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# Online Abstract Book

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du Congrès Suisse de Radiologie  
of the Swiss Congress of Radiology

Celebrating 100 Years  
of SGR-SSR

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## **Dear Delegates and Visitors of the Swiss Congress of Radiology 2013, Dear Colleagues!**

The Swiss Society of Radiology (SGR-SSR) and the Swiss Society of Nuclear Medicine (SGNM-SSMN) are delighted about the high quality of abstracts which were submitted for presentation at the annual Swiss Congress of Radiology. The continuous excellent work of all authors is highly appreciated by both societies as it makes the congress to a prestigious scientific meeting.

After introducing the new “Online Abstract Book of the Swiss Congress of Radiology” in 2011, this is the third issue which is solely published online. Our society members encouraged us to continue with this form as the online-only web publication of the abstract book offers several advantages over a printed version such as cost efficiency, durable and platform independent documentation of scientific abstracts, integration of the abstract data into both the Society’s and Congress’ web page as well as permanent accessibility for all over the world.

The “Online Abstract Book of the Swiss Congress of Radiology” will permanently be accessible on both the Society’s and Congress’ web page at [www.sgr-ssr.ch](http://www.sgr-ssr.ch) and [www.radiologiekongress.ch](http://www.radiologiekongress.ch). It includes all the abstracts of the scientific talks and posters presented at the annual Swiss Congress of Radiology in Luzern.

Proper citation of scientific abstracts is however important, especially in case of online-only web publications. The Swiss Society of Radiology therefore recommends the use of the following structure to cite abstracts from the new “Online Abstract Book of the Swiss Congress of Radiology”:

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We look forward to welcome you to the Swiss Congress of Radiology 2013 in Luzern.

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### SGR-SSR Office

SGR-SSR Secretariat

Christoph Lüsi

Moosstrasse 2

CH-3073 Gümligen

Phone +41 31 301 22 55

Fax +41 31 952 76 83

E-Mail [info@sgr-ssr.ch](mailto:info@sgr-ssr.ch)

Website [www.sgr-ssr.ch](http://www.sgr-ssr.ch)



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### Congress Organisation Company and Exhibition Management

MCI Schweiz AG

Flughofstrasse 54

CH-8152 Glattbrugg

Phone +41 44 809 42 87

Fax +41 44 809 42 01

E-Mail [info@radiologiekongress.ch](mailto:info@radiologiekongress.ch)

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SS101

**Combination of MRI and dynamic FET PET analyses for initial glioma grading***V. Dunet, P. Maeder, M. Nicod Lalonde, R. A. Meuli, J. Prior; Lausanne*

**Purpose:** For the past decade, MRI and PET with 18F-fluoro-ethyl-tyrosine (FET) have been increasingly used in the evaluation of patients with gliomas. However, tumor grading remains challenging. The purpose of this study was to assess the additive value of MR spectroscopy (MRS), diffusion imaging and dynamic FET-PET parameters for glioma grading.

**Methods and Materials:** Thirty-eight patients (42±15 aged, F: M 0.46) with untreated histologically proven brain gliomas were included. All underwent MRI with spectroscopy and diffusion sequences and FET-PET within 3±4 weeks. Performances of tumor FET time-activity-curve, early-to-middle  $SUV_{max}$  ratio, Choline/Creatine ratio and apparent diffusion coefficient (ADC) histogram distribution pattern to distinguish between low and high-grade gliomas were assessed. Combination of these parameters and respective odds were also evaluated by multivariate logistic regression analysis.

**Results:** Tumor time-activity-curve reached the best accuracy (67%) when taken alone to distinguish between low and high-grade gliomas, followed by ADC histogram analysis (65%). Early-to-middle ratio and MRS had only of moderate value with an accuracy of 58% and 48% respectively. Combination of time-activity-curve and ADC histogram analysis improved the sensitivity from 67% to 86% and the specificity from 62–67% to 100% ( $P<0.008$ ). On multivariate logistic regression analysis, tumor time-activity-curve on dynamic FET-PET however remains the best predictor of high-grade glioma (odds 69.8, SE 130,  $P=0.023$ ).

**Conclusion:** Combination of dynamic FET-PET results and diffusion MRI reached excellent performance to distinguish between low and high-grade gliomas. The use of FET-PET/MR is thus thought to be highly relevant in the initial assessment of primary brain tumors.

SS102

**Comparison of contrast-enhanced PET/MRI and contrast-enhanced PET/CT in patients with head and neck cancer***F. Kuhn, M. Hüllner, S. Kollias, G. K. von Schulthess, P. Veit-Haibach; Zürich*

**Purpose:** PET/MR has the potential to become a powerful tool in clinical oncological imaging. The purpose of this prospective study was to evaluate the diagnostic performance of contrast-enhanced (ce) MRI in patients with head and neck cancer in comparison with ceCT to characterize PET-positive lesions.

**Methods and Materials:** Eighty consecutive patients referred for primary staging or re-staging of head and neck cancer underwent sequential whole-body 18F-FDG PET with CT-based attenuation correction (AC), contrast-enhanced CT and conventional diagnostic MRI (2-point Dixon based T2 weighted and native/contrast enhanced T1 weighted sequences) of the head and neck in a tri-modality PET/CT-MR system. PET-positive lesions were assessed by CT and MRI for their anatomical localization, conspicuity and additional information for characterisation.

**Results:** In 38 patients with at least one PET-positive lesion, 60 lesions were evaluated. No significant difference was found between MRI and CT regarding lesion localization. MRI performed significantly better than CT regarding conspicuity of tumors (Wilcoxon signed rank test,  $p<0.01$ ) and similarly regarding conspicuity of PET-positive lymph nodes ( $p=0.08$ ). In CT fewer artefacts (7%) reduced the diagnostic confidence compared to MRI (16%). Overall lesion characterization with MRI was considered superior to CT in 33% of lesions, equal to CT in 58% and inferior to CT in 9%.

**Conclusion:** CeMRI outperformed ceCT in terms of conspicuity and characterization of PET-positive head and neck tumor lesions and performed similarly in cervical lymph node assessment. Hence, cePET/MRI has the potential to replace cePET/CT as the primary diagnostic imaging tool for the evaluation of head and neck cancers.

SS103

**CT-perfusion in lung cancer: Correlation of perfusion parameters and PET/CT parameters – initial results***M. Hüllner<sup>1</sup>, T. Collen<sup>2</sup>, K. Strobel<sup>2</sup>, P. Gut<sup>2</sup>, P. Veit-Haibach<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Luzern*

**Purpose:** To investigate the correlation of CT-perfusion (CTP) parameters (blood flow (BF), blood volume (BV), mean transit time [MTT]) and FDG-PET/CT parameters (maximum standardized uptake value ( $SUV_{max}$ ), mean standardized uptake value ( $SUV_{mean}$ ), PET volume (PETvol), total lesion glycolysis (TLG)) in patients with lung cancer.

**Methods and Materials:** Fifty-four patients (median age 65 years, range 42 to 79 years, 12 female, 42 male) with suspected lung cancer were referred for baseline staging PET/CT. A CTP scan of the lung tumor was performed (40 ml of contrast medium at 4.5 ml/s flow rate, delay 3s, tube voltage 100 kV, tube current 100 mAs, scan length 7cm, scan time 60s, rotation time 1.0s, reconstructed slice thickness 5 mm) and post-processed with a commercially available perfusion software. BF, BV, and MTT of the tumor tissue were calculated and correlated with  $SUV_{max}$ ,  $SUV_{mean}$ , PETvol and TLG by Spearman's correlation coefficient.

**Results:** According to biopsy, 5 patients had a SCLC, 40 NSCLC (23 adenocarcinoma (AC), 9 squamous cell carcinoma (SCC), 7 large cell carcinoma (LCC), 1 neuroendocrine carcinoma), 9 patients had non-neoplastic lesions. Mean BF, BV and MTT was 35.8 mL/100 mL tissue \* min<sup>-1</sup>, 8.5 mL/100 mL tissue, and 13.9 seconds. Mean  $SUV_{max}$ ,  $SUV_{mean}$ , PETvol and TLG was 11.7, 7.2, 33.45 cm<sup>3</sup> and 284.2. Weak inverse correlations were found between BF and  $SUV_{max}$  and  $SUV_{mean}$  (-0.28; 0.27). For all other CTP parameters, no statistically significant correlation was found with PET/CT parameters.

**Conclusion:** CT-perfusion parameters showed only partially weak correlation with PET/CT parameters. This suggests that both parameter sets may reflect independent patho-physiological mechanisms of lung cancer.

SS104

**Comparison of PET/CT and PET/MRI for abdomino-pelvic cancer lesions: First clinical experience and basic MR sequence selection***D. Schmidt, P. Appenzeller, M. Hüllner, F. Kuhn, D. T. Schmid, A. Boss, G. K. von Schulthess, P. Veit-Haibach; Zürich*

**Purpose:** The purpose of our study was to compare directly the diagnostic accuracy of non-contrast enhanced PET/CT and non-contrast enhanced PET/MRI with three different MR sequences with regards to abdomino-pelvic tumors.

**Methods and Materials:** Fortythree patients with various oncological diseases were referred for clinical PET/CT and prospectively included. PET/MRI was performed within a 3T PET/CT-MRI system. The MR pulse sequences comprised an ultra fast gradient echo T1w (LAVA), a balanced gradient echo T2w (FIESTA) and an ultra fast spin echo T2w (SSFSE). All lesions were compared concerning detectability, anatomic localization, size and conspicuity (score 1–4). For statistical analyses Wilcoxon signed rank test was used.

**Results:** Onehundredeightyfive PET positive lesions were detected. Seventyfour of 185 PET-positive lesions were evaluated included bone. No statistically significant difference was found for lesion detectability in PET/MRI and anatomic localization compared to PET/CT. Lesions were significantly smaller on PET/CT compared to all PET/MRI sequences, and on SSFSE compared to LAVA and Fiesta (mean size CT: 16.9 mm, mean size MRI: 23.0 mm). Lesion conspicuity was higher on all PET/MRI sequences than on PET/CT, and higher on LAVA compared to on SSFSE and Fiesta (mean scores: PET/CT 2.15, PET/MRI 3.19). PET/MR imaging was superior compared to PET/CT imaging for delineation of lymph nodes, GIT and liver lesions ( $P<0.05$ ). For PET/MR sequence selection LAVA and SSFSE were overall superior to FIESTA for conspicuity of all lesions.

**Conclusion:** PET/MRI is superior compared to PET/CT concerning lesion conspicuity in abdomino-pelvic tumors. LAVA and SSFSE were superior to FIESTA for lesion conspicuity.

SS105

### The value of fused MR/FDG PET in the assessment of patients with recurrent gynecological malignancies prior to pelvic exenteration

*L. Burger<sup>1</sup>, H. A. Vargas<sup>2</sup>, O. F. Donati<sup>1</sup>, V. Andikyan<sup>2</sup>, H. Schöder<sup>2</sup>, E. Sala<sup>2</sup>, H. Hricak<sup>2</sup>; <sup>1</sup>Zürich, <sup>2</sup>New York/US*

**Purpose:** To assess the incremental value of fused MRI [18F]-FDG-PET compared to MRI or PET/CT for local disease extent prior to pelvic exenteration for recurrent gynecological malignancies, and to determine if FDG uptake metrics [SUV<sub>max</sub>, total lesion glycolysis (TLG) and metabolic tumor volume (MTV)] can be used as predictive biomarkers for overall survival.

**Methods and Materials:** 31 patients undergoing FDG-PET/CT and pelvic MRI within 90 days prior to pelvic exenteration were retrospectively selected. The presence of bladder, rectum and pelvic sidewall invasion was determined on PET/CT, 3 months later on MRI and subsequently on fused MRI/PET images. For each patient SUV<sub>max</sub>, TLG and MTV were measured. Areas under the curve (AUCs) for detecting pelvic organ or side wall invasion were calculated. Kaplan Meier graphs were used to determine associations between SUV<sub>max</sub>, TLG, MTV and overall survival.

**Results:** The AUCs for bladder, rectum and pelvic side wall invasion were 0.90, 0.92 and 0.77 for PET/CT, 0.86, 0.97 and 0.89 for MRI and 0.94, 0.99 and 0.99 respectively for fused MRI/PET. There was a significant association between TLG/MTV and overall survival ( $p=0.05/p=0.001$ ), but not for SUV<sub>max</sub> ( $p=0.317$ ).

**Conclusion:** In patients undergoing pelvic exenteration for recurrent gynecological malignancies, fused MRI/PET was more accurate than PET/CT or MRI alone for assessment of local disease extent. TLG and MTV were predictive biomarkers for overall survival, but SUV<sub>max</sub> was not associated with overall survival.

SS106

### Diagnostic accuracy of PET/MRI in gynecological malignancies:

#### Initial results

*P. Veit-Haibach<sup>1</sup>, N. Hauser<sup>2</sup>, B. Chilla<sup>2</sup>, G. K. von Schulthess<sup>1</sup>, J. M. Fröhlich<sup>1</sup>, R. A. Kubik-Huch<sup>2</sup>; <sup>1</sup>Zürich, <sup>2</sup>Baden*

**Purpose:** To assess and to compare the diagnostic accuracy of PET/CT and PET/MRI in primary and metastatic gynecological malignancies.

**Methods and Materials:** 13 female patients with different gynecological diseases underwent a contrast-enhanced tri-modality PET/CT-MRI examination (PET/CT D 690 and 3T MRI 750W, GE Healthcare). Patients were injected with an average of 320 MBq F18-FDG. A full diagnostic, contrast-enhanced MRI of the abdomen and pelvis, based on the current guidelines, was acquired. After the MRI, patients were transferred on a dedicated shuttle to the PET/CT. Here, a standard PET/CT was acquired. PET/MRI and PET/CT were evaluated concerning detection and conspicuity of the primary tumor, lymph node metastases and distant metastases. Readers also evaluated if the PET/MRI revealed relevant additional information compared to PET/CT.

**Results:** Concerning the primary tumour, the PET/CT was superior in 2 cases, PET/MRI in 5 cases, concerning lymph nodes PET/CT was superior in 2 cases, PET/MRI in 2 cases, in abdominal metastases PET/CT was superior in 2 cases, PET/MRI in none. PET/CT overall showed additional relevant additional information in 9 cases mainly concerning distant metastases, while PET/MRI showed relevant additional information in 3 cases concerning the primary tumour.

**Conclusion:** In this initial trial, PET/MRI is well feasible within a tri-modality PET/CT-MRI system. The PET/MRI shows mainly advantages concerning the evaluation of the primary tumor/local pelvic situation while the PET/CT has advantages concerning distant metastases. PET/CT with fast whole body imaging and an integrated full diagnostic pelvic protocol has to be evaluated concerning the differences in distant metastases detection.

