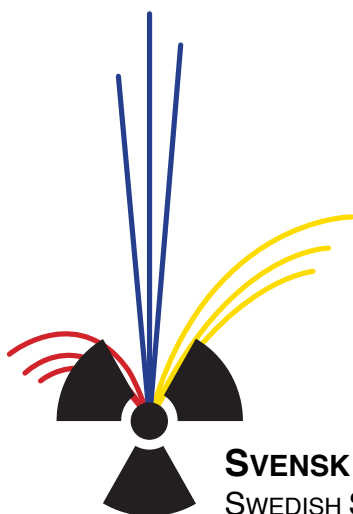# Nationellt möte om sjukhusfysik 2014

Vann Spa Hotell och Konferens

12-14 november

SVENSK FÖRENING FÖR RADIOFYSIK
SWEDISH SOCIETY OF RADIATION PHYSICS
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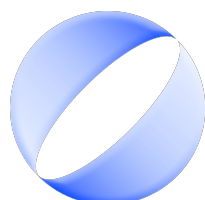MICROPOS MEDICAL

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Tisdag 11/11

11.30 - 12.30	**Lunch**
Eftermiddagen	Kurser enligt separat schema
19.00 -	**Middag**

Onsdag 12/11

Förmiddagen	Fortsättning kurser, cheffysikermöte, arbetsgrupperna	
11.30 - 12.30	**Lunch**	
12.30 - 12.45	**Välkommen**	*Lars Ideström och Anders Tingberg*

Session 1		*Moderator: Agnetha Gustavsson*
12.45 - 13.15	*Holger Sköldborn-pristagare:* Elektromagnetiska fält och hälsoeffekter	*Jonna Wilén*
13.15 - 14.00	Framtidens sjukhusfysik i Sverige med anknytning till NKS (Nya Karolinska) - kommer sjukhusfysikerns roll att förändras?	*Annette Fransson-Andreo*
14.00 - 14.30	Radiomics	*Tufve Nyholm*
14.30 - 14.45	*Swerays Shooting Star:* Evaluation of biomarkers for molecular imaging and radioimmunotherapy in combination with HSP90 inhibition in squamous cell carcinomas	*Anja Mortensen*

14.45 - 15.15	**Kaffe och utställning**

Session 2		*Moderator: Lars Ideström*
15.15 - 15.45	*Kurt Lidén-pristagare:* Dosimetriska utmaningar inom röntgendiagnostiken	*Anne Thilander Klang*
15.45 - 16.45	*SSFF:s specialinbjudne föreläsare:* Om klimathotet	*Pär Holmgren*

	Spa & mingel
19.30 -	**Middag**

Torsdag 13/11

Session 3	Parallella sessioner: Strålterapi och nuklearmedicin	Moderatorer: Per Nilsson och Sofie Ceberg
08.15 - 08.30	The latest updates in internal dosimetry for diagnostics in nuclear medicine	Martin Andersson
08.30 - 08.45	Optimisation of reconstructions on a SIEMENS Biograph mCT for whole body PET/CT examinations following the EARL recommendations	Ted Nilsson
08.45 - 09.00	*Bästa examensarbete 1:* Dose response of pancreatic neuroendocrine tumours treated with peptide receptor radionuclide therapy using ^{177}Lu-dotatate	Ezgi Ilan
09.00 - 09.15	Towards mapping the brain connectome in depression: functional connectivity by perfusion SPECT	Johanna Öberg
09.15 - 09.30	*Bästa examensarbete 2:* Breathing interplay effects during Tomotherapy: a 3D gel dosimetry study	Anna Ljusberg
09.30 - 09.45	A national quality registry for radiotherapy	Tufve Nyholm
09.45 - 10.00	Evaluation of Mobius3D - an independent 3D dose calculation program	Gordana Dzever
10.00 - 10.30	**Kaffe och utställning**	
10.30 - 10.45	Hazard analysis of respiratory gating in radiation therapy	Maria Duvaldt
10.45 - 11.00	*Bästa examensarbete 3:* Robustness of the voluntary breath-hold approach for the treatment of early stage lung cancer with spot scanned proton therapy	Jenny Dueck
11.00 - 11.15	Optisk ytscanning för patientpositionering och rörelseövervakning vid strålbehandling	Malin Kügele

