R. The future OR in endoscopic surgery. Expo-Shanghai 2010, Nordic Lighthouse, September 13-15, 2010.

Wik AK. Challenges for operating nurses in endoscopic surgery. Expo-Shanghai 2010, Nordic Lighthouse, September 13-15, 2010.

Thorvik K. Telemedicine in Norway. Expo-Shanghai 2010, Nordic Lighthouse, September 13-15, 2010.

## **Popular science**

Skogås JG, Langø T, Myhre HO, Sæther OD. Operating Room of the Future – experience so far and future plans. Health/Medicine/Technology – HMT no 2, 2010.

[http://project.vbook.no/project.asp?version\\_id=629&page=05#b5](http://project.vbook.no/project.asp?version_id=629&page=05#b5)

## ***Visual media***

From the FOR operating room in the Centre for cardiac and vascular diseases. TV-Adressa May 23<sup>rd</sup>, 2010.

<http://www.adressa.no/tv/?id=13921>

Adresseavisen, September 2010. Article about the SMIT international conference.

Teknisk ukeblad no 29, September 23<sup>rd</sup>, 2010. In the front: Norwegian imaging technology makes convalescence after operations easier. Medical technology could be the new Norwegian oil.



## Economy / results (NOK)

<b>14011044 Costs of moving/reorganisation</b>	
<b>Costs 2010:</b>	
Accumulated costs	546 200
Accumulated internal costs	96 154
Overhead	-
<b>For disposition rest of the year 2010</b>	<b>642 355</b>

<b>14011044 FOR</b>	
<b>Costs 2010:</b>	
	1 500 000
Accumulated costs	1 304 348
Accumulated internal costs	-
Overhead	195 652
<b>For disposition rest of the year 2010</b>	<b>-</b>

<b>14011044 3D Ultrasound</b>	
<b>Costs 2010:</b>	
	1 319 940
Accumulated costs	1 051 620
Accumulated internal costs	96 154
Overhead	172 166
<b>For disposition rest of the year 2010</b>	<b>(0)</b>

**14011044 – Accumulated per December 2010**

	<b>Budget</b>	<b>Account</b>	<b>Difference</b>
Income	3 520 865	2 819 940	700 925
Running costs	4 040 772	2 902 168	1 138 604
Balance before internal transferrals	(519 907)	(82 228)	(437 679)
Internal transferrals	79 048	192 308	(113 260)
Results before/after internal transferrals	(598 955)	(274 536)	(324 419)



## **Future plans /FOR in the new hospital**

Our goal is to make FOR a research infrastructure of good international quality. We want to increase quality as well as quantity of research relevant for FOR.

FOR should be in the international front regarding image-guided minimally invasive therapy.

FOR has been running since 2005 and continued in 2010 in the new hospital structure with focus on all operating clinics. The core organisation is unchanged, but the research activity is now decentralised to the various operating centres. Altogether we have 6 operating rooms with a modern AV/ICT structure which is continuing the concept of “the interactive lecture/seminar room”. Thus it is possible to make live transmission and interactive communication in full high-definition (HD). The most important motivation for continuing FOR in the new hospital is to be a basis for good clinical research, but also to have a centre of competence for the building and organisation of operating departments. Today a lot of hospitals are constructed or on the planning stage in Norway as well as other European countries. The operating rooms are the most expensive part of the hospital and the operating departments are expensive to run. Often one has to do changes soon after the operating rooms are finished. We want to gain experience and to be leading within this field, thereby optimising the investments. We will focus on architecture, use of materials, ergonomics, ICT-solutions, logistics and health economy and hope to be able to build operating rooms at a lower cost and to organise them efficiently. It is important to do this in a systematic way, getting solid knowledge about operating departments.

FOR has a close relationship with many important collaborators, in industry, with clinical departments and with technological research groups. The most important agents involved in FOR are St. Olavs Hospital, the Medical Faculty, NTNU and SINTEF. Various centres of competence like; “Centre of competence 3D-Ultrasound” and “National Centre of Advanced Laparoscopic Surgery” as well as University College of Sør-Trøndelag are important collaborators and it is important to preserve the synergy effect of this cooperation in the years to come.

We want to strengthen the international cooperation. Several international groups want to cooperate with FOR. So far we have focussed on Massachusetts General Hospital in Boston, Operating Room of the Future in Tübingen, Germany and research group at Krakow University Hospital in Poland. . Furthermore, we have cooperation via organisations like EAES and SMIT. The annual SMIT conference was held in Trondheim in 2010.

We have established a cooperation with Yonsei University Health System, Seoul, Korea. Priority is given to the projects on geriatric medicine, the intelligent hospital and transmission of high quality medical information.

The PhD-candidates are financed through external funding. This has made it possible to obtain a good scientific activity in spite of a small annual budget. FOR had targeted 1-2 PhD-degrees and 1 Master degree per year. In the near future there will be an increasing demand for scientific work which forms the basis of Master degrees and FOR can be a good platform in this work.

We want to refine and expand indications for stent-graft treatment of aneurysms, dissections and trauma of the arterial system. This can be achieved by using stent-grafts with side-arms for the renal and mesenteric arteries. One project is to apply navigation for deployment of such endoprotheses. Within laparoscopic surgery we also focus on navigation to make the procedures safer. New techniques for treating morbid obesity have been developed. An interesting principle is to apply a pacemaker to stimulate the vagus nerve in these patients. This work is organised as an international multicenter study. Within pulmonary medicine we have applied navigation for endoscopy and endobronchial procedures. Several projects have started within the fields of ENT surgery, oral surgery and neurosurgery. We look forward to extend our collaboration with these units.

In 2010 FOR has developed, established and implanted a teaching system for all doctors in surgical disciplines at St Olav within the use of electro-medical equipment. Focus areas are application of high-energy technology, application of C-arms and x-ray protection .Hospital hygienics has also been included in the program. Through the Health Academy of Regional Health Trust, a collaboration has been established in order to expand this arrangement to all hospitals within Central-Norway.

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