SS107

### Selective internal radiotherapy (SIRT) of hepatic tumors: A 2-year experience

*V. Obmann, J. Kettenbach, C. Boy, H. Hoppe, J. Heverhagen, V. Banz-Wüthrich, M. Kellermann, R. López-Benítez; Bern*

**Purpose:** Selective internal radiotherapy (SIRT) with the beta emitter Yttrium-90 is a rapidly developing therapy option for liver malignancies. SIRT has emerged as a new therapeutic concept for the palliative treatment of primary and secondary liver tumors not suitable for surgery, chemotherapy or percutaneous tumor ablation. The purpose of this retrospective study was to evaluate the clinical and radiological response of patients with non-resectable liver tumors after SIRT.

**Methods and Materials:** Over a two-year period 58 patients with advanced liver disease were selected by a multidisciplinary tumor board as candidates to receive SIRT. Clinical and radiological follow-up were performed by CT and/or MRI at one and three months, and every three months thereafter. Patients' survival, response to treatment (RECIST 1.0 and m-RECIST) and clinical outcome were assessed.

**Results:** SIRT was performed according to interventional and nuclear medical guidelines in 53 of 58 (91%) eligible patients. Overall survival after 3, 6 and 12 months was 90.5%, 71.4% and 43.8% respectively. Fifteen of 53 (28%) patients died during the observation period. So far, radiological tumor response in 40 out of 53 patients showed complete remission in 0%, partial remission in 27.3%, stable disease in 63.6% and tumor size progression in 9.0%. Seven patients were eligible for further downsizing by a second SIRT, chemoembolization or surgical resection. The majority of patients showed no treatment-related clinical symptoms. However, there was one severe adverse event related to ulceration from non-targeted deposition of SIRT-spheres with life-threatening consequences.

**Conclusion:** SIRT provides a promising tumor response even in advanced cases of liver disease.

SS108

### Feasibility and preliminary results of SPECT/CT arthrography of the wrist in comparison with MR arthrography in patients with suspicion for ulnocarpal impaction

*I. Steurer-Dober<sup>1</sup>, U. Hug<sup>1</sup>, M. Hüllner<sup>1</sup>, M. D. S. Pérez Lago<sup>1</sup>, E. Bodmer<sup>1</sup>, U. von Wartburg<sup>1</sup>, P. Veit-Haibach<sup>2</sup>, K. Tornquist<sup>1</sup>, K. Strobel<sup>1</sup>; <sup>1</sup>Luzern, <sup>2</sup>Zürich*

**Purpose:** To evaluate feasibility and performance of SPECT/CT arthrography of the wrist in comparison with MR arthrography in patients with suspicion for ulnocarpal impaction.

**Methods and Materials:** 25 wrists of 24 patients (4 female, 20 male; mean age, 43 years (range, 22–66 years) were prospectively evaluated. A mixture of iodinated contrast media and gadolinium was injected in the distal radioulnar and midcarpal joints prior to MR and SPECT/CT imaging. Late phase SPECT/CT was performed 3.5 hours after intravenous injection of approximately 650 MBq Tc99m DPD. MR and SPECT/CT images were separately reviewed regarding bone marrow edema, radionuclide uptake, scapholunate ligament, lunotriquetral ligament, TFCC and overall diagnosis of ulnar impaction.

**Results:** MR arthrography and SPECT/CT arthrography image quality was fully diagnostic in 20/25 wrists, suboptimal in 5/25 and 4/25. SPECT/CT arthrography was not diagnostic for SL-, LT- and TFCC lesions due to insufficient intraarticular contrast in one wrist. MR and SPECT/CT showed concordant findings regarding TFCC lesions in 20/24 wrists, SL in 18/23 wrists and LT in 20/23. MR bone-marrow-edema and scintigraphic uptake was concordant in 19/25 wrists. MR showed partial TFCC defects in three patients with normal SPECT/CT. MR showed bone-marrow-edema in 4/25 wrists without scintigraphic uptake. Regarding overall diagnosis of ulnar impaction the concordance reached 96%.

**Conclusion:** SPECT/CT arthrography of the wrist is feasible. Regarding diagnosis of ulnar impaction we found a high concordance with MR arthrography. MR was more sensitive regarding bone marrow changes and partial TFCC tears. SPECT/CT arthrography can replace MR arthrography in patients with MR contraindications.

## SS109

**Diagnostic accuracy of SPECT/CT, MRI, CT, bone scan and plain radiographs in patients with unspecific wrist pain**

*L. Werner<sup>1</sup>, M. Hüllner<sup>2</sup>, A. Bürkert<sup>1</sup>, M. Pérez-Lago<sup>1</sup>, K. Strobel<sup>1</sup>, U. Hug<sup>1</sup>, P. Veit-Haibach<sup>2</sup>; <sup>1</sup>Luzern, <sup>2</sup>Zürich*

**Purpose:** To investigate the diagnostic accuracy of SPECT/CT, MRI, CT, bone scan and plain radiographs in patients with unspecific wrist pain.

**Methods and Materials:** Thirty-two patients (median age 38 years, range 18–73 years; 19 female, 13 male) with unspecific pain of the hand or wrist were evaluated retrospectively. The diagnosis of unspecific wrist pain was made by the referring hand surgeon. All patients were imaged by plain radiographs, planar early-phase imaging (bone scan) and late-phase SPECT/CT imaging including CT, and MRI. Two experienced and two inexperienced readers analyzed the images with a standardized read-out protocol to detect the causative lesion. Diagnostic accuracy, specificity and sensitivity were determined for all imaging modalities. The standard of reference consisted of complete clinical examination and imaging, and a mean follow-up of 20 months. Eleven patients additionally underwent arthroscopy.

**Results:** For experienced readers, the most accurate modality was SPECT/CT (accuracy 77%, specificity 90%, sensitivity 74%), then MRI (56%, 10%, 65%, respectively) and bone scan (44%, 70%, 39%, respectively). The best performing modality for inexperienced readers was also SPECT/CT (accuracy 44%, specificity 60%, sensitivity 41%), followed by MRI (38%, 80%, 30%, respectively) and bone scan (38%, 90%, 28%, respectively). The accuracy of plain radiographs and CT was generally poor for all readers.

**Conclusion:** SPECT/CT is superior to MRI in diagnosing the causative lesion and in ruling out patients without causative lesions. Even inexperienced readers achieve reasonable results by SPECT/CT, similar to experienced readers by conventional bone scan. SPECT/CT may be a helpful diagnostic tool in patients with unspecific pain of the wrist.



SS110

**New approach for triple rule-out CT angiography (TRO)***P. Zukowski, G. Bodendörfer, A. Jaff, P.-A. Moret, C. Theodoloz, H. Bänziger, Riaz*

**Purpose:** Recent studies have demonstrated advantages for non-invasive imaging of the coronary arteries. In this study we aimed to test the applicability of new TRO protocol using a iCT 256 platform. Acute chest pain is a common symptom but triage decisions in these patients remain a challenge. ECG or levels the cardiac enzymes often are unspecific. Protokol Triple rule-out allows the depiction of the pulmonary arteries, the thoracic aorta and the coronary arteries.

**Methods and Materials:** Since 1.12.2012 among 54 patients with acute chest pain and an intermediate or high risk for acute coronary syndrome (ACS) underwent TRO-CTA using a new optimized iCT 256 platform.

**Results:** Among 17 true positive patients with coronary severe (>50%) stenosis, 3 underwent percutaneous coronary intervention. Based on negative TRO 26 patients were discharged on the same day. One patient has non-ruptured thoracic aorta aneurism. Pulmonary embolism was presented in 9 patients, one with incidental pulmonary carcinoma. One patient had Horton's disease. In with 5 patients we had sever cardiac dysfunction with pleural or/and pericardial effusion. Average time of CT-scan was 7s, Average dose 8mSy.

**Conclusion:** In comparison to TRO in the standard 64 rows unit a new optimized iCT 256 platform offer us a shorter scan time, lower dose and lower contrast level an better image quality. TRO-CTA can safely reduce the number of hospitalized patiens.

SS111

**Type A aortic dissection:****CT signs to predict the involvement of the aortic valve***A. Platon, D. Didier, C. Becker, P.-A. Poletti; Genève*

**Purpose:** To determine indirect signs predictive of the extension of type A aortic dissection into the aortic leaflets, on non-ECG gated CT examinations, which would be helpful for surgeon to plan the intervention.

**Methods and Materials:** CT from all consecutive patients who underwent emergency surgery in our institution between 2008 and 2011 for a type A aortic dissection were analyzed in consensus by three radiologists, blinded from surgical findings. The following measures were obtained: mean diameters of the aortic annulus, sinus of Valsalva, sinotubular junction and ascending aorta, based on measures performed in two different planes. The presence of hemopericardium was also recorded. Then, the surgical record of each patient was analyzed for the presence of an extension of the dissection into the aortic valve. Measures obtained from CT were compared to surgical results to determine whether they can predict the involvement of the aortic valve.

**Results:** 20 patients (13 men, 7 women, mean age 60 years) met our inclusion criteria. Eleven of them had an extension of the dissection into the aortic valve, found at surgery. Among the 5 signs reported at CT, the mean diameter of the sinus of Valsalva was significantly larger ( $p=0.02$ ) in patients with involvement of aortic valve (mean 44.3 mm, range 35.8–55.5 mm) than in patients without valvular involvement (mean 38.1 mm, range 32.3–44 mm).

**Conclusion:** The mean diameter of the sinus of Valsalva is a useful indirect sign to suggest the extension of a type A dissection into the aortic valve on a non-gated CT.

SS112

**ECG-gated aortic CT using high-pitch and iterative reconstruction: Dose and image quality preliminary results***A.-L. Hachulla, J.-P. Vallee, X. Montet, D. Didier; Genève*

**Purpose:** To study dose length-products (DLP), image quality and contrast-to-noise ratio (CNR) of thoraco-abdominal gated aortic CT obtained with a high-pitch CT imaging protocol using sinogram-affirmed iterative reconstruction (SAFIRE®) or filtered back projection (FBP).

**Methods and Materials:** Fifty-five patients underwent gated aortic CT without  $\beta$ -blockers on a Somatom Definition Flash CT scanner for aortic disease with Flash protocol using a pitch of 3.2 with both SAFIRE® and FBP reconstruction algorithms. CNR between vessels and myocardium was calculated on the aorta and the coronary arteries. Subjective image quality of the aorta and the coronary arteries was graded on a 3-point scale.

**Results:** High-pitch acquisition protocol resulted in a DLP of  $234 \pm 93$  mGy.cm for an acquisition of the entire aorta, with a mean heartbeat of  $73 \pm 16$  beats per minute. No heart motion or breathing artifacts were observed. CNR (ascending aorta vs myocardium) was  $7.3 \pm 2.8$  and  $10.6 \pm 4$  for FBP and SAFIRE® algorithms respectively ( $p < 0.0001$ ). CNR (right coronary vs myocardium) was  $6.5 \pm 3.0$  and  $9.4 \pm 4.3$  for FBP and SAFIRE® algorithms ( $p < 0.0001$ ). Despite relatively high heart rate, the diagnostic quality of proximal and mid-segments of the coronary arteries was graded as excellent in all patients with the exception of the vertical segment of the right coronary artery (non diagnostic in 6/55 patients).

**Conclusion:** ECG-gated aortic CT with high-pitch acquisition reconstructed with SAFIRE® allows better CNR than with FBP alone. Despite the lack of  $\beta$ -blockers, proximal and mid-segments of the coronary arteries could be evaluated in the same acquisition.

SS113

**Paravalvular regurgitation after transapical aortic valve implantation: Prognostic power of calcification with respect to volume and location***T. Dellas Buser, D. Inderbitzin, N. Kawel-Boehm, F. Rueter, O. Reuthebuch, B. Kaufmann, J. Bremerich; Basel*

**Purpose:** To assess the prognostic power of aortic valve calcifications in predicting paravalvular aortic regurgitation (PAR) after transapical transcatheter aortic valve implantation (TAVI).

**Methods and Materials:** Twenty-one patients (15 men, mean 82 years) with severe aortic stenosis received a catheter mounted porcine root valve sewn onto a Nitinol self-expanding stent (JenaValve, München, Germany) over a transapical approach. Procedure planning included contrast enhanced multidetector CT and transesophageal echocardiography. After implantation patients received follow-up by transthoracic echocardiography.

Aortic valve calcifications were assessed on CT with respect to volume and location using dedicated postprocessing software (TeraRecon, Foster City, USA). Each aortic cusp was analyzed separately. PAR was graded as none, trace to mild, moderate and severe. Significance of valvular calcifications was determined by means of Student's t-test.

**Results:** Postprocedural PAR was observed in 57% (12/21) of patients. PAR was graded trace to mild in 11 and moderate in one patient. There was a weak but significant correlation between calcifications of the right coronary cusp and PAR ( $p=0.045$ ). Numerically calcifications of the non-coronary cusps exceeded those of the coronary cusps. Interestingly, these were not correlated with postprocedural PAR ( $p>0.05$ ). Other significant predictors of PAR were preprocedural valvular orifice cross-sectional area as assessed by the continuity equation using doppler echocardiography ( $p=0.034$ ) and effective diameter ( $p=0.045$ ) as determined from annular area by CT.

**Conclusion:** In TAVI planning CT based assessment of aortic valvular calcifications can predict postprocedural PAR. Patients with severe calcifications of the right coronary cusp in particular seem to be at risk for postprocedural paravalvular aortic regurgitation.

SS114

**Stenosis quantification in coronary CT angiography: Impact of an integrated circuit detector with iterative reconstruction***F. Morsbach<sup>1</sup>, L. Desbiolles<sup>2</sup>, A. Plass<sup>1</sup>, S. Leschka<sup>2</sup>, B. Schmidt<sup>3</sup>, V. Falk<sup>1</sup>, H. Alkadhi<sup>1</sup>, P. Stolzmann<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>St. Gallen, <sup>3</sup>Forchheim/DE*

**Purpose:** To assess an integrated circuit (IC) detector, improving spatial resolution by means of reduced cross-talk between detector channels, in coronary CT angiography regarding image quality and stenosis quantification.

**Methods and Materials:** In the ex-vivo part of the study, a coronary phantom including 63 defined stenoses were scanned with 128-section dual-source CT equipped with IC and with conventional detector technology. Data was reconstructed with filtered-back projection (FBP) and with iterative reconstruction (IR) at a slice-thickness of 0.6 mm and for data acquired with the IC detector with a slice-thickness of 0.5 mm. Phantom observations were validated in 30 consecutive patients (11 female; mean age 62) undergoing coronary CT angiography with IC. The patient images were reconstructed with FBP (slice-thickness: 0.6 mm) and with IR (slice-thickness: 0.5 mm). All images were assessed for image quality and degree of stenosis.