Session 3	Parallella sessioner: Röntgen, MR och strålskydd	Moderatorer: Agnetha Gustafsson och Therese Geber Bergstrand
08.30 - 08.45	Evaluation of metal artefact reduction techniques for CT scanners provided by four different vendors	Karin Andersson
08.45 - 09.00	The effect of education and real-time dosimeters on personnel in interventional radiology	Louise Blomkvist
09.00 - 09.30	Optiskt stimulerad luminescens (OSL)-teknik och tillämpningar	Therese Geber Bergstrand

09.30 - 09.45	Classification of diffuse low contrast lesions in DBT at different dose levels using a SRSAR reconstruction method	*Pontus Timberg*
09.45 - 10.00	Påverkan av systemkonfiguration och rörspänning på bildkvaliteten i lungtomosyntes - en visual grading-studie med antropomorft lungfantom	*Christina Söderman*
10.00 - 10.30	**Kaffe och utställning**	
10.30 - 10.45	Optimization of MPRAGE to improve tissue contrast and SNR	*Rebecca Edén*
10.45 - 11.00	Do we need action levels in paediatric interventional cardiology?	*Angela Karambatsakidou*
11.00 - 11.15	Back to basic	*Love Kull*

11.15 - 12.00   *Årsmöte:* **Svensk förening för radiofysik**

12.00 - 13.00   **Lunch och utställning**

Session 4		*Moderator: Anders Tingberg*
13.00 - 14.00	*Kalle Vikterlöf-föreläsare:* Medical Physics 2.0	*Ehsan Samei*
14.00 - 15.30	Workshops (inkl. kaffe)	
	a) QC-arbete inom strålbehandling: Föreläsningar av Julia Götstedt, Carina Norberg och Sofi Holmquist	*Magnus Gustafsson & Jörgen Olofsson*
	b) SPECT-CT: vad ska man med den till?	*Sven-Åke Starck och Ulrika Dahlén*
	c) Webbaserad strålskyddsutbildning	*Jerker Edén Strindberg*
	d) Ungt forum - livet efter legitimationen	
	Info om Svensk Förening för Radiofysik	*Disa Åstrand*
	Info om Svenska Sjukhusfysikerförbundet	*Lars Ideström*
	Kursrådet	*Sofie Ceberg*
	Hur blir man specialist?	*Sofie Ceberg*
	Hur är det att gå KT-programmet på Karolinska sjukhuset?	*Rebecca Edén*

Session 5		Moderator: Sofie Ceberg
15.30 - 15.45	Kursrådet informerar	Sofie Seberg
15.45 - 16.00	ST-programmet: en statusuppdatering och frågestund	Lars Ideström & Sara Olsson

16.00 - 17.00	***Årsmöte:* Svenska Sjukhusfysikerförbundet**	
	Spa & mingel	
19.30 -	**Konferensmiddag med dans och underhållning**	

Fredag 14/11

Session 6		Moderator: Tommy Knöös
09.00 - 09.30	Varför gör vi kvalitetskontroll?	Tommy Knöös
09.30 - 09.45	Rapport från arbetsgruppen inom nuklearmedicin	
09.45 - 10.00	Rapport från cheffysikergruppen	

10.00 - 10.30	**Kaffe och avslutning på tipspromenaden**	

| Session 7		Moderator: Therese Geber Bergstrand
10.30 - 10.50	Bestämning av diagnostiska standarddoser (DSD) 2013	Richard Odh
10.50 - 11.10	Registrering av standarddoser via SSM:s web	Stefan Thunberg
11.10 - 11.30	Konsekvensutredning över förslag till ökade säkerhetskrav kring Cs-137 strålkällor	Stefan Thunberg

11.30 - 12.00	**Avslutning** • SSFF's pris till bästa föreläsning • Vinnare i tipspromenaden	**Lars Ideström & Anders Tingberg**
12.00 - 13.00	**Lunch och hemresa**	

SVENSKA SJUKHUSFYSIKER FÖRBUNDET
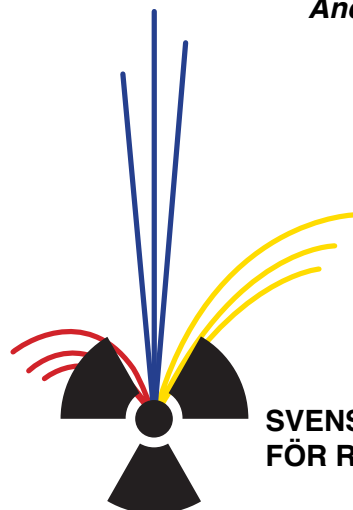
SVENSK FÖRENING FÖR RADIOFYSIK

The latest updates in internal dosimetry for diagnostics in nuclear medicine

M Andersson*[1], L Johansson[2], S Mattson[1], D Minarik[1] and S Leide Svegborn[1]

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[2]Department of Radiation Sciences, Umeå University, Sweden

Aim and background: Effective dose represents the potential risk to a population of stochastic effects of ionizing radiation (mainly lethal cancer). In recent years, there have been a number of revisions and updates influencing the way to estimate the effective dose. For diagnostic in nuclear medicine the major changes have been the incorporation of the new reference adult voxel phantom. To incorporate this phantom, a new computer program (IDAC2.0) have been developed.