**Results:** Image quality was significantly ( $P<0.001$ ) higher with the IC detector as compared to the conventional detector. The IC detector yielded significantly more accurate results regarding stenosis grading: FBP:  $12.1\pm 7.6\%$  vs.  $13.7\pm 7.6\%$  ( $P=0.043$ ) and IR:  $10.5\pm 6.6\%$  vs.  $13.0\pm 6.9\%$  ( $P<0.001$ ). Images with a slice thickness of 0.5 mm reconstructed with IR ( $8.8\pm 5.9\%$ ) obtained by the IC detector significantly ( $P<0.001$ ) improved measurement accuracy in the phantom as compared to FBP with a slice thickness of 0.6 mm ( $12.1\pm 7.6\%$ ). In patients we found a significantly ( $P<0.001$ ) higher image quality, and stenoses were quantified significantly ( $P=0.009$ ) more severe with FBP (47.6%) as compared to IR (42.1%).

**Conclusion:** Our study indicates more accurate stenosis quantification in coronary CT angiography when acquiring data using an IC detector and combining IR with high-resolution images as compared to conventional detector technology and FBP reconstructions.

SS115

**Quantitative BOLD response of the left ventricular myocardium to hyperoxic respiratory challenge at 1.5 T and 3.0T cardiac magnetic resonance imaging***S. Winklhofer, S. Pazahr, R. Manka, A. Boss, H. Alkadhi, P. Stolzmann; Zürich*

**Purpose:** To quantify the changes of myocardial transverse relaxation times ( $\Delta T_2^*$ ) induced by hyperoxic respiratory challenge at different field strengths in an intra-individual comparison of healthy volunteers.

**Methods and Materials:** Blood oxygen level dependent (BOLD) cardiovascular magnetic resonance (CMR) data was acquired in ten healthy volunteers (5 women; 5 men; median age 29 years, range 22–35 years) at 1.5T and 3.0T. Medical air (21% O<sub>2</sub>), pure oxygen and carbogen (95% O<sub>2</sub>, 5% CO<sub>2</sub>) were alternatively administered in a block-design temporal pattern to induce normoxia, hyperoxia and hyperoxic hypercapnia, respectively. Parametrical  $T_2^*$  relaxation time maps were computed, average  $T_2^*$  values were derived from Region-of-Interest analysis by two independent and blinded readers in 16 standard myocardial segments on 3 short axis slices per patient.

**Results:** Inter- and intra-reader correlations of  $T_2^*$  measurements were good (ICC=0.75 and ICC=0.79, both  $P<0.001$ ). Under normoxia, the mean  $T_2^*$  values were  $30.6\pm 7.0$  ms at 1.5T and  $27.6\pm 7.6$  ms at 3.0T. Both hyperoxic gases induced significant ( $P<0.001$ ) relaxation time increases  $\Delta T_2^*$  (oxygen: 1.5T,  $3.5\pm 5.9$  ms; 3.0T,  $2.1\pm 6.3$  ms; carbogen: 1.5T,  $2.9\pm 7.1$  ms; 3.0T,  $4.3\pm 7.6$  ms). As opposed to 1.5T, the magnitude of  $\Delta T_2^*$  response was higher at 3.0T and under carbogen as compared with oxygen breathing ( $p<0.01$ ).

**Conclusion:** The myocardial  $\Delta T_2^*$  response to hyperoxic respiratory challenge can reliably be quantified with BOLD CMR. The magnitude  $T_2^*$  increases significantly with a higher field strength as well as with carbogen as compared to oxygen breathing. Future studies are warranted to investigate the potential diagnostic role of BOLD response in assessing patients with coronary cardiomyopathy.

SS116

**Comparison of high resolution non-contrast-enhanced MR-Angiography of pedal vessels with digital subtraction angiography and contrast-enhanced MR-Angiography***T. Schubert<sup>1</sup>, M. Klarhöfer<sup>1</sup>, T. Haas<sup>1</sup>, A. L. Jacob<sup>2</sup>, S. Kos<sup>3</sup>; <sup>1</sup>Basel, <sup>2</sup>Zürich, <sup>3</sup>Luzern*

**Purpose:** This study was conducted in order to compare a high resolution (HR), non-contrast-enhanced MRA-sequence (native SPACE, [1,2]) of the pedal arteries with a digital subtraction angiography (DSA) as the gold standard as well as a contrast-enhanced MRA- (ceMRA-) sequence in patients with peripheral arterial occlusive disease (pAOD).

**Methods and Materials:** The study consists of 11 pAOD patients that underwent DSA, non-enhanced MRA (native SPACE) and ceMRA (TWIST acquisition technique) of the pedal vessels with a high spatial resolution. All patients underwent a percutaneous transluminal angioplasty or stenting and received the MR-Angiographies the following day.

**Results:** 154 vessel segments were evaluated. A statistical significant difference between native SPACE (mean=2.48) and TWIST (mean=2.21;  $p=0.002$ ) and between native SPACE and DSA (mean=2.29;  $p=0.02$ ) regarding vessel visibility (1=excellent, 5=none) was found. The degree of stenosis (0=none, 4=occlusion > 50% of segment) was graded significantly higher using native SPACE (mean=1.72) compared to the TWIST sequence (mean 1.47;  $p=0.004$ ) as well as the DSA (mean=1.45;  $p=0.005$ ). However, no significant differences were found regarding diagnostic utility (1=good, 3=not usable) between native SPACE (mean=1.34) and TWIST (mean=1.25;  $p=0.15$ ) with DSA (mean 1.12) being superior to both MRA sequences (DSA vs. native SPACE:  $p=0.0005$ , DSA vs. TWIST:  $p=0.019$ ).

**Conclusion:** HR-Native SPACE is suitable for the depiction of pathologies in very small, distal pedal vessels.

SS117

**Assisted recanalization of long and calcified chronic total occlusions using a high frequency vibrational device: Preliminary experience***F. Glauser<sup>1</sup>, A. Chouiter<sup>2</sup>, L. Perrin<sup>1</sup>, A.-M. Jouannic<sup>1</sup>, F. Doenz<sup>1</sup>, S. D. Qanadli<sup>1</sup>; <sup>1</sup>Lausanne, <sup>2</sup>Neuchâtel*

**Purpose:** Recanalization of peripheral chronic total occlusions (CTO) is technically challenging, especially in long and calcified lesions. The aim of this study was to assess the safety and the efficacy of a high frequency vibrational device (Crosser) in CTO recanalizations.

**Methods and Materials:** Seventeen patients, mean age 70 years, with peripheral arterial disease were enrolled. Five patients were Fontaine IV stage while 12 had intermittent claudication. Fourteen patients had heavy calcified CTOs documented by CT or angiography: iliac (n=3), femoropopliteal (n=9) or tibial (n=1). CTO was in native vessels in all patients (eleven de-novo and three in-stent) and was considered refractory to guidewire in 6 patients. The Crosser device consisted on a crossing device based upon high frequency mechanical vibration. Primary technical success was the ability to cross CTO using the crosser device. Safety endpoints were thromboembolisms and perforations related to the Crosser device. A 3 month follow-up was obtained for all patients.

**Results:** The primary technical success rates for Crosser recanalization were respectively 88%. The mean recanalized length was 156 mm and the mean Crosser use time was 6.7 minutes. The Crosser achieved intraluminal intended recanalization in 53%. There were no adverse events related to the Crosser device. Recanalized vessels were treated with angioplasty/stents. Clinical success was 91% at 3 months follow-up.

**Conclusion:** The Crosser device is safe and shows promising results in challenging cases as long and calcified lesions and in-stent CTO. Further evaluations, however, are needed to better select patients for such device.

SS118

**Radiation dose to the operator during fluoroscopically-guided spine procedures**

A. Cianfoni<sup>1</sup>, H. E. Hawk<sup>2</sup>, E. Pravata<sup>1</sup>, M. U. Manzoor<sup>2</sup>, Z. Rumboldt<sup>2</sup>, W. Huda<sup>2</sup>; <sup>1</sup>Lugano, <sup>2</sup>Charleston SC/US

**Purpose:** Fluoroscopy is widely used for diagnostic and therapeutic spine procedures. The purpose of this study was to quantify Dose incident on the operator measured Above the Lead Apron (DALA) during a wide range of fluoroscopy-guided spine procedures, and its correlation with the amount of radiation incident on the patient (DALA area Product – DALAP).

**This abstract has been withdrawn**

SS119

**Phase contrast mammography: A novel diagnostic tool for breast imaging**

Z. Wang<sup>1</sup>, N. Hauser<sup>2</sup>, R. A. Kubik-Huch<sup>2</sup>, G. Singer<sup>2</sup>, E. Roessl<sup>3</sup>, U. Stevendaal<sup>3</sup>, N. Wieberneit<sup>3</sup>, I. Schulze-Wenck<sup>3</sup>, M. Stampanoni<sup>4</sup>; <sup>1</sup>Villigen, <sup>2</sup>Baden, <sup>3</sup>Hamburg/DE, <sup>4</sup>Zürich

**Purpose:** Phase-contrast and scattering-based x-ray imaging can potentially revolutionize the radiologic approach to breast imaging by providing additional and complementary information to conventional, absorption-based methods. We present the results of a multicenter, international reader study aiming at the evaluation of the clinical relevance of phase contrast mammography.

**Methods and Materials:** Freshly dissected whole breast specimens of 33 patients with histo-pathologically proven breast cancer were imaged using a Talbot-Lau interferometer equipped with a conventional x-ray tube. The interferometer was operated at a tube voltage of 40 kVp with mean energy of 28 keV, and current of 25 mA. The device simultaneously recorded absorption, differential phase and small-angle scattering signals. These three quantities were combined into novel, high-frequency-enhanced radiographic images and compared to digital mammograms. Six international readers evaluated clinically relevant parameters such as general image quality, presence of artifacts, and visibility of diagnostic features (i.e. lesion conspicuity, microcalcifications and skin infiltration) on a 5-point-scale.

**Results:** Our novel imaging approach yields complementary and otherwise inaccessible information on electron density distribution and small-angle scattering power of the breast tissue. The study indicates that phase contrast mammography images are superior to conventional mammograms in general image quality ( $p < 0.001$ ), lesions sharpness and delineation ( $p < 0.001$ ), visibility and sharpness of microcalcifications ( $p < 0.001$ ), and contain additional clinically relevant information ( $p < 0.001$ , 1–10% superior).

**Conclusion:** The evaluations on the potential clinical significance of phase contrast mammography reveal that this novel approach yields images with improved image quality and increased clinical relevance compared to conventional digital mammography.

SS120

**Novel ultrasound tomography for investigation of breast lesions with microcalcifications**

V. Marmarelis<sup>1</sup>, M. Sofras<sup>2</sup>, S. Hadjiagapis<sup>2</sup>, M. Orme<sup>3</sup>, D. Koulouchi<sup>4</sup>, P. Liakou<sup>4</sup>, G. Zografos<sup>4</sup>, S. Dellas<sup>5</sup>, S. Forte<sup>5</sup>; <sup>1</sup>Los Angeles/US, <sup>2</sup>Voula/GR, <sup>3</sup>Palos Verdes Peninsula/US, <sup>4</sup>Athens/GR, <sup>5</sup>Basel

**Purpose:** The novel 3D diagnostic imaging technology of Multimodal Ultrasound Tomography (MUT) was used to investigate breast lesions in areas with microcalcifications in mammograms of 62 BIRADS-4 volunteers who, subsequently, underwent biopsy.

**Methods and Materials:** MUT performs 3D tomographic scans of the whole pendulant breast in water-bath using transmission ultrasound in fixed-coordinate system. Specially designed sequences of ultrasonic pulses are used over multiple view-angles in each coronal scanning plane. MUT reconstructs multiple images for each coronal slice, based on refractivity and frequency-dependent attenuation and dispersion. Multimodal fusion of these images allows reliable lesion differentiation in composite images. This capability was tested in 62 female volunteers (ages 36–68) presenting microcalcifications in their mammograms, who were referred to biopsy. The MUT results were validated with histopathology performed on biopsy samples.

**Results:** MUT was able to detect and classify correctly all the 62 main lesions identified by histopathology of the biopsy samples, which included 15 malignant lesions (9 DCIS, 1 LCIS, 4 invasive ductal carcinomas and 1 matrix producing carcinoma). All detected malignant lesions had maximum dimension <8 mm. The smallest detected lesions (4 DCIS) had maximum dimension of 3 mm.

**Conclusion:** These results demonstrate the potential capability of MUT technology to detect and differentiate small breast cancer lesions (down to 3 mm in maximum dimension) in BIRADS-4 patients with mammographic microcalcifications.

SS121

**Role of preoperative MR imaging in the evaluation of patients with persistent or recurrent gynecologic malignancies prior to pelvic exenteration**

O. F. Donati<sup>1</sup>, Y. Lakhman<sup>2</sup>, E. Sala<sup>2</sup>, I. Burger<sup>1</sup>, H. A. Vargas<sup>2</sup>, D. Goldman<sup>2</sup>, V. Andikyan<sup>2</sup>, K. Park<sup>2</sup>, D. Chi<sup>2</sup>, H. Hricak<sup>2</sup>; <sup>1</sup>Zürich, <sup>2</sup>New York/US

**Purpose:** To determine: (1) the diagnostic performance of MRI in assessing local tumor extent and (2) to evaluate the association between MRI features and survival in patients with persistent or recurrent gynecologic cancers prior to pelvic exenteration.

**Methods and Materials:** The IRB approved and waived informed consent for this retrospective, HIPAA-compliant study of 50 patients with biopsy-proven persistent or recurrent gynecologic malignancies who underwent pelvic exenteration between January 1999 and December 2011 and had preoperative MRI within 90 days from surgery. Two radiologists independently assessed invasion of adjacent organs (graded on a 5-point scale) and measured tumor size. Diagnostic accuracy of MRI for organ invasion and interreader agreement were calculated. Kaplan-Meier curves and Cox regression analysis were used to evaluate the associations between MRI features and patient survival.

**Results:** Areas under the receiver operating characteristic curve (AUCs) for invasion of the bladder, rectum, and pelvic sidewall were 0.96, 0.90 and 0.98 for reader 1 and 0.95, 0.88 and 0.90 for reader 2. Corresponding sensitivities/specificities were 87.0%/92.6%, 81.3%/97.0% and 87.5%/97.2% for reader 1, and 87.0%/100.0%, 75.0%/97.0% and 75.0%/94.4% for reader 2. There was excellent interreader agreement for both organ invasion ( $\kappa = 0.81–0.85$ ) and tumor size (ICC=0.89). A significant association was found between pelvic sidewall invasion on MRI and both, overall and recurrence-free survival ( $P = 0.01–0.04$  for the two readers).

**Conclusion:** Preoperative MRI is accurate in predicting organ invasion and may serve as a predictive biomarker in patients with recurrent gynecologic malignancies undergoing pelvic exenteration.

SS122

**Breast MRI: Spatial analysis of diffusion tensor data reveals exponential dependence of diffusion parameters**

J. Wiederer, S. Pazahr, A. Boss; Zürich

**Purpose:** Diffusion Tensor Imaging of the breast may provide a powerful new approach for the detection of intraductal processes such as DCIS. The aim of this investigation was to perform a spatial analysis of diffusion tensor parameters (MD: mean diffusivity, FA: fractional anisotropy) to find a standardized methodology for the characterization of breast tissue and pathologies.

**Methods and Materials:** Seven young, healthy female volunteers (age under 35) without known breast pathology were included in the study after ethics approval. MRI examinations were performed in a 3T MR imager with a dedicated breast coil applying a double-spin-echo prepared echo-planar diffusion sequence (TR/TE 8250 ms/74 ms, b-value 500 s/mm<sup>2</sup>, 6 non-collinear encoding directions, 12 averages, 35 slices). Diffusion tensor calculations were performed offline with homemade computer routines. Spatial distribution of MD and FA was analysed by linear and exponential regression.

**Results:** In all volunteers, parametrical maps of MD and FA showed excellent image quality. A typical pattern of the diffusion parameters was found: the higher the diffusivity, the lower the anisotropy of the diffusion directionality. The dependence exhibited an exponential behavior with a correlation coefficient  $R = 0.60$  ( $R \text{ linear} = 0.57$ ). For MDs below (above)  $1.5 \times 10^{-3} \text{ mm}^2/\text{s}$ , mean FA was  $0.49 \pm 0.09$  ( $0.30 \pm 0.09$ ).

**Conclusion:** The spatial analysis of DTI parameters allows describing different compartments of breast tissue, hypothetically corresponding to different sizes of efferent ducts. The smaller ducts with slower water diffusion exhibit a higher directionality. The proposed analysis technique potentially allows the standardized detection of intraductal pathologies.



SS123

**Histopathological B3 lesions following minimally invasive vacuum-assisted breast biopsy (VABB): MIBB Database Analysis**C. Saladin<sup>1</sup>, H. Haueisen<sup>2</sup>, G. Kampmann<sup>3</sup>, C. Öhlschlegel<sup>4</sup>, B. Seifert<sup>5</sup>, L. Rageth<sup>5</sup>, C. Rageth<sup>5</sup>, S. Stadlmann<sup>1</sup>, R. A. Kubik-Huch<sup>1</sup>;<sup>1</sup>Baden, <sup>2</sup>Aarau, <sup>3</sup>Sorengo-Lugano, <sup>4</sup>St. Gallen, <sup>5</sup>Zürich

**Purpose:** For the histology of breast biopsies, B-classification has become established standard. B3 lesions (benign with unclear malignant potential) are a particular challenge, as there are no binding recommendations regarding the further procedure. Our study objective was to analyse all B3 lesions, diagnosed at VABB and captured in the MIBB data base.

**Methods and Materials:** 9152 VABB performed between 2009 and 2011, captured in the MIBB database, were examined for the frequency of B3 lesions, which were analysed, correlated with imaging and compared with surgical follow-up resection.

**Results:** Of the 9152 biopsies, 17% were B3 lesions (ADH 18%, papillary lesions 25%, FEA 23%, LN 16%, radial scars 8%). Microcalcifications were present in 82% of ADH lesions, 36% of papillary lesions, 88% of FEA, 73% of LN and 63% of radial scars. In 75% of biopsies with B3 diagnosis a clip was inserted. In 48% mammographic findings could be removed completely during biopsy, in 51% partially. Surgical follow-up resection was performed in 38%. The overall rate of malignancies in the definitive histology was 21% (ADH 26%, LN 26%, FEA 18%, radial scar 11%, papillary lesion 3%).

**Conclusion:** With 17% of all analysed biopsies, the B3 rate was high. The overall rate of malignant findings after follow-up excision was 21%, being highest for ADH and LH. These data are intended to serve as a basis for recommendations by the MIBB Group regarding the further procedure after a B3 lesion has been diagnosed in the VABB.

SS124

**Pharmacovigilance – the rising star or a legal burden?**

J. Froehlich, C. Cobbaert; Zürich

**Purpose:** Health care professionals are legally obliged to notify at least unexpected and/or serious adverse events to the Health Authorities or manufacturers. The spontaneous reporting adds up to the signal detection of rare adverse events justifying PV as surveillance after market approval of drugs. To shed some light on industries' PV activities and thus increase the safety of contrast media.

**Methods and Materials:** Review of all spontaneously reported adverse events during first 11 months of 2012 from Switzerland concerning marketed medicines of Guerbet without considering causal relationship.

**Results:** In total 50 adverse events of which 14 were coded as severe were available for analysis. A mean age of 49.2 years [range 18–79] resulted with a male:female ratio of 1.08 (26/24). Cases originated from a total of 17 centers besides literature/Swissmedic cases with large majority from German speaking part (48). The most common expected symptoms were nausea (n=17), vomiting (10), pruritus and rash (6), respiratory problems (5), and allergic-like reactions (urticaria, hypersensitivity [16]). Unexpected reactions were blurred vision, flickering of eyes, renal insufficiency after Gd, loss of voice and iodide mumps. Most frequent treatment consisted of H1-antihistamines and corticosteroids (11), while epinephrine was not mentioned.

**Conclusion:** Analysis of spontaneous reporting does not provide controlled systematic safety data but are important to complement the knowledge about rare adverse events. Late reactions are in general underreported and cases often lack clinical anamnesis, treatment and outcome information. The clinician is rarely involved in PV issues. With on the horizon new gateways allowing the patients to report directly their own experience we are challenged by new forms of safety reporting and coding.

SS125

**Effects of pathological alteration of blood-protein concentration on r1- and r2-relaxivity of MRI contrast-agents**

S. Götschi, J. M. Fröhlich, N. Chuck, G. Andreisek, D. Nanz, A. Boss; Zürich

**Purpose:** To measure the response of plasma T1, T2, and r1, and r2 molar relaxivities of four MR-contrast agents to variation of protein concentration at physiological and pathological levels.

**Methods and Materials:** In this in-vitro study solutions at normal and at 3 pathological plasma-protein concentrations (albumine, IgG) were prepared with four different contrast agents (gadobutrol, gadoteric acid, gadoxetic acid, gadofosveset) at gadolinium concentrations between 0 and 2.5 mmol Gd/l. MRI spin-echo inversion-recovery and multi-spin-echo data of the solutions in a water phantom kept at a constant temperature of 37°C were acquired at 1.5T and 3.0T to allow calculation of r1 and r2 molar relaxivities with custom routines. These data were used to calculate the protein-induced change of the signal in a typical 3D gradient-echo angiography acquisition.

**Results:** The r1 and r2 relaxivities at physiological plasma protein concentration at 1.5T were [(mmol/l)<sup>-1</sup> sec<sup>-1</sup>]: 4.23 (gadobutrol), 3.75 (gadoteric acid), 6.23 (gadoxetic acid) and 7.20 (gadofosveset). Higher plasma-protein concentrations resulted in increased relaxivities, particularly of gadoxetic acid and gadofosveset. The largest relaxivity increase was observed for gadofosveset at high IgG concentration (+27.4% and +468.3% for r1 and r2, respectively). The r1 and r2 values measured at 1.5T and 3T did not significantly differ. Computer simulations suggested no relevant effects of protein concentration on signal intensity in MR angiography.

**Conclusion:** In spite of distinct alterations of r1 and r2 by pathological plasma protein concentrations, patients with corresponding diseases do not require an adaptation of the contrast-medium dosage when undergoing MR angiography.

SS126

**Effect of protein binding substances on T1 times and the partition coefficient in contrast-enhanced cardiac magnetic resonance imaging**N. Kawel-Boehm<sup>1</sup>, F. Santini<sup>1</sup>, T. Haas<sup>1</sup>, J. Froehlich<sup>2</sup>, J. Bremerich<sup>1</sup>; <sup>1</sup>Basel, <sup>2</sup>Zürich

**Purpose:** Contrast enhanced cardiac MR with T1 mapping enables quantification of diffuse myocardial fibrosis. Various factors, however, can interfere with T1 measurements. The purpose of the current study was to assess the effect of co-medication with a typical protein binding drug (Ibuprofen) on T1 values in vitro and in vivo.

**Methods and Materials:** 50 vials were prepared with different concentrations of gadobenate dimeglumine (0–16 mmol/l), Ibuprofen (0–4.85 mmol/l) and human serum albumin (0–4 g/l) in physiologic NaCl solution and imaged at 1.5T with a spin echo sequence at multiple TRs to measure T1 values and calculate relaxivities. 10 volunteers (5 men; 31±6.3 years) were imaged at 1.5T. T1 values for myocardium and blood pool were determined for various time points after administration of 0.15 mmol/kg gadobenate dimeglumine using a modified look-locker inversion-recovery sequence before and after administration of Ibuprofen over 24 hours. The partition coefficient was calculated as  $\Delta R1_{\text{myocardium}} / \Delta R1_{\text{blood}}$ , where  $R1 = 1/T1$ .

**Results:** In vitro no significant correlation was found between relaxivity and Ibuprofen concentration, neither in absence ( $r = -0.15$ ,  $p = 0.40$ ) nor in presence of albumine ( $r = -0.32$ ,  $p = 0.30$ ). In vivo there was no significant difference in post contrast T1 times of myocardium and blood, respectively and also in the partition coefficient between exam 1 and 2 ( $p > 0.05$ ). There was an excellent correlation of T1 times of myocardium and blood, respectively between exam 1 and 2 ( $r = 1.0$ ,  $p < 0.0001$ ).

**Conclusion:** Contrast enhanced T1 mapping is unaffected by co-medication with protein binding substances and has an excellent reproducibility.



SS127

**Quantification of inhomogeneous iron oxide uptake over a 3D volume in a small animal arthritis model using dUTE MRI and customized segmentation software**

*L. A. Crowe<sup>1</sup>, A. Gramoun<sup>1</sup>, W. Wirth<sup>2</sup>, K. Grosdemange<sup>1</sup>, A. Petri-Fink<sup>3</sup>, F. Eckstein<sup>2</sup>, H. Hofmann<sup>3</sup>, J.-P. Vallee<sup>1</sup>; <sup>1</sup>Genève, <sup>2</sup>Salzburg/AT, <sup>3</sup>Lausanne*

**Purpose:** Iron oxide nanoparticles (SPION) MRI contrast agents target macrophages in antigen-induced-arthritis (AIA) in rat. SPION are easily detectable on MRI as dark regions, but quantification in vivo remains extremely challenging. We developed and validated a quantification method for SPION uptake in synovium based on positive contrast dUTE and semi-automated software.

**Methods and Materials:** Rats (n=23) with right knee AIA were given intravenous SPION (7mg) 5 days after AIA. MRI used a Siemens 3T clinical scanner and 4cm loop coil and quantifiable dUTE: 3D isotropic resolution 0.18 mm, UTE/TE2 0.07 ms/2.46 ms, TR 9.6 ms, flip angle 10° with simultaneous acquisition then subtraction of two echoes.

The software allows simultaneous segmentation of the original images and the positive contrast dUTE with semi-automatic radius constrained thresholding requesting only a click in the area of interest. Pixel intensity histogram, mean and 3D volume are calculated. Manual segmentation was used for validation.

**Results:** Both TE2 and dUTE of arthritic knee show SPION in synovium and marrow. With dUTE, SPION is clearly higher intensity than surrounding tissues, unlike the TE2 where bone and ligaments are at similar low intensity to SPION, meaning automatic segmentation fails due to leakage. The semi-automatic method was successful for dUTE in all cases and approximately 3x faster. The values of dUTE intensity also have the advantage of proportionality with concentration. Manual and semi-automatic segmentation (n=16) show excellent agreement ( $p < 0.0001$ , slope=1.04,  $R^2 = 0.9949$ ).

**Conclusion:** We demonstrate 3D quantification of irregular SPION uptake with easier and faster assessment using semi-automated segmentation and dUTE, as applied to iv SPION uptake in arthritic rat knee.

## SS128

**Accuracy of multidetector-row CT for restaging after neoadjuvant treatment in patients with esophageal cancer**

A. Konieczny, P. Meyer, A. Schnider, P. Komminoth, M. Schmid, N. Lombriser, D. Weishaupt; Zürich

**Purpose:** To assess the diagnostic accuracy of 64-Multidetector-row CT (MDCT) for restaging of patients with esophageal cancer undergoing neoadjuvant therapy.

**Methods and Materials:** Results of pathologic staging were correlated with those of 64-MDCT scans before and after neoadjuvant treatment in 35 patients using the American Joint Committee on Cancer/TNM classification (7th edition). CT-response was determined using Response Evaluation Criteria in Solid Tumors Group method, modified for one-dimensional, tumor diameter measurement.

**Results:** 64-MDCT predicted T-stage correctly in 34% (12/35), overstaged in 49% (17/35), understaged in 17% (6/35). Sensitivity/specificity were as follows: T0, 20%/92%; T1&T2, 31%/59%; T3, 60%/64%; T4, 100%/4%. Negative predictive values for T3/T4 were 80%/100%.

MDCT accurately predicted complete histopathologic response in 20% (sensitivity 20%, specificity 96%, accuracy 74%) and overstaged in 80%. The tumor regression grade was predicted correctly by MDCT in only 8% (2 of 25 patients) and underestimated in 68% (17/25).

For the N-stage, accurate staging was noted in 69% (24/35). Posttherapy MDCT overstaged N-stage in 17% (6/35) and understaged in 14% (5/35). For pathologic N-stage evaluation the posttreatment MDCT sensitivity/specificity were: N0, 79%/82%; N1, 57%/75%; N2, 0%/97% and N3, 33%/100%.

In none of the 35 patients distant organ metastasis were found.

**Conclusion:** Although MDCT tends to be able to exclude advanced tumor stages (T3, T4) with a higher likelihood, the diagnostic accuracy of high resolution MDCT for restaging esophageal cancer and assessing the response to neoadjuvant therapy has not improved in comparison to older generation CT. Therefore, the future assessment of esophageal tumor response should focus on combined morphologic and metabolic imaging.

## SS129

**Factors that may affect the density of intra-corporeal cocaine containers at low-dose CT**

A. Platon, E. Lock, C. Becker, P.-A. Poletti; Genève

**Purpose:** It has been reported that illegal intra-corporeal cocaine containers (packets) which appear isodense to the bowel content at low-dose CT (LDCT) may remain undetected at abdominal radiograph. This work aims to determine the parameters that can influence the density of intra-corporeal illegal cocaine containers at LDCT.

**Methods and Materials:** 630 consecutive suspects of conveying packets were examined using a LDCT. For each positive case, the weight, the percentage of cocaine, and the chemical content of the cutting agents have been measured as well as the mean radiographic density (Hounsfield units) and the volume of the packets at LDCT. Bulk density (g/cm<sup>3</sup>) was calculated. Univariate and multivariate analyses were performed to determine the parameters associated with the isodense aspect of the packets, defined as a < 40 UH density.

**Results:** Packets were detected by LDCT in 85 suspects. A chemical analysis could be obtained from 64 of them. 18 subjects were excluded because holders of different types of packets. The 46 remaining conveyors formed our study group. Packets were isodense in 13 conveyors, hyperdense in 33. Two parameters were associated with an isodense aspect of the packets: a bulk density less than 1 g/cm<sup>3</sup> (p=0.003), and a cocaine content of less than 50% (p=0.007). None of the cutting agent did influence the density. At multivariate analysis, only the bulk density remained discriminating (p=0.038).