Material & Methods: The program uses the latest biokinetic models and assumptions of the ICRP, which also includes the incorporation of the Human Alimentary Tract Model (ICRP 100). The S-values are generated through mono-energetic photon and electron SAF-values from the new voxel phantoms and decay data of ICRP publication 107. Absorbed dose and effective dose estimations are based on the latest tissue weighting factors (ICRP 103).

Results: We recalculate the effective dose values for the 338 different radiopharmaceuticals using the new data and compare them with the previous published by ICRP. For 79% of the radiopharmaceuticals, the new calculations gave a lower effective dose per unit administered activity than earlier estimated. As a mean for all radiopharmaceuticals, the effective dose was 25% lower. The use of the new adult computational voxel phantoms has a larger impact on the change of effective doses than the change to new tissue weighting factors.

Conclusions: The use of the new computational voxel phantoms and the new weighting factors has generated new effective dose estimations. These are supposed to result in more realistic estimations of the radiation risk to a population undergoing nuclear medicine investigations than hitherto available values.

References

1. Andersson M, Johansson L, Minarik D, Mattsson S, Leide-Svegborn S. **An internal radiation dosimetry computer program, IDAC2.0, for estimation of patient dose for radiopharmaceuticals.** *Radiat Prot Dosimetry* 2013 (doi: 10.1093/rpd/nct337).
2. Andersson M, Johansson L, Minarik D, Leide Svegborn S, Mattsson S. **Effective dose to adult patients from 338 radiopharmaceuticals estimated using ICRP biokinetic data, ICRP/ICRU computational reference phantoms and ICRP 2007 tissue weighting factors.** EJNMMI Physics 2014 (accepted, soon in press)

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Optimisation of reconstructions on a SIEMENS Biograph mCT for whole body PET/CT examinations following the EARL recommendations

Ted Nilsson*

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Background: In 2010 the EANM procedure guidelines for tumor PET imaging was published. The guidelines provide recommendations on how to handle several factors affecting the results in quantitative ^{18}F-Fluorodeoxyglucose (FDG) PET imaging. After the publication of the guidelines, the project of EARL FDG PET/CT accreditation started. The purpose of the accreditation program is to harmonise the results of quantitative PET imaging among accredited centers. A research area that will benefit from the harmonisaton process would be multi-centre oncology PET studies, where Standardised Uptake Values (SUVs) are compared between different centers.

Aim: The primary aim was to find an optimal reconstruction setting, making an EARL FDG PET/CT accreditation feasible for the Siemens Biograph mCT scanner used for PET/CT examinations at the Karolinska University Hospital in Huddinge. A secondary aim was to investigate how Body Mass Index (BMI) affected the image quality for whole body PET/CT examinations.

Materials and methods: A phantom study using six spheres filled with ^{18}F-FDG was performed according to instructions in the guidelines. The acquisitions of the phantom were reconstructed with various numbers of Equivalent Iterations (EI) and filter widths of the reconstruction filters in order to perform a contrast and noise analysis. A research software provided by the EARL collaboration was used to check if the reconstructions resulted in Recovery Coefficients (RC) that complied with the EARL specifications. Three EARL compliant reconstruction protocols, using various combinations of Time-Of-Flight (TOF) information and Point Spread Function (PSF) modeling was applied retrospectively together with the clinically used protocol to patient images. The patients were divided into three groups based on their BMI so that the effect of BMI on image quality could be studied. Image quality criteria were defined and the reconstructions were graded by five radiologists in a visual grading study. The statistical method Visual Grading Regression (VGR) was used in the analysis of the results.

Results: The results from the study indicate that the number of EI need to be increased above the 42 which is currently used for whole body examinations to reach a better contrast for small lesions. None of the EARL compliant reconstructions performed better than the current clinical protocol in the visual grading study. A large difference in how experienced and inexperienced radiologists graded the images was observed. The study of how BMI affected image quality gave ambiguous results. These results are likely caused by inclusion of too few patients in each BMI group.