**Conclusion:** A bulk density less than 1 g/cm<sup>3</sup> is the only parameter significantly associated with an isodensity of the packets.

## SS130

**Crohn's disease activity: Correlation of inflammatory mediators with overall small-bowel motility**

S. Bickelhaupt<sup>1</sup>, S. Pazahr<sup>1</sup>, J. M. Froehlich<sup>1</sup>, R. Cattin<sup>2</sup>, H. Bouquet<sup>3</sup>, G. Rogler<sup>1</sup>, P. Frei<sup>1</sup>, A. Boss<sup>1</sup>, M. A. Patak<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Biel, <sup>3</sup>Bern

**Purpose:** Active Crohn's disease (CD) increases the level of inflammatory markers of which C-reactive protein (CRP) and calprotectin are commonly used to monitor disease activity. The aim was to evaluate the correlation between CRP and calprotectin levels and overall small bowel motility in patients with Crohn's disease assessed with MRI.

**Methods and Materials:** 13 patients with Crohn's disease (4f/9m, mean 42y) were included in this IRB-approved prospective study. MRI (1.5-T, Philips Achieva) was performed after a 1-h-preparation of 1000 ml-Mannitol-Solution (3%). Cine T2w-2D-SSFP motility acquisitions (TR2.47/TE1.23/250 ms-slice-repetition-time) were performed in free breathing over 69–84 sec. Randomly chosen small-bowel segments were analysed in two abdominal quadrants using dedicated MR-motility assessment software (Motasso). Contraction frequency, amplitude, luminal diameter and amplitude diameter ratio (occlusion ratio, ADR) were evaluated as well as CRP (ngl/ul) and Calprotectin (ug/g) levels. Pearson's correlation was calculated.

**Results:** Calprotectin was determined in mean 12-days (SEM±10.09) before, CRP 15-days (SD±28.80) before MRI. A significant inverse-linear-correlation was found between the contraction frequency and both the level of CRP (r=-0.701, p=0.008) and calprotectin (r=-0.805, p=0.001). Expansion of the mean small bowel diameter significantly correlated with calprotectin levels (r=0.857, p<0.001) but not with CRP (r=0.447, p=0.126). The absolute amplitude of the contractions did not correlate neither with the level of CRP (r=-0.527, p=0.064) nor with calprotectin (r=-0.612, p=0.026). The ratio describing relative luminal occlusion during contraction (ADR) significantly correlated with calprotectin (r=0.736, p=0.004) and with CRP (r=0.577, p=0.039).

**Conclusion:** Alterations of overall small bowel motility during active phases of CD significantly correlate with the level of calprotectin and CRP.

## SS131

**Identification of bowel fibrosis in patients with Crohn's disease using magnetization transfer MRI**

S. Pazahr, I. Blume, P. Frei, N. Chuck, D. Nanz, G. Rogler, M. A. Patak, A. Boss; Zürich

**Purpose:** To assess the feasibility of magnetization transfer (MT) imaging of the bowel wall in patients with Crohn's disease (CD) and to evaluate its utility for the detection of intestinal fibrosis.

**Methods and Materials:** In this prospective study, 31 patients (age 39.0±13.2y) with CD were examined in a 1.5T MR scanner. To establish a standard of reference two independent readers classified the patients in different disease states using standard MR enterography, available clinical data and histological findings. In addition to the standard protocol, a 2D gradient-echo sequence (TR/TE 32 ms/2.2 ms; flip angle 25°) with/without 1100Hz off-resonance prepulse was applied. MT ratios (MTR) of the small bowel wall were computed off-line on a pixel-by-pixel basis. MTR in fibrotic scars and acutely inflamed bowel-wall segments were compared for statistical significance versus MTR values in normal segments using the paired student's t-test.

**Results:** The MT sequences acquired images of sufficient quality and spatial resolution for the detection of the small bowel wall without detrimental motion artefacts. In normal small bowel wall segments an intermediate MTR of 25.4±3.4% was measured. The MTR was significantly increased in bowel-wall segments with fibrotic scarring (35.3±4.0%, p<0.0001). In segments with acute inflammation, the mean MTR was slightly smaller (22.9±2.2%).

**Conclusion:** MT imaging of the small bowel wall is feasible in humans with sufficient image quality and may contribute to distinguish between fibrotic strictures and acute inflammatory stenosis of the bowel wall in patients with CD at the expense of only a few minutes additional examination time.

SS132

### Urinary stone detection and characterization with dual energy CT urography after furosemide intravenously injection: Preliminary results

C. Hansen, D. Botsikas, C. Becker, X. Montet; Genève

**Purpose:** To investigate the added advantage of dual energy CT in the detection and characterization of urinary stones in the excretory phase after iv furosemide administration.

**Methods and Materials:** 24 urinary stones were detected in 69 consecutive patients that underwent dual-energy CT urography for macroscopic hematuria. The scanning protocol consisted of a split bolus double or triple phase acquisition, with a true non-contrast series (TNC) and a mixed nephrographic-excretory phase with or without a corticomedullary phase. Stone density was measured in TNC and virtual non contrast (VNC) series calculated from the mixed nephrographic-excretory phase. Stones were characterized based on their X-ray absorption characteristics at 100 kVp and 140 kVp at both TNC and excretory phase.

**Results:** All stones with diameter more than 2 mm were detected in the VNC phase (n=20) and in the excretory phase (n=20). 13 of these stones could be characterized in the TNC and the excretory phase and the results were strictly identical for both phases, 6 of them being recognized as non-uric acid and 7 as uric acid stones. Presumably the low iodine concentration in the urine due to furosemide injection allowed both detection and correct characterization of stones in the mixed phase. Densities measured in VNC were significantly lower than densities measured in the TNC phase.

**Conclusion:** Excretory phase dual energy CT after furosemide administration allows detection and characterization of urinary stones greater than 2 mm, through the diluted urine. Our data indicate that using this specific protocol, the TNC phase of CT urography could be eliminated, thus contributing to a significant radiation dose reduction.

SS133

### Model based iterative reconstruction-low dose abdominal CT for detection of renal stones: Initial experience

S. Stefanelli, D. Botsikas, S. Boudabbous, C. Becker, X. Montet; Genève

**Purpose:** To study the added benefit of second generation model based iterative reconstructions (MBIR) on low-dose abdominal CT for the detection of urinary tract stones compared to first generation of iterative reconstruction (ASIR).

**Methods and Materials:** Thirty-six consecutive patients (23 men – 13 women), mean age 52.27±16.36 y underwent unenhanced low-dose abdominal CT for detection or follow-up of urinary tract stones from August to November 2012. Ureteral definition was evaluated subjectively by two blinded readers who graded it in a scale from 1 (excellent definition) to 4 (=not distinguishable) and objectively by calculating contrast to noise ratio (CNR) for soft tissue-fat on a standard 40% ASIR-FBP reconstruction and on the corresponding MBIR series. Stone position, maximal density and diameter on the axial plane were also evaluated on both series.

**Results:** There was a substantial agreement between readers for subjective evaluation of ureteral definition ( $k=0.729$ ). The ureteral definition was significantly better for the MBIR series (mean score=2.331±0.968) compared to the ASIR/FBP series (median score=2.032±0.976) ( $p<0.0001$ ). The CNR was significantly better on the MBIR (=17.34±4.75) compared to ASIR/FBP (=6.18±2.1) ( $p<0.0001$ ). Fifty-eight stones were found in total. Their maximal density measured from MBIR was significantly higher (753±386) than that measured from FBP/ASIR (559±352) ( $p<0.0001$ ). Stones size was over evaluated on MBIR (mean diameter=4.9±2.6 mm) compared to FBP/ASIR (=4.5±2.6 mm) ( $p<0.0001$ ).

**Conclusion:** MBIR reconstruction of low dose abdominal CT can offer significantly better ureteral definition and its systematic use is recommended. Though, it has the tendency to systematically over evaluate the stones densities and sizes compared with ASIR/FBP.

SS134

### Metal artifact reduction in hip prosthesis with iterative reconstructions

F. Morsbach<sup>1</sup>, S. Bickelhaupt<sup>1</sup>, G. Wanner<sup>1</sup>, A. Krauss<sup>2</sup>, B. Schmidt<sup>2</sup>, H. Alkadhi<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Forchheim/DE

**Purpose:** To evaluate the effect of a novel iterative frequency split-normalized (IFS) metal artifact reduction (MAR) on image quality of computed tomography (CT) in hip-prosthesis.

**Methods and Materials:** In the first study-part, an artificial hip-phantom with steel and titan-based shafts, using three inlays of water, fat, and contrast-media placed in the pelvis, was used to test and optimize the IFS algorithm. Image quality and accuracy of CT number measurements of inlays was determined. In the second study-part, 41 consecutive patients with unilateral (n=32) or bilateral (n=9) hip-prosthesis were included. Datasets using filtered back projection (FBP), IFS, and a previously published MAR algorithm using linear-interpolation were reconstructed. Two readers evaluated axial, coronal, and sagittal CT image reformations for overall image quality and evaluated image quality of pelvic organ depiction; CT numbers in the urinary bladder, gluteal muscle, and subcutaneous fat were measured.

**Results:** Ex-vivo experiments revealed the best image quality for IFS. Measurements of CT numbers of the inlays were more accurate for IFS. In patients, we found a significant improvement in overall image quality for all reformations ( $P<0.001$ ), and a significantly increased image quality of pelvic organs ( $P<0.001$ ) for the IFS algorithm. CT numbers of the bladder ( $P<0.001$ ) and muscle ( $P=0.043$ ) were significantly less variable for IFS as compared to images reconstructed with FBP and the linear interpolation MAR algorithm, whereas we found no significant difference for fat ( $P=0.159$ ).

**Conclusion:** The IFS algorithm significantly reduces metal artifacts from hip-prostheses, increases image quality and improves measurement accuracy of CT numbers as compared to FBP and linear interpolation MAR algorithms.

SS135

### Multi-b-values diffusion sequence acquired in PET-MRI 3T scanner: Comparison of the apparent diffusion coefficient in the prostate cancer detection

T. de Perrot, M. Pusztaszeri, C. Iselin, J.-P. Vallee; Genève

**Purpose:** To assess the influence of flow sensitive b0 images on the ADC maps of the prostate for cancer detection.

**Methods and Materials:** 11 consecutive patients scheduled for a prostatectomy were imaged on a 3T PET-MRI by a standard diffusion sequence using b-values of 0–500–1000–1500 s/mm<sup>2</sup>. A monoexponential model was fitted to obtain two ADC maps, one with all the b-values (flow-sensitive ADC) and the other after exclusion of the b0 data (flow-insensitive ADC). The whole prostate and the cancer foci were segmented to label each voxel as normal or tumoral according to the histological slides. After normalization, a voxel-by-voxel analysis was performed to build AUC curves for the both ADC maps as well as a combination of the 4 b-values ADC map with the b0, b500, b1000 and b1500 images using a Bayes classifier. AUC were compared using a Delong test.

**Results:** 91806 prostatic voxels were obtained with 5607 tumoral voxels. The 4b-values flow-sensitive ADC map performed better than the 3b-values flow-insensitive ADC map with respectively an AUC of 0.7497 and 0.706 ( $p<0.001$ ). The Bayes model including the individual b0, b500, b1000 and b1500 images in addition to the flow sensitive ADC map further improved the AUC at 0.8001 ( $p<0.001$ ) for cancer detection.

**Conclusion:** Flow-sensitive ADC map was superior to flow-insensitive ADC map for prostate cancer detection. This also provides a statistical demonstration of the commonly accepted practice to look for enhanced signal in cancer on increasing b-values images in the area of reduced ADC.

SS136

**Multiparametric prostate MRI with T2-weighted, diffusion-weighted and dynamic contrast-enhanced sequences: Are all pulse sequences necessary for the detection of locally recurrent prostate cancer after radiotherapy?**

*O. F. Donati<sup>1</sup>, S.-I. Jung<sup>2</sup>, H. A. Vargas<sup>3</sup>, D. Gultekin<sup>3</sup>, J. Zheng<sup>3</sup>, C. Moskowitz<sup>3</sup>, H. Hricak<sup>3</sup>, M. Zelefsky<sup>3</sup>, O. Akin<sup>3</sup>; <sup>1</sup>Zürich, <sup>2</sup>Seoul/KR, <sup>3</sup>New York/US*

**Purpose:** To compare the diagnostic accuracy of T2-weighted MRI (T2) to that of multiparametric MRI (MP-MRI) combining T2 with diffusion-weighted imaging (DWI) and/or dynamic contrast-enhanced MRI (DCE) for detecting locally recurrent prostate cancer (PCa) after radiotherapy (RT).

**Methods and Materials:** This retrospective HIPAA-compliant study was approved by the IRB; informed consent was waived. Fifty-three men (median age, 70y) with suspected post-RT recurrence of PCa underwent MP-MRI including DWI- and DCE-sequences within 6 months of biopsy. Two readers independently evaluated the likelihood of PCa on a 5-point scale on T2, T2+DWI, T2+DCE and T2+DWI+DCE with at least a 4 week interval between evaluations. Areas under receiver operating characteristics curves (AUC) were calculated on a per-sextant and per-patient basis. Interreader agreement was assessed and quantitative assessment of ADC,  $K^{trans}$  and  $K_{ep}$  was performed.

**Results:** At biopsy, recurrences were present in 35/53 (66%) patients. In detection of recurrent PCa, T2+DWI yielded higher AUCs (0.79–0.86, reader 1; 0.75–0.81, reader 2) than T2 alone (0.63–0.67, reader 1; 0.46–0.49, reader 2 [ $p \leq 0.014$  for all]). DCE-sequences did not contribute significant incremental value to T2+DWI ( $p=1.0$ , reader 1;  $p=0.347$ , reader 2). Interreader agreement was higher for combinations of MP-MRI than for T2 ( $\kappa=0.34$ – $0.63$  vs  $\kappa=0.17$ – $0.20$ ). Medians of quantitative parameters differed significantly ( $p < 0.001$ ) between benign tissue and PCa (ADC, 1.64 vs 1.13 ( $\times 10^{-3}$  mm<sup>2</sup>/s);  $K^{trans}$ , 0.16 vs 0.33 (min<sup>-1</sup>);  $K_{ep}$ , 0.36 vs 0.62 [min<sup>-1</sup>]).

**Conclusion:** MP-MRI has greater accuracy in detecting recurrent PCa after RT than T2 alone, with no additional benefit if DCE is added to T2+DWI.

SS137

**Defining the diffusion restriction in MRI caused by prostate cancer cells: A quantitative in-vitro study**

*N. Chuck, D. Eberli, F. Azzabi Zouraq, A. Boss; Zürich*

**Purpose:** Despite the current limitations MRI is becoming the favored imaging modality in prostate cancer diagnosis and follow-up. Diffusion-weighted-magnetic-resonance-imaging (MRI) is one of the protocols used for increased detection and characterization of prostate cancer, by showing restrictions in water movement. We hypothesize that the loss of growth-inhibition by cell-cell-contact in prostate-cancer is mainly responsible for the change in diffusion-restriction seen in MRI-images. Therefore, the aim of this in-vitro-study is to quantitatively define the diffusion-restriction of water in the apparent-diffusion-coefficient (ADC) caused by increasing concentrations of prostate-cancer cells diluted in agarose gel.