Conclusions: The favored EARL compliant reconstruction by the radiologists was the one using 189 EI with PSF modeling and TOF information in the reconstruction process. Once the department has become EARL accredited this protocol can be used when quantitative results are reported in multi-centre studies.

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Towards mapping the brain connectome in depression: functional connectivity by perfusion SPECT

Ann Gardner[1], Disa Åstrand[2], Johanna Öberg*[2], Hans Jacobsson[2], Cathrine Jonsson[2], Stig Larsson[2], Marco Pagani[2,3]

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[2]Karolinska University Hospital, Stockholm
[3]Institute of Cognitive Sciences and Technologies, CNR, Rome, Italy

Introduction: Chronic depression, as compared with non-chronic depression, is characterized by a younger age at onset, more frequent depressive episodes, and more co-morbid medical and other psychiatric conditions.
The aim of this study was to assess differences in brain perfusion distribution and connectivity between patients (N = 91) with persistent depressive disorder (PDD) and healthy controls (N = 65).

Method: All patients had a chronic type of unipolar depressive disorder that fulfilled DSM-5 criteria for PDD. Criteria include depressed mood for most of the day on most days for at least two years. Resting-state perfusion was investigated by SPECT using a three-headed Gamma Camera (Trionix, Triad XLT) equipped with low-energy ultrahigh- resolution collimators. The patients were administered i.v. with 1000 MBq ^{99m}Tc-HMPAO.
Prior to interregional correlation analysis, the areas of perfusion changes in the PDD patients were assessed with respect to the control group using statistical parametric mapping. This preliminary step aimed at identifying regions of likely blood flow changes where additional perfusion connectivity was further evaluated by voxel-based analysis. Brain connectivity was explored through a voxel-wise interregional correlation analysis using as covariate of interest the normalized values of clusters of voxels in which perfusion differences were found at group analysis.

Result: Significantly increased rCBF distribution ($p < 0.05$ FDR$_{corr}$) was found in the patients as compared with the controls in a cluster covering large part of the bilateral cerebellum (Fig 1). No significant hypoperfusion at the chosen threshold was found.
With voxel-wise interregional correlation analysis this cluster showed a highly significant negative correlation ($p < 0.001$ FWE$_{corr}$) with bilateral caudate nuclei in the patients (Fig 2). When the same cluster was negatively correlated in the control group to relative CBF distribution in the whole brain, a huge cluster encompassing mainly fronto-parietal and subcortical regions was found to be significant at $p < 0.005$ FDR$_{corr}$ level.
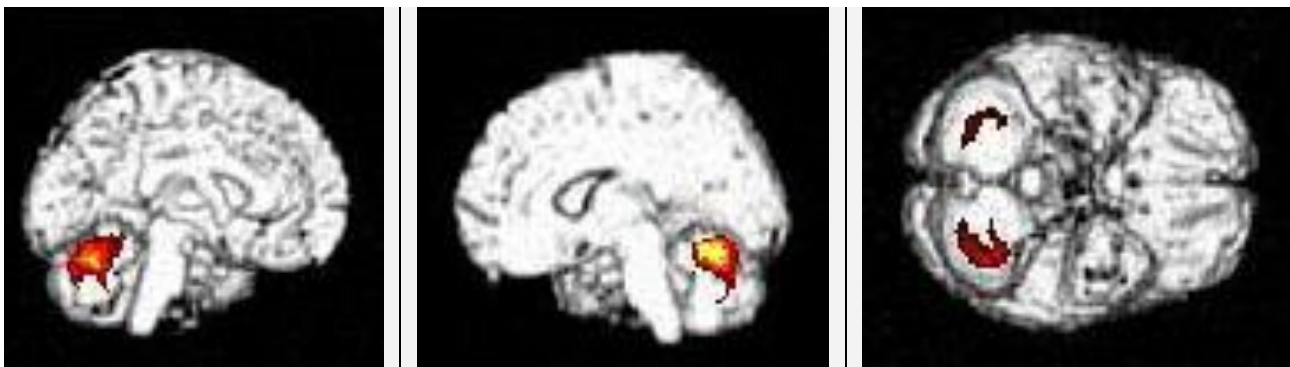No positive correlations were found in either group ($p < 0.05$ FDR$_{corr}$).

Fig 1. Cerebellar hyperperfused cluster in patients as compared to controls. Height significance threshold: p<0.05, corrected for multiple comparisons (FDR), at both peak and cluster levels. Figure displays regions of significant difference, color-graded in terms of z values.
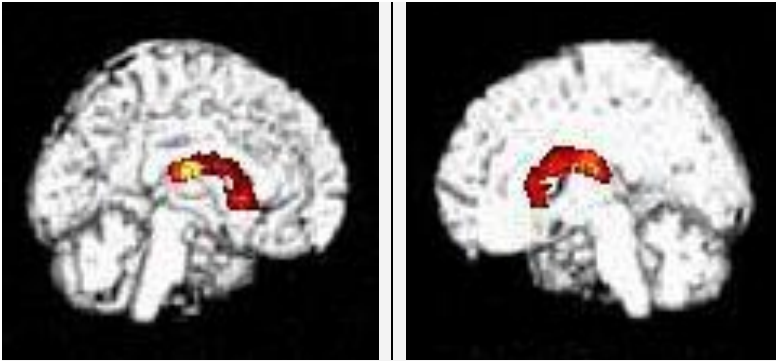
Fig 2: The cluster, presented in Fig 1, showed a highly significant negative correlation with bilateral caudatus in the patients using voxel-wise interregional correlation analysis. When the same cluster was negatively correlated in the control group to relative cerebral blood flow in whole brain, a cluster encompassing mainly fronto-parietal and subcortical regions was found to be significant (not shown here). No positive correlations in both groups were found at the chosen statistical threshold.

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A national quality registry for Radiotherapy

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[€]Chair of and representing SSM:s national reference group for the project
[£]Chair of and representing RCC:s national workgroup for the RT registry

An IT solution designed to facilitate a national quality registry for radiotherapy has been implemented. The solution consists of a local storage of DICOM RT data in a structured database (MIQA), and an application for recalculation of the data from the 4D representation to dose-volume parameters for each fraction. These data are then sent to the same platform that hosts most of the Swedish quality registries for cancer (INCA).

MIQA is a multipurpose system that provides data to the RT-registry and could also be used as a local quality database and research database. MIQA includes basic functionality to monitor the status of the treatment for patients in order to only send data sets that are complete. It also includes functionality to map structure names to the national nomenclature for radiotherapy that has recently been introduced. The installations of MIQA throughout Sweden have begun and according to plan it should be installed at all university hospitals mid spring 2015.

The use of a national quality registry will follow the same principles as the already existing registries under INCA. The primary use will be regular comparison between different clinics. These comparisons will include both dose-volume parameters and volumes of targets and organs at risk. The hope is that we in a longer perspective will achieve an increased consistency in our treatments in Sweden. The quality registry will also be open for research, provided ethical permit for the study.

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Evaluation of Mobius3D - an independent 3D dose calculation program

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Purpose: The aim of this study was to evaluate Mobius3D software and implement into the clinic. Mobius3D is an independent dose calculation program with reference beam data that calculates 3D radiation dose using their collapsed cone algorithm. The software and algorithm is developed by Mobius Medical Systems.

Method: The first step was to analyse the differences between the Mobius3D reference beam data and our reference data used in Eclipse, our treatment planning system, to see if the data fits our own or if we need to make some adjustments. Comparison was made between depth doses, output factors and off-axis factors. To become familiar with the calculation accuracy we compared some simple fields performed on a water phantom and a water phantom with different media (bones, lungs and air). We then made a comparison between planned and measured doses using 20 static fields of different sizes, shapes, energies, wedges and SSD distances. We made 20 measurement points in both the target and risk organ for dynamic fields, IMRT and VMAT. The measurements were made with a TW30012 ion Chamber in the Cirs phantom model 002H9K.

Result: The difference between the results with our reference data and Mobius' reference data is less than 3%. The difference between the calculated and measured doses performed on our Varian Clinac machines are, in our opinion, reasonable. There is a difference in the calculations between the Eclipse and the Mobius equivalent in air/lung tissue that will be reflected in the calculations of the plan check.

Conclusion: Agreement between the reference data was good so no adjustments were necessary but we have to be observant of differences in the calculations which will be reflected in the plan checks.

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Hazard Analysis of Respiratory Gating in Radiation Therapy

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The present project was conducted as part of an undergraduate project course in hazard analysis for radiotherapy. The aim of this project was to investigate the hazards of respiratory gating at Norrland University Hospital. Respiratory gating is a treatment method used for postoperative treatment of cancer in the left breast, to protect the left coronary vessel in the heart.