**Methods and Materials:** Cell dilutions between 0 to  $1 \times 10^9$  cells/ml using DU145 prostate-cancer-cell line in agarose-gels were prepared in 16 well dishes. MR-imaging was performed in a Bruker 4.7-T-PharmaScan 47/16 US with a gradient-strength of 375mT/m, a slew rate of 3375T/(m·sec), and a linear-polarized-hydrogen-whole-body mouse radiofrequency-coil. Six different b-values were evaluated (0,200,400,600,800,1000s/mm<sup>2</sup>) using a diffusion spin-echo sequence (TE/TR 27 ms/2300 ms).

**Results:** A mono-exponential decay of the diffusion MR-signal was found depending on the b-value. Stronger diffusion restriction was measured for increasing cell concentrations with the lowest ADC-value of  $1.18 \times 10^{-3}$  mm<sup>2</sup>/s for the highest cell concentration of  $1 \times 10^9$  cells/ml and the lowest ADC-value of  $2.23 \times 10^{-3}$  mm<sup>2</sup>/s for the agarose-gel without prostate-cancer-cells. A negative linear relationship between cell-concentration and ADC was discovered with the equation  $ADC \text{ (mm}^2/\text{s)} = -1.08 \times 10^{-12} \times \text{cells/ml} + 2.16 \times 10^{-3}$ .

**Conclusion:** For the first time, we report a direct linear relationship between the quantitative-diffusion-restriction in diffusion-weighted-MRI and the concentration of prostate-cancer-cells. Our described parameters will help to improve protocols for diffusion-weighted-MRI and might increase prostate-carcinoma detection highlighting dense clusters of prostate cancer cells.

SS138

**Detection of significant disease using diffusion weighted MRI in the prostate**

*L. Bains, J. Froehlich, M. Triantafyllou, G. Petralia, D. Chong, H. C. Thoeny; Bern*

**Purpose:** The purpose of this investigation was to assess the diagnostic accuracy and interreader reliability of diffusion weighted (DW) MRI for the detection of significant and non-significant primary prostate cancers.

**Methods and Materials:** 111 male patients with primary prostate (n=78), bladder cancer (n=18), or both (n=15) underwent DW MRI at 3T prior to prostatectomy/cystectomy. Three independent readers with 5–10 years of clinical MRI experience assessed T2-weighted and DW MRI for prostate cancer, blinded to all clinical information. Sensitivity, specificity, and diagnostic accuracy were calculated for significant and non-significant disease using histopathology as a gold standard. Significant disease was defined as prostates with lesions >1 cm with a Gleason score  $\geq 7$ .

**Results:** Prostate cancer was detected with a sensitivity of 91% and specificity of 56% with good interreader agreement ( $\kappa = 0.57$ ). Significant disease was detected with a sensitivity of 96%, no false positives (FP) and a low number of false negatives (FN) (n=2 for all readers). Non-significant disease was detected with a sensitivity of 61% and a higher number of FN (n=5/6/6 for the 3 readers respectively). 73% (11/15) of FN readings were in patients with Gleason score 6 or lower, and 53% (8/15) were in tumors smaller than 1 cm in diameter.

**Conclusion:** Significant prostate cancer was detected with excellent sensitivity and a low number of FP and FN findings. DW MRI may provide additional information for the selection and monitoring of prostate cancer patients when used together with traditional biomarkers.



SS139

### Femoral and tibial torsion measurements in children and adolescents using 3D models based on low-dose biplanar radiographs: Comparison to low-dose computed tomography

A. Rosskopf, R. Sutter, C. W. A. Pfirrmann, L. Ramseier, F. M. Buck; Zürich

**Purpose:** To assess the reliability of three-dimensional measurements of femoral and tibial torsion in children and adolescents using low dose biplanar radiographs – with low-dose CT as a reference standard.

**Methods and Materials:** Femoral and tibial torsion were measured for preoperative planning in fifty patients (mean age 10.9 years; range 4.7–14.8 years) using 3D models based on low-dose simultaneous biplanar radiographs (EOS imaging system). Transverse low-dose CT images served as reference standard. All measurements were performed by two independent readers. A clinically acceptable difference was defined as max. 5.0° intermethod variance.

**Results:** The range of femoral torsion was -4.8°–63.7° (retrotorsion/antertorsion) for EOS and -9.6°–54.3° for CT measurements, and the range of external tibial torsion was 9.9°–47.4° (EOS) and 5.9°–50.0° (CT). The mean difference between the two methods was 4.0°±3.4° for the femoral measurements and 4.4°±3.8° for the tibial measurements. Differences in measurements between EOS and CT were larger in patients below 9 years of age, with a mean difference for femoral measurements of 5.5°±3.2° (<9 years) compared to 3.6°±3.3° (9–15 years), and a mean difference for tibial measurements of 4.5°±2.8° (<9 years) compared to 4.1°±3.0° (9–15 years). A mean difference of more than 5.0° was seen only for femoral torsion measurements in the group younger than 9 years of age.

**Conclusion:** Measurements of femoral and tibial torsion are reliable using low-dose biplanar radiographs (EOS). Measurement differences between EOS and CT were largest in children below 9 years of age, especially for the femoral torsion.

SS140

### A new way to measure lower limb length and alignment using 3D models based on biplanar linear radiography – A comparison with measurements on supine CT scans and upright full-length radiographs

R. Guggenberger, C. W. A. Pfirrmann, P. Koch, F. M. Buck; Zürich

**Purpose:** To compare lower limb length and alignment angle measurements on supine computed tomography (CT), upright full-length radiography (UFR) and 3D models based on upright biplanar radiography (BLR).

**Methods and Materials:** IRB-approved study including 51 patients (29 female; mean age 68.8 years; range 43–92 years) scheduled for total knee replacement. Lower limb length and alignment angles were measured on CT, UFR and 3D models based on BLR by two independent readers. Measurements of different modalities were compared by paired t-tests. Agreement between readers and modalities was assessed by calculation of Pearson correlation coefficients and Bland-Altman analyses.

**Results:** Mean limb lengths were 783 mm (SD±56.1 mm, Range 639–927 mm), 785 mm (SD±53.0 mm, 655–924 mm), 780 mm (SD±55.4 mm, 633–921 mm) and 783 mm (SD±55.9 mm, 636–924 mm) for CT, UFR and 3D models using standard and prototype software, respectively. Mean alignment angles were 2.3° (SD±5.5°, Range -12°–20°), 2.5° (SD±6.7°, -17°–18°), 3.4° (SD±6.6°, -14°–18°), respectively. Length and angle measurements differed significantly comparing standard 3D models to CT and UFR, respectively ( $p < 0.001$ ). Pearson correlation coefficients were 0.992, 0.993, 0.995 and 0.998 for limb length and 0.968, 0.983 and 0.984 for angle measurements in CT, UFR and 3D models from standard and prototype software, respectively. Bland-Altman analyses showed positive mean difference in length (2.7 mm, SD±5.5; 5.4 mm, SD±13.1) and negative mean difference in angle measurements (-1.1°, SD±2.5; -0.9°, SD±3.1) for CT and UFR compared to 3D models.

**Conclusion:** Upright 3D models allow for lower limb length and alignment angle measurements comparable to measurements on supine CT scans and UFR.

SS141

### Total knee arthroplasty MR imaging featuring slice-encoding metal artifact correction: Reduction of artifacts for STIR and intermediate-weighted sequences

R. Sutter<sup>1</sup>, R. Hodek-Würz<sup>2</sup>, S. F. Fucentese<sup>1</sup>, C. W. A. Pfirrmann<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Münsterlingen

**Purpose:** To compare Slice-Encoding Metal Artifact Correction (SEMAC) sequences versus optimized standard MR sequences in patients with total knee arthroplasty (TKA).

**Methods and Materials:** Forty-two patients with TKA underwent 1.5T MRI. Sequences optimized for metal implant imaging (SEMAC) were compared to standard sequences optimized with high bandwidth (hiBW) for STIR and intermediate-weighted proton density (PD) images. In twenty-nine patients, CT was available as reference standard. Signal void and insufficient fat saturation were quantified. Qualitative criteria (anatomy, distortion, blurring, noise) were assessed on a five-point scale (1, no artifacts; 5, severe artifacts) by two readers. Abnormal imaging findings were noted. A t-test and a Wilcoxon signed-rank test served for statistics.

**Results:** Signal void areas and insufficient fat saturation were smaller for the SEMAC sequences than for the optimized standard sequences ( $p < 0.001$  for all comparisons). Depiction of anatomic structures was better on STIR-SEMAC versus STIR-hiBW (2.9–3.7/4.2–4.9), and on PD-SEMAC versus PD-hiBW (2.5–3.5/3.1–3.8), which was statistically significant ( $p < 0.001$  to  $p = 0.007$  for different structures). Distortion and noise were lower for SEMAC than for the standard sequences ( $p \leq 0.001$ ), while no technique had a clear advantage for blurring. Detection of abnormal imaging findings was markedly increased for the SEMAC technique ( $p < 0.001$ ) and was most pronounced for STIR images (98/74 findings for STIR-SEMAC for reader 1/2, vs. 37/37 findings for STIR-hiBW). Sensitivity for detection of periprosthetic osteolysis was improved for STIR-SEMAC (100%/86% for reader 1/2) vs. STIR-hiBW (14%/29%).

**Conclusion:** SEMAC sequences showed a statistically significant artifact reduction. The detection of clinically relevant findings such as periprosthetic osteolysis was markedly improved.

SS142

### Correlation of bone bruise pattern of the knee joint with trauma mechanism and soft-tissue knee injuries

N. Berger, G. Andreisek, A. Karer, B. Seifert, E. J. Ulbrich; Zürich

**Purpose:** To correlate bone bruise patterns in the knee joint with one of the 5 traumamechanisms (pivot shift, dashboard, hyperextension, clip injury and lateral patellar dislocation) and with soft-tissue knee injuries.

**Methods and Materials:** Retrospective study of all posttraumatic knee MRIs over a period of 2 years (220 of 247 MRIs were included). Evaluation of 33 predefined bone bruise localisations of the knee in the sag T2w and coronal proton weighted images by two independent readers. The soft-tissue injuries of the knee MRIs were taken from the written radiologic report, the traumamechanisms from the clinical report.

**Results:** The traumamechanism in the 220 MRIs occurred in the following distribution: 144 clip, 39 pivot shift, 25 lateral patellar dislocations, 8 hyperextensions and 4 dashboard injuries. Bone bruise was most often (threshold >40 patients) found in the central femoral condyle (56), central lateral femoral condyle (48), anterior lateral femoral condyle (41), posterior lateral tibial condyle (74) and the medial posterior tibial condyle (45). In the patients with clip injury (144 patients) the bone bruise was localized especially in the lateral tibial postero condyle (44). The bone bruise of the patients with ACL rupture was localized most often in the lateral tibial postero condyle (59). The inter-observer agreement was excellent ( $\kappa$  0.81).

**Conclusion:** There are specific bone bruise patterns depending on the 5 traumamechanisms and on the soft-tissue knee injuries.



SS143

### Distal tibiofibular syndesmosis: MR anatomy in asymptomatic volunteers

M. Maier<sup>1</sup>, B. Mengiardi<sup>2</sup>, C. W. A. Pfirrmann<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Basel

**Purpose:** To describe MR imaging findings of the distal tibiofibular syndesmosis in asymptomatic volunteers.

**Methods and Materials:** MR imaging was performed in 70 asymptomatic volunteers (36 women, 34 men; median age 46 years; range 23–70 years). Visibility and signal intensity of Bassett's ligament, anterior inferior tibiofibular (AITFL), posterior inferior tibiofibular (PITFL), inferior transverse (ITL), interosseous (IOL) and intermalleolar ligament (IML) were analyzed. Number of fascicles of AITFL and thickness of all ligaments was evaluated.

**Results:** AITFL, PITFL, ITL and IOL were always visible (70/70). Bassett's ligament was only seen in 81% (57/70) and IML in 80% (56/70). On T2w images all ligaments were almost always hypointense (97%–100%). On T1w images PITFL, ITL and IML were more commonly of intermediate signal (67%, 67%, and 89%) while AITFL, Bassett and IOL were usually hypointense (89%, 90% and 100%). The AITFL, PITFL and IOL were commonly striated (81%, 91% and 99%). AITFL consists of 3 fascicles in 55% (range 1–4 fascicles). Median thickness and range were 4.2 mm (2.1–6.7 mm) for AITFL, 2 mm (1–5.2 mm) for Bassett, 4.9 mm (3–6.2 mm) for PITFL, 4.9 mm (3–6.4 mm) for ITL and 2 mm (0.9–3.2 mm) for IML.

**Conclusion:** In asymptomatic volunteers, all ligaments of the tibiofibular syndesmosis are usually hypointense on T2w images. Bassett's ligament and IML are not present in about 20%. AITFL, PITFL and IOL have normally a striated appearance.

SS144

### Dixon-based MRI for assessment of muscle-fat content in-vitro and in patients with achillodynia in comparison to healthy volunteers

M. A. Fischer, C. W. A. Pfirrmann, N. N. Espinosa, D. Raptis, F. M. Buck; Zürich

**Purpose:** To prospectively evaluate dual gradient-echo MRI with dixon-based generation of fat-/water-images (MRI<sub>DIXON</sub>) for quantification of the muscle-fat content (MFC) in-vitro and in patients with achillodynia compared to asymptomatic volunteers.

**Methods and Materials:** MRI<sub>DIXON</sub> was used to measure the MFC of 15 phantoms containing titrated mixtures of organic muscle/fat from 0–100% as well as of the gastrocnemius (Dixon<sub>GASTRO</sub>) and tibialis anterior (Dixon<sub>TIBIALIS</sub>) muscles in 30 patients (13 women; mean age, 57±15 years) with achillodynia and in 20 matched asymptomatic volunteers (10 women; mean age, 30±14 years) at 1.5T. Accuracy of MRI<sub>DIXON</sub> in quantification of MFC was assessed in-vitro as-well-as in-vivo using single-voxel MR-spectroscopy (MRS) as the standard of reference. Dixon<sub>GASTRO</sub> and Dixon<sub>TIBIALIS</sub> were related to visual grading of the MFC (grades 0–4) in both muscles (Visual<sub>GASTRO</sub> and Visual<sub>TIBIALIS</sub>).