To identify potential hazards, a mapping of the work flow at the radiation therapy department has been made. This was done by auscultating each work instance involved and performing the hazard analysis according to the model *Action Error Analysis*. Furthermore, interviews with doctors, staff at the treatment station, staff at the imaging station and hospital physicists has been held. A diversity of hazards has been identified, and the hazards considered more relevant have been thoroughly evaluated.

One hazard arises when the patient's breathing curve changes during the treatment, due to increased relaxation and comfortableness of the patient. This lowers the base of the breathing curve and the position of the fixed gating window. The patient geometry can thus not be repeated each treatment session and the risk is that control of the dose distribution inside the patient is lost. The patient may also unawarely perform "fake breathing", that is raising the chest or the spine while not actually breathing as planned. This makes the breathing curve look right but in reality the heart and the breast are not separated as much as they should be. To demonstrate this, MRI-examinations of volunteers has been made.

One conclusion from this project is that it is of utter importance to get the patient well informed and relaxed from the first day of treatment, to get same height of the gating window and to not raise the chest or lift the spine by mistake. There is also a risk of confusing two patients since Varians RPM cannot communicate and verify the patient information in MOSAIQ.

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Optical surface scanning for patient set-up and motion monitoring during radio therapy

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Objective: Today's modern radiation therapy uses sophisticated treatment planning in three dimensions based on patient CT data. The dose can be delivered with high accuracy to the volume intended to be irradiated and this leads to that the patient's position and immobilization becomes increasingly important. For proton therapy this is a major issue. Demands on technology and methods to verify patient setup on a daily basis have to be met, preferably without an extra absorbed dose contribution.
We are investigating whether an optical scanning system, Catalyst (©2011 C-RAD Positioning AB), can reduce positioning errors and monitor the patient on a daily basis. This would increase our information about patient set-up and position during treatment delivery and contribute to an enhanced patient safety.

Material and Method: The optical system uses a non-rigid algorithm to calculate the iso-center position and projects a color map onto the patient's skin for detection of local deviations between the reference position and the live position. The body surface structure and the iso-center position from the dose planning system are used as a reference setup. During this surface based setup, local deviation is manually corrected for with the help of the color map. The optical system then calculates the couch adjustment needed to position the iso-center correctly.
During treatment the patient is monitored in real-time and all motions are logged at a screen in the control room. Tolerances for motion can be set and if the patient moves more than allowed the treatment beam will automatically be turned off.

Conclusions: It is of importance to know the optical systems strength and limitations. We found that surface based patient setup provides with more information about the patient position than laser based setup for breast cancer patients. The system provides with a daily control of the patient position that is not operator dependent and does not contribute with extra absorbed dose.

The limitation of the optical system is how it correlates the surface with internal motion; therefore internal targets still need verification imaging. Patient monitoring during treatment is valuable, especially for targets with small margins.

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Evaluation of metal artifact reduction techniques for CT scanners provided by four different vendors

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Purpose: In the last couple of years, several commercial strategies for reducing metal artifacts in CT imaging have been launched. A study where several metal artifact reduction techniques, commercially available and from different vendors, are applied for images degraded by artifacts due to the same kind of metallic implants, and also evaluated in the same way, is lacking in literature. Hence this study was made with an aim to evaluate four metal artifact reduction strategies in CT studies of hip prostheses.

Methods: Monoenergetic reconstructions of Dual Energy CT data and several metal artifact reduction algorithm software, used with Single or Dual Energy CT, were evaluated by CT imaging of a bilateral hip prostheses phantom. Image areas both close to the prosthesis and in the dark zone between the two prostheses were studied based on CT number accuracy.

Results: The result showed that the dedicated metal artifact reduction algorithms reduced the noise (up to 240 HU) and lead to mean values of CT numbers closer to the reference (water) values. The monoenergetic reconstructions of Dual Energy CT data did not show any general improvement in the CT numbers in the regions analysed.

Conclusions: This quantitative evaluation of CT images of a bilateral hip prostheses phantom shows that a reconstruction algorithm dedicated for reduction of metal artifacts is preferable for improvement of the CT number accuracy in the artifact affected regions analysed. However, one of the metal artifact reduction algorithms only reduced the noise in one of the regions. Hence, the choice of metal artifact reduction algorithm may depend on the diagnostic question considered. Additional evaluation of the different metal artifact reduction strategies could be performed by visual grading of the images.

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The effect of education and real-time dosimeters on personnel in interventional radiology

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Purpose: To evaluate the effect on staff doses from a real-time personal dosimeter system and conventional radiation safety education at an interventional x-ray suite dedicated to endoscopic retrograde cholangiopancreatography (ERCP) procedures.