**Results:** Correlation of MFC derived from MRI<sub>DIXON</sub>, phantoms and MRS was excellent with correlation-coefficient (R2) ranging from 0.93–0.99 and mean measurement bias ranging from –0.1–+0.8%. Mean Dixon<sub>GASTRO</sub>/Dixon<sub>TIBIALIS</sub> was 7.0±4.7/4.9±2.3 in patients and 3.6±0.7/3.6±0.5 in volunteers. Visual<sub>GASTRO</sub>/Visual<sub>TIBIALIS</sub> ranged from 0–2/0–3 and 0–1/0–1, respectively. No significant difference was seen for Dixon<sub>TIBIALIS</sub> between patients and volunteers (p=.07), whereas Dixon<sub>GASTRO</sub> was significantly higher in patients (p<.01). Both, Visual<sub>GASTRO</sub> and Visual<sub>TIBIALIS</sub> did not differ in patients and volunteers (all, p>.05).

**Conclusion:** MRI<sub>DIXON</sub> allows for accurate quantification of MFC and demonstrates a significantly higher fat content in the gastrocnemius muscle in patients suffering of achillodynia than in asymptomatic volunteers, outperforming visual assessment of MFC.

SS145

### MR findings at the calcaneal attachment of the plantar fascia in asymptomatic volunteers

C. Ehrmann<sup>1</sup>, M. Maier<sup>1</sup>, B. Mengiardi<sup>2</sup>, C. W. A. Pfirrmann<sup>1</sup>, R. Sutter<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Basel

**Purpose:** To assess the spectrum of MR findings at the calcaneal attachment of the plantar fascia in asymptomatic volunteers.

**Methods and Materials:** The study was approved by the institutional review board and informed consent was obtained. MR examinations of 77 asymptomatic volunteers (40 women, 37 men; mean age 48.0 years, range 23–83 years) were obtained. Signal characteristics and thickness of the medial, central and lateral fascicle of the plantar fascia were assessed independently by two radiologists. The presence of soft tissue edema, bone marrow edema and bony spur formation at the attachment of the plantar fascia was noted.

**Results:** Mean thickness of the plantar fascia was 0.6 mm (medial fascicle), 4.0 mm (central fascicle) and 0.3 mm (lateral fascicle). Increased signal intensity in the plantar fascia was seen in the T1w sequence in 16 volunteers (20.8%), in the T2w sequence in 6 volunteers (7.8%) and in the STIR sequence in 5 volunteers (6.5%). Soft tissue edema above the plantar fascia was seen in 5 volunteers (6.5%) and below the plantar fascia in 16 volunteers (20.8%). A calcaneal spur was detected in 15 volunteers (19.5%). Calcaneal bone marrow edema was present in 4 volunteers (5.2%).

**Conclusion:** Soft tissue edema below the plantar fascia as well as calcaneal spurs are common findings in asymptomatic volunteers and should be used with caution for diagnosing plantar fasciitis. Increased signal on fluid sensitive sequences within the plantar fascia is less frequent in asymptomatic volunteers.

SS146

### MR characterization of cartilage of the ankle joint after autologous matrix induced chondrogenesis (AMIC) using dGEMRIC, quantitative T1 and T2 relaxation time measurement and quantitative DWI

M. Kretzschmar, O. Bieri, M. Wiewiorski, V. Valderrabano, U. Studler; Basel

**Purpose:** To evaluate quantitative MRI parameters using new sequences for quantitative T2-relaxation time and diffusion measurement for the characterization of neo-cartilage in patients with osteochondral lesions (OCL) of the talus treated with AMIC.

**Methods and Materials:** 23 Patients with OCL of the Talus and AMIC aided chondral repair were scanned in a 3 Tesla MRI, mean follow up interval was 23 month. Standardized imaging protocol included: Isometric Dual Echo Steady State (DESS) sagittal plane, 3D-spoiled gradient echo sequence with two different flip angles sagittal pre and post contrast (45min p.i. Magnevist Schering, Berlin, Germany) 3. Partially spoiled steady state free precession (SSFP) for T2-mapping, 4. Diffusion weighted Dual Echo Steady State (dwDESS) sagittal plane. Data analysis was performed with the DICOM software (OsiriX). Regions of interest were positioned in the cartilage layer of the talus at the AMIC-treated OCL-region and at a corresponding normal appearing region. T1, T2 and DWI values were calculated and documented as mean values within the ROIs. Statistical significance was tested with the Wilcoxon matched-pairs signed rank test (significance level p≤0.05)

**Results:** Compared to normal appearing cartilage we found a significantly increased diffusion coefficient in the AMIC-neo-cartilage (p<0.05) whereas no significant difference of T2-relaxation time measurements could be detected. dGEMRIC showed a significant difference in concentration of glycosaminoglycan between the cartilage and repair tissue.

**Conclusion:** Multiparametric quantitative MRI is able to characterize biochemical properties of chondral repair tissue of the talus and may be a useful tool for the observation of the formation of neo-cartilage during follow up.

SS147

**Human hand radiography using X-ray differential phase and dark-field contrast imaging***T. Thuerling<sup>1</sup>, R. Guggenberger<sup>2</sup>, H. Alkadhi<sup>2</sup>, M. Vich<sup>2</sup>, Z. Wang<sup>1</sup>, C. David<sup>1</sup>, M. Stamparoni<sup>2</sup>; <sup>1</sup>Villigen, <sup>2</sup>Zürich*

**Purpose:** X-ray differential phase contrast (PC) and dark-field (DC) imaging is an emerging technique for medical imaging. The purpose is to show the first results of PC and DC imaging of the entire adult human hand.

**Methods and Materials:** Three adult human cadaver hands were imaged with an X-ray grating interferometer setup, providing two contrast modes, PC and DC, in addition to the standard absorption radiograph. The quality of visualization of various anatomical structures was evaluated and quantified by two independent and blinded radiologists.

**Results:** Interreader agreement for visualization was moderate for all structures in conventional radiography ( $\kappa=0.42-0.44$ ,  $p=0.057-0.13$ ), while being substantial and significant for all structures in PC and for periarticular bone and joint space in DC images ( $0.70-0.88$ ,  $p<0.05$ ). Soft tissue visualization was rated higher in PC compared to both absorption and DC images ( $p<0.05$ ), whereas periarticular bone and joint space could be better assessed in pure absorption and DC images ( $p<0.001$ ). Joint space visualization was rated significantly higher in DC images than conventional radiography ( $p<0.05$ ). Calcifications of periarticular soft tissue and of the triangulo-fibrocartilage complex were depicted with better quality on DC images as compared to PC and conventional radiography.

**Conclusion:** PC and DC imaging of the entire adult human hand on an X-ray tube system is feasible and improves the image quality of bone and soft tissue as compared to conventional radiography. Early evidence suggests that soft tissue calcifications can be depicted better on DC images.

SS148

**3T direct MR arthrography of the wrist: Value of finger trap distraction to assess intrinsic ligament and triangular fibrocartilage complex tears***M. Cerny, R. Marlois, N. Theumann, C. Bollmann, L. Wehrli, D. Richarme, R. Meuli, F. Becce; Lausanne*

**Purpose:** To determine the value of applying finger trap distraction during direct MR arthrography of the wrist to assess intrinsic ligament and triangular fibrocartilage complex (TFCC) tears.

**Methods and Materials:** Twenty consecutive patients were prospectively investigated by three-compartment wrist MR arthrography. Imaging was performed with 3T scanners using a three-dimensional isotropic (0.4 mm) T1-weighted gradient-recalled echo sequence, with and without finger trap distraction (4kg). In a blind and independent fashion, two musculoskeletal radiologists measured the width of the scapholunate (SL), lunotriquetral (LT) and ulna-TFC (UTFC) spaces. They evaluated the amount of contrast medium within these spaces using a four-point scale, and assessed SL, LT and TFCC tears, as well as the disruption of Gilula's carpal arcs.

**Results:** With finger trap distraction, both readers found a significant increase in width of the SL space (mean  $\Delta=+0.1$  mm,  $p\leq 0.040$ ), and noticed more contrast medium therein ( $p\leq 0.035$ ). In contrast, the differences in width of the LT (mean  $\Delta=+0.1$  mm,  $p\geq 0.057$ ) and UTFC (mean  $\Delta=0$  mm,  $p\geq 0.728$ ) spaces, as well as in amount of contrast material within these ( $p=0.607$  and  $p\geq 0.157$ , respectively) were not statistically significant. Both readers detected more SL ( $\Delta=+1$ ,  $p=0.157$ ) and LT ( $\Delta=+2$ ,  $p=0.223$ ) tears, although statistical significance was not reached, and Gilula's carpal arcs were more frequently disrupted during finger trap distraction ( $p=0.025$ ).

**Conclusion:** The application of finger trap distraction during direct MR arthrography of the wrist widens the SL space and increases the amount of contrast medium therein. This technique may enhance both the detection and characterisation of SL and LT ligament tears.

SS149

**MR variants of the ulnar collateral ligament and pulley system of the thumb in asymptomatic volunteers***A. Hirschmann, R. Sutter, A. Schweizer, C. W. A. Pfirrmann; Zürich*

**Purpose:** Characterization of normal MR appearance of the ulnar collateral ligament (UCL) and adductor pollicis aponeurosis (APA) of the first metacarpophalangeal joint (MCP) and the thumb pulley system.

**Methods and Materials:** This study had institutional review board-approval, informed consent was obtained. MR scans of the thumb in 34 asymptomatic volunteers (17 women, 17 men; mean age  $33.9\pm 9.2$  years) were obtained on a dedicated 1.5T extremity scanner. Visibility and signal intensity (SI) was quantified on a 3-point Likert scale (low/increased/striated) for the UCL and APA of the MCP joint and pulley system (A1/variable[Av]/oblique[Ao]/A2) of the thumb. Descriptive statistic was used.

**Results:** All structures could be identified in asymptomatic volunteers. The UCL had commonly a striated appearance (79%/62% reader1/reader2) in intermediate-weighted fat-suppressed images while only a few had an increased (15%/29%) or low (6%/9%) SI. Striation was present in 50%/82% of APA. The Ao and A2 pulleys showed an increased SI in all volunteers (100%), the Av pulley had a low SI in 50%/74% and an increased SI in 44%/21%, the A1 pulley had a commonly increased SI (62%/76%).

**Conclusion:** Contrary to most reports in the literature each of the 4 pulleys as well as the UCL and APA were visible in all volunteers. Most of the UCL and the APA have a striated appearance, this should not be mistaken for a tear when evaluating patients with suspected gamekeeper's thumb. Increased signal intensity is normal for the Ao and A2 pulleys.

## SS201

**Lowering the dose of thoraco-abdominal CT: The role of model-based iterative reconstruction (MBIR) algorithms**

*S. Toso, A. Neroladaki, D. Botsikas, A.-L. Hachulla, C. Becker, X. Montet, Genève*

**Purpose:** To compare the effect of adaptive statistical iterative reconstruction (ASIR) at 40% (ASIR-40) and 100% (ASIR-100) and model-based iterative reconstruction (MBIR) algorithms on image quality and contrast-to-noise ratio (CNR) at decreased mA levels and 100 kVp.

**Methods and Materials:** Two hundred patients underwent contrast-enhanced thoraco-abdominal CT on a GE 750HD scanner. The mA were decreased by steps of 5% every twenty patients. CNR was calculated at two levels: left heart chamber vs. myocardium, and portal vein vs. liver parenchyma. Image quality was graded on a 3-point scale.

**Results:** At all dose levels, the CNR (portal vein vs liver parenchyma) calculated on MBIR was significantly higher than that on ASIR-40 and ASIR-100:  $5.8 \pm 1.6$  vs  $3.0 \pm 1.2$  and  $4.7 \pm 1.2$  ( $p < 0.01$ ).

At all dose levels, the CNR (left heart chamber vs. myocardium) calculated on MBIR was higher than that on ASIR-40 ( $5.4 \pm 1.7$  vs  $3.1 \pm 1.5$ ,  $p < 0.001$ ) but was not different from ASIR-100 ( $5.4 \pm 1.7$  vs  $4.9 \pm 1.1$ ,  $p > 0.05$ ). DLP significantly decreased from  $986 \pm 326$  to  $455 \pm 185$  mGy-cm ( $p < 0.0001$ ).

At the lowest dose, the image quality was graded as none diagnostic using ASIR but diagnostic with MBIR.

**Conclusion:** Contrast-enhanced thoraco-abdominal CT combined with MBIR allows dose reduction of 50% with preserved image quality and high CNR.

## SS202

**Radiation dose and image quality in thoraco- abdominal CT using high-pitch acquisition and iterative reconstruction**

*J. Gariani, D. Bostikas, A.-L. Hachulla, C. D. Becker, X. Montet, Genève*

**Purpose:** To compare dose length-products (DLP) and contrast-to-noise ratios (CNR) of thoraco-abdominal CT obtained with a high-pitch CT imaging protocol using sinogram-affirmed iterative reconstruction (SAFIRE®) or filtered back projection (FBP) with a standard protocol including standard pitch and reconstructed with FBP.

**Methods and Materials:** Nineteen patients underwent thoraco-abdominal CT on a Somatom definition flash scanner with a pitch of 3.2, using both SAFIRE® and FBP algorithms. Images obtained in 19 patients with similar BMI on the same scanner with pitch 1 and reconstructed with FBP served for comparison. CNR was calculated at two levels: left heart chamber vs. myocardium, and portal vein vs. liver parenchyma.

**Results:** The high-pitch acquisition protocol resulted in a significantly lower DLP [mGy-cm] as compared with standard pitch CT ( $400 \pm 141$  vs.  $768 \pm 262$ ,  $p < 0.0001$ ). The CNR (left heart chamber vs myocardium) was  $3.8 \pm 1.5$ ,  $3.17 \pm 1.5$  and  $4.0 \pm 2.6$  for pitch 1/ FBP, pitch 3.2/FBP and pitch 3.2/ SAFIRE®, respectively. The CNR (portal vein vs liver parenchyma) was  $3.7 \pm 2.2$ ,  $3.6 \pm 1.5$  and  $4.0 \pm 1.6$  for pitch 1/ FBP; pitch 3.2/ FBP; and pitch 3.2/ SAFIRE®, respectively. High-pitch images reconstructed with SAFIRE® showed a significantly higher CNR than those reconstructed with FBP ( $p = 0.03$  for the heart and  $p = 0.0085$  for the liver).

**Conclusion:** Thoraco-abdominal CT with high-pitch acquisition and combined with SAFIRE® allows a significant dose reduction and similar CNR as compared with standard- pitch and FBP.

## SS203

**Iterative reconstruction algorithm for abdominal computed tomography: Can the radiation dose be decreased while preserving the low-contrast detectability?**

*S. Schindera<sup>1</sup>, D. Odedra<sup>2</sup>, S. A. Raza<sup>2</sup>, T. K. Kim<sup>2</sup>, H.-J. Jang<sup>2</sup>, Z. Szucs-Farkas<sup>3</sup>, P. Rogalla<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Toronto/CA, <sup>3</sup>Biel*

**Purpose:** To compare the low-contrast detectability and image quality of abdominal CT at different radiation dose levels reconstructed with iterative reconstruction (IR) and filtered back projection (FBP).