Method: Doses were monitored for one physician, one radiographer and one assistant. A real-time dosimeter system, i-2 (Unfors Raysafe, Billdal, Sweden), was used to determine the staff dose from each individual procedure. The dosimeter system is composed of personal dosimeters wirelessly connected to a base station with a display showing doses in real-time.

It was assumed that the scattered radiation was proportional to the dose area product (DAP). Therefore personal doses were divided by the DAP, thus quantifying the staff radiation safety methodology. The study included three measurement periods: Before radiation safety education (first period), after radiation safety education (second period), and with the real-time dosimeter system displayed (third period). The education contained one hour lecture and one hour practical radiation safety training inside the suite. Statistical analysis was performed using the Mann-Whitney U test.

Results: When comparing the first and second period a small decrease in dose levels was observed for all staff categories, but the difference was not significant (Z=-0.69, p=0.49 for the physician, Z=-0.36, p=0.72 for the radiographer and Z=-0.83, p=0.41 for the assistant.) A decrease in dose levels was observed between the second and third period for the physician and the radiographer (Z=-3.50, p<0.001 and Z=-2.72, p=0.006 respectively). For the assistant, the decrease was not significant (Z=-0.49, p=0.63).

Conclusion: Introducing a real-time personal dosimeter system into an interventional x-ray suite has the potential to significantly reduce staff doses.

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Classification of diffuse low contrast lesions in DBT at different dose levels using a SRSAR reconstruction method

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[2]Department of Clinical Sciences Malmö/Diagnostic Radiology, Lund University, Malmö, Sweden

Purpose: To investigate classification of diffuse margined masses in reconstructed digital breast tomosynthesis (DBT) slices at different dose levels using a Super Resolution and Statistical Artifact Reduction (SRSAR) reconstruction method developed by Siemens.

Method: Thirty cases containing low contrast diffuse lesions / suspicious structures acquired on a DBT system (Mammomat Inspiration, Siemens) were collected. The projection images were dose reduced by software as if acquired at 100%, 75% and 50% dose level (AGD of approximately 1.6 mGy for a standard breast, measured according to Euref v0.15). A SRSAR reconstruction method (utilizing IRIS (iterative reconstruction filters), and outlier detection using Maximum-Intensity Projections and Average-Intensity Projections) was used to reconstruct single central slices to be used in a classification task, (30 images per observer and dose level). Five radiologists participated and their task was to assign a confidence rating based on their likelihood of recall in a screening situation. The images were randomly presented (balanced by dose level). Each trial was separated by two weeks to reduce possible memory bias. The outcome was analyzed for statistical differences using ROC methodology.

Results: The results indicate that it is possible reduce the dose by 25% without jeopardizing recall.

Major findings and Conclusions: The classification performance for masses can be maintained at a lower dose level by using SRSAR reconstruction.

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Påverkan av systemkonfiguration och rörspänning på bildkvaliteten i lungtomosyntes – en visual grading-studie med antropomorft lungfantom

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Syfte: Att undersöka den potentiella nyttan, ur ett bildkvalitetsperspektiv, av att öka dosen per projektionsbild i lungtomosyntes genom att, vid en konstant effektiv dos, minska antingen vinkelintervallet för insamlingen av projektionsbilderna eller projektionstätheten, definierat som antal projektionsbilder genom det vinkelintervall i vilket dom blivit insamlade, samt att utvärdera påverkan av rörspänningen på bildkvaliteten.

Material och metoder: Ett antropomorft lungfantom avbildades med nio olika kombinationer av vinkelintervall och projektionstäthet och tio olika rörspänningar med GE:s tomosyntessystem VolumeRAD. Alla bildinsamlingar gjordes vid en effektiv dos motsvarande standarddosnivån för en undersökning med lungtomosyntes på VolumeRAD-systemet. Fyra observatörer medverkade i en visual grading-studie där rekonstruerade tomosyntesbilder bedömdes enligt ett antal kriterier för bildkvalitet. Bildkvaliteten utvärderades i förhållande till defaultkonfiguration och rörspänning på VolumeRAD-systemet.

Resultat: Generellt minskade bildkvaliteten med minskande projektionstäthet. För två av kriterierna ökade bildkvaliteten med minskande vinkelintervall. Rörspänningen påverkade inte bildkvaliteten i någon större utsträckning.

Slutsatser: Vid standarddosnivån för VolumeRAD-systemet kan de potentiella fördelarna med att öka dosen per projektionsbild inte fullt ut kompensera de negativa effekterna till följd av en minskning av antalet projektionsbilder. Följaktligen är standardkonfigurationen med 60 projektionsbilder insamlade över 30º ett bra alternativ. Rörspänningen vid lungtomosyntes har ingen stor inverkan på den kliniska bildkvaliteten.

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Optimization of MPRAGE to improve tissue contrast and SNR

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Introduction: MPRAGE is a 3D T1-weighted gradient echo sequence used for structural brain analysis. For good brain tissue segmentation a high tissue contrast, high uniformity and high SNR is crucial. This can be achieved with the MPRAGE sequence.

Aim: The aim of this project was to optimize the MPRAGE sequence with respect to CNR and tissue segmentation at 3T. Sequence parameters from the ADNI-protocol were used as reference. By decreasing the bandwidth from 238 Hz/px to 150 Hz/px, SNR was increased about 20%. To improve the tissue contrast different flip angles (FA) and inversion times (TI) were tested. Some of the most frequently used segmentation programs today (Freesurfer and FSL) are optimized for segmentation of images acquired with 1.5T scanners. A 3D T1- weighted sequence with optimal CNR at 3T can be useful for future optimization projects of the segmentation programs and lead to more reliable brain tissue segmentations.

Method: FA and TI were varied in a phantom study to find the sequences with best tissue contrast. 13 sequences were selected for further analysis and tested on a human volunteer. The segmentation analysis was made with FSL (Sienax) and Freesurfer. The tissue contrast for the sequences that resulted in the best segmentation was analyzed by two radiologists. They preferred sequence number 1, 2 and the Freesurfer-sequence before ADNI (table 1). The best sequence was tested for reproducibility by scanning a volunteer 8 times.

	FA	TI	BW
ADNI	9	900	238
1	9	914	150
2	9	964	150
Freesurfer	7	1100	199

Results: The segmentation results and the radiologists rating combined indicated that sequence 1 is the best choice for both clinical use and brain tissue segmentation. The reproducibility in measurement with Freesurfer and FSL respectively for sequence 1 can be seen in table 2.

	CoV [%] WM	CoV [%] GM	CoV [%] Total brain volume
Freesurfer	0,4	1,0	0,7
FSL	1,1	0,9	0,7

Conclusion: With modern scanners and sequences it can be hard to visually see differences in segmentation results since these sequences are very robust. The radiologist's preferred three sequences before the ADNI-sequence. Since ADNI is used in the clinical sequence protocols at Karolinska University Hospital and many other sites an optimization is needed. The final sequence has better SNR, CNR than ADNI and the segmentation results with both FSL and Freesurfer were satisfactory.

References
1. Fischl B, *NeuroImage* 62 (2012) 774-781
2. Smith S.M, *NeuroImage* 17 (2002) 479- 489
3. Smith S.M, *NeuroImage* 23 (2004) S208-S219

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Do we need action levels in paediatric interventional cardiology?

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Purpose: Children with congenital cardiac disease undergoing radiological interventions are more susceptible to radiation damage, compared to adults. This combined with the fact that the number of patients undergoing such radiological procedures is increasing, the need of establishing action levels, is increased as well. The aim of this study was to establish action levels and to evaluate doses and risks and possible correlations of age and gender dependency on these metrics.

Methods: Doses and risks in paediatric patients, undergoing interventional cardiac radiological procedures, at Karolinska have been assessed with the software code PCXMC v.2.0. The code applies the LNT (linear no-threshold) model for risk estimations together with Euro-American mortality and cancer incidence data taken from ICRP 103. The action levels were established for a risk level corresponding to 1%.

Results: Effective doses estimated with ICRP 103 tissue weighting factors yielded 10-20% higher values than those obtained using data from ICRP 60 for the patient cohort in this study. The total risk for fatal cancer was between 0.003% and 2% and the organs contributing the most to the total risk were the lungs and the (female) breast. The proposed action levels are as following: neonate (female, male): 7 Gycm^2; 16 Gycm^2, 1 year (female, male): 15 Gycm^2; 37 Gycm^2, 5 years (female, male): 38 Gycm^2; 70 Gycm^2, 10 years (female, male): 72 Gycm^2; 166 Gycm^2, 15 years (female, male): 208 Gycm^2; 370 Gycm^2.

Conclusions: Effective dose normalized by dose-area product showed a dependence on patient age. Furthermore, the risk for radiation induced fatal cancer displayed a dependence on both age and gender which reflects on the variable action levels.

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