**Methods and Materials:** A custom liver phantom with 12 simulated hypodense tumors (diameters of 5, 10, 15 and 20 mm; tumor-to-liver contrast of -10, -20, and -40 HU) was designed. The phantom was scanned with a standard abdominal CT protocol (equivalent 100% dose) and four low-dose protocols (20%, 40%, 60%, and 80% of the standard protocol dose). CT datasets were reconstructed with hybrid IR and FBP. Image noise was measured, and the tumors' contrast-to-noise ratios (CNRs) were calculated. Tumor detection was independently assessed by three blinded radiologists. A total of 840 simulated tumors were presented to the radiologists.

**Results:** IR yielded image noise reduction of 44–64% and a CNR increase of 74–180% compared to FBP at the same dose level ( $P < 0.001$ ). The overall sensitivity for tumor detection was 64.7–85.3% for IR and 66.3–85.7% for FBP at the 20% to 100% doses, respectively. There was no significant difference in the sensitivity for tumor detection between IR and FBP at the same dose level ( $P = 1.0$ ). The sensitivity of the protocol at the 20% dose using FBP and IR was significantly lower compared to the protocol at the 100% dose using FBP and IR ( $P < 0.05$ ).

**Conclusion:** Although hybrid IR at a reduced radiation dose provides the same or better image quality compared with FBP at standard protocol dose, the low-contrast detectability is decreased.

## SS204

**Combining automated attenuation-based tube voltage selection and iterative reconstruction: A liver phantom study**

*D. B. Husarik<sup>1</sup>, S. Schindera<sup>2</sup>, F. Morsbach<sup>1</sup>, N. Chuck<sup>1</sup>, B. Seifert<sup>1</sup>, Z. Szucs-Farkas<sup>3</sup>, H. Alkadhi<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Basel, <sup>3</sup>Biel*

**Purpose:** To compare qualitative and quantitative image parameters, sensitivity for the detection of hypodense liver lesions, as well as radiation dose on CT images using combined automated attenuation-based tube potential selection and iterative reconstructions.

**Methods and Materials:** A custom-built phantom simulating the liver during the portal-venous-phase containing 43 hypodense lesions (5–15 mm) in three tumor-to-liver contrast levels (10–50 HU at 120 kVp) was placed in a water-filled cylindrical container simulating an intermediate-size patient. Imaging was performed using an automated attenuation-based tube potential selection algorithm at 80 kVp, 100 kVp and 120 kVp, with corresponding automated adjustments of the tube-current to 318 mAs/261 mAs/210 mAs. Each acquisition was reconstructed with FBP and with three strength levels of sinogram-affirmed iterative reconstruction (IR3–5). Contrast-to-noise ratios (CNR) were calculated and image noise was assessed. Qualitative analysis consisted of sensitivity for the detection of lesions and subjective image quality scores performed by two independent radiologists.

**Results:** CNR was higher (43–102%) and mean image noise was lower (31–52%) on IR-images than on FBP-images at all tube voltages. While subjective scores for 100 kVp IR-images were superior to 120 kVp FBP-images, those for 80 kVp IR-images were inferior. Also in contrast to the promising quantitative results, the sensitivity for detection of hypodense liver lesions was lower on 80 kVp IR-images, while it was similar and higher on 100 kVp IR-images compared to 120 kVp FBP-images. Radiation dose was reduced by 26% at 100 kVp and by 56% at 80 kVp compared to 120 kVp.

**Conclusion:** The combination of automated attenuation-based tube potential selection and IR results in higher objective and subjective image quality, higher sensitivity for detection of hypodense liver lesions, while allowing for a radiation dose reduction of 26%.

SS205

**Dynamic MDCT of the liver with iodixanol 270, 80 kVp and iterative reconstruction: A useful alternative for detection of hypervascular and hypovascular focal lesions?***D. Botsikas, I. Barnaure, S. Terraz, C. Becker, X. Montet; Genève*

**Purpose:** To evaluate the image quality of hepatic MDCT with dynamic contrast enhancement using iodixanol 270 mg/mL (Visipaque 270) and 80 kVp acquisitions reconstructed with sinogram affirmed iterative reconstruction (SAFIRE®) in comparison with a standard MDCT protocol.

**Methods and Materials:** Fifty-seven consecutive patients with known or suspected hepatocellular carcinoma were scanned with two different four-phase CT protocols. The first group of 25 patients underwent a dual-energy CT at 80–140 kVp with injection of 2 ml/kg of iodixanol 270. The 80 kVp component of the first group was reconstructed iteratively (Safire®-Siemens). The second group of 32 patients underwent a standard 120 kVp acquisition after injection 2 ml/kg of Iohexol 350 mg/ml (Accupaque 350®) and reconstructed with filtered back projection (FBP). An equivalent number of hyperdense and hypodense hepatic lesions were identified with both protocols. Aorta/liver parenchyma contrast to noise ratio (CNR) in arterial phase, hypervascular lesion/liver parenchyma CNR in arterial phase, hypodense lesion/liver parenchyma CNR in portal and late phase were calculated in both groups.

**Results:** Both patient groups were similar regarding age, sex and body weight. Aorta/liver CNR was better for the first group ( $p=0.0078$ ). Hypervascular lesions/liver CNR was not statistically different ( $p=0.86$ ) for the two groups. Hypodense lesion/liver CNR in the portal phase was significantly better for the first group ( $p=0.0107$ ). Hypodense lesion/liver CNR in the late phase was the same for the 2 groups ( $p=0.9926$ ).

**Conclusion:** MDCT imaging with 80 kVp with SAFIRE® and iodixanol 270 yields equal or even better image quality and may be proposed for patients with impaired renal or cardiac function.

SS206

**Integrated circuit detector technology in abdominal computed tomography: Value in obese patients***F. Morsbach<sup>1</sup>, S. Bickelhaupt<sup>1</sup>, S. Rätzer<sup>1</sup>, B. Schmidt<sup>2</sup>, H. Alkadhi<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Forchheim/DE*

**Purpose:** To assess the effect of an integrated circuit (IC) detector for abdominal CT imaging on image quality in normal-weight and obese patients.

**Methods and Materials:** Firstly, an abdominal phantom with different density inlays was scanned with extension rings of various sizes (up to 600 mm diameter). The phantom was scanned on a CT-machine equipped with a conventional discrete circuit (DC) detector and with an IC-Detector (120 kVp, tube current-time product 150 mAs and 75 mAs). Images were reconstructed with filtered back projection (FBP) and iterative reconstruction (IR). Two readers evaluated subjective image quality and image noise was measured. Secondly, 30 patients were included who underwent abdominal CT both with the IC-Detector and a previous CT with the DC-Detector at similar protocol parameters (120 kVp, 210 mAs and 110 mAs, using automated attenuation-based tube current modulation). Patient images were reconstructed with FBP and image noise was measured.

**Results:** Image quality in the phantom was rated higher by both readers. Noise was significantly reduced ( $P<0.001$ ) comparing images acquired with IC-Detector to those with the DC-Detector for the largest phantom. Noise was similar in the small phantom ( $P>0.05$ ). Noise reduction using the IC-Detector was highest (44.5%) for the largest phantom scanned at 75 mAs. In the 20 patients scanned at 210 mAs, noise was significantly ( $P=0.025$ ) reduced by 6.4% using the IC-Detector. In the 10 patients scanned at 110 mAs, noise was not significantly ( $P=0.722$ ) different among scans with the DC and the IC, whereas tube-current modulation automatically reduced the mAs by 11% ( $P=0.022$ ) in patients scanned with the IC-Detector.

**Conclusion:** Use of an IC-Detector reduces image noise in obese patients and allows for dose reduction in abdominal CT.

SS207

**Impact of body habitus on Dual Source CT iodine measurements and assessment of iodine concentration in abdominal organs during multi-phasic scans***M. Benz, M. Pansini, M. Kekelidze, G. Bongartz, S. Schindera; Basel*

**Purpose:** Dual-source computer tomography (DSCT) provides information about tissue composition such as iodine concentration after contrast media injection. The aim of this study was to assess the correlation between iodine concentration and DSCT iodine measurements, to analyze the effect of body habitus on DSCT iodine measurements, and to compare the iodine concentration in abdominal organs during pre-contrast, arterial, and portal venous phase DSCT.

**Methods and Materials:** Twenty vials with varying iodine concentrations (0–360 mg/ml) were scanned on a DSCT scanner (Siemens Somatom Definition Flash, Forchheim, Germany). Eight of these 20 vials (with iodine concentrations ranging between 0–111 mg/ml) were additionally scanned in three cylindrical water-filled phantoms simulating patients with estimated body weights of 36–42 kg, 72–85 kg and 118–142 kg, respectively. DSCT iodine measurements were correlated to real iodine concentrations. The iodine uptake in the liver, pancreas, kidney, spleen, fat, muscle, and aorta was analyzed in 70 patients during pre-contrast ( $n=10$ ), arterial ( $n=10$ ), and portal venous phase ( $n=50$ ) scans.

**Results:** DSCT iodine measurements correlated significantly with iodine concentration at low iodine levels (0–29.6 mg/ml) ( $p<0.001$ ). However, DSCT iodine measurements underestimated iodine concentrations at high iodine levels. DSCT iodine measurements did not differ significantly between the three phantom sizes at low iodine levels (0.74–29.6 mg/ml) ( $p=0.22$ ). The aorta during arterial phase revealed the highest measurable iodine concentration (mean,  $14.6\pm 2.8$  mg/ml; range, 10.0–18.1 mg/ml).

**Conclusion:** DSCT iodine measurements accurately represent iodine concentrations and do not depend on body habitus at iodine levels reached during clinical contrast DSCT scans.

SS208

**Multi-parametric assessment of liver perfusion by MR-DWI: Correlation with phase-contrast portal venous flow measurements***F. Regini<sup>1</sup>, S. Colagrande<sup>1</sup>, L. N. Mazzoni<sup>1</sup>, S. Busoni<sup>1</sup>, P. Q. R. Santini<sup>2</sup>, R. Wytenbach<sup>2</sup>; <sup>1</sup>Firenze/IT, <sup>2</sup>Bellinzona*

**Purpose:** To verify the bi-exponential model of signal decay in diffusion weighted imaging (DWI) of the liver by evaluation of related parameters: apparent diffusion coefficient (ADC), slow diffusion coefficient (D), fast diffusion coefficient (D\*) and perfusion fraction (PF).

**Methods and Materials:** Forty healthy volunteers (19 f; mean age 32y, range 20–52y) underwent MR imaging at 3.0-T including 2D-Phase-Contrast (PC) acquisitions ( $V_{enc}=40$  cm/sec), to measure portal venous flow, and DWI acquisitions (free breath, 14 b-values, b-range=0–800 s/mm<sup>2</sup>), repeated before and 30 minutes after a standard meal (600 kcal). DWI parameters were calculated using signal intensities at every b value, measured with three different circular ROIs drawn on right liver lobe.

Paired sample t-test and Pearson correlation coefficient test were performed to evaluate differences in various parameters when calculated before and after the meal and to detect possible correlation with portal flow.

**Results:** After the meal portal flow increased in all the subjects (mean increment $\pm$ SD=887 $\pm$ 281 ml/min; 96 $\pm$ 33%). ADC, D, and PF did not show a statistically significant increment after meal at t-test, while D\* did (mean increment $\pm$ SD=30 $\pm$ 50%,  $p<0.001$ ), although with large variability. Pearson correlation coefficient did not show a significant correlation of portal flow and D\* increments when calculated before and after the meal.

**Conclusion:** D\* is the only DWI parameter that increases with portal flow, confirming its dependence on perfusive phenomena, as hypothesized originally by Le Bihan. This observation underlines the importance of estimating D\* in MR studies concerning diseases involving perfusional changes, although technical issues can make this difficult.



## SS209

**CT perfusion for evaluation of early treatment response of liver metastases after <sup>90</sup>Y radioembolization**

C. S. Reiner, F. Morsbach, B.-R. Sah, N. Schäfer, T. Pfammatter, H. Alkadhi; Zürich

**Purpose:** To evaluate computed tomography (CT) perfusion for the assessment of early treatment response after <sup>90</sup>Y-radioembolization of patients with liver metastases.

**Methods and Materials:** 17 consecutive patients (10 male, 7 female; age range, 35–79y) with liver metastases underwent dynamic contrast-enhanced CT liver perfusion (128-slice dual source CT, four-dimensional spiral mode, scan range 14.8 cm, 15 scans, cycle time 3 seconds) before and 4 weeks after <sup>90</sup>Y-radioembolization. The parameter arterial liver perfusion (ALP) was calculated from CT perfusion and tumor diameters were measured. Success of <sup>90</sup>Y-radioembolization was evaluated on follow-up imaging (mean follow-up time 124 days) based on the Response Evaluation Criteria in Solid Tumors (Version 1.1). The paired t-test was used to compare the tumor parameters pre- and post-<sup>90</sup>Y-radioembolization for different response groups.

**Results:** In the responder group (n=6) mean ALP pre-<sup>90</sup>Y-radioembolization was  $34.02 \pm 12.48$  and significantly decreased to  $20.40 \pm 11.00$  ml/100 ml/min post-<sup>90</sup>Y-radioembolization (p=0.029). In the non-responder group (n=11) mean ALP pre-<sup>90</sup>Y-radioembolization was not significantly different from mean ALP post-<sup>90</sup>Y-radioembolization ( $12.08 \pm 7.96$  vs.  $15.80 \pm 9.37$  ml/100 ml/min, p=0.064). The mean tumor diameter showed no significant difference between pre- and post-<sup>90</sup>Y-radioembolization for both groups (responder: p=0.242, non-responder: p=0.107).

**Conclusion:** CT perfusion shows early decrease of ALP in liver metastases responding to <sup>90</sup>Y-radioembolization, while tumor diameter remains unchanged early after treatment. Hence, CT perfusion may be a valuable technique for early response assessment after <sup>90</sup>Y-radioembolization.

## SS210

**A scoring system for distinguishing infected from non-infected abdominal fluid collections after surgery**

R. Gnann, M. Fischer, S. Breitenstein, C. A. Karlo, R. Zbinden, B. Seifert, H. Alkadhi; Zürich

**Purpose:** To develop an objective, easy-to-use scoring system based on radiologic and clinical findings that helps distinguishing infected from non-infected abdominal fluid collections after surgery.

**Methods and Materials:** The score developmental cohort consisted of 100 consecutive patients (mean age  $58y \pm 16.5$ , 17–87) admitted for drainage of an abdominal fluid collection 86 days (mean) after surgery. All of the patients had a foregoing abdominal CT scan obtained in the portal-venous phase of enhancement within one day of CT-guided intervention showing an encapsulated abdominal fluid collection. Imaging features and clinical parameters were analyzed. Significant predictors for developing a score were identified using univariate and multivariate logistic regression analysis. This score was validated in another subsequently enrolled 30 patients with abdominal fluid collection 68 days (mean) after surgery. Microbiologic analysis from fluid samples served as the standard of reference for determining infected and non-infected fluid collections.

**Results:** Hounsfield Units, air entrapment, C-reactive protein and diabetes were selected for constructing the score. The cutoff values were 0–2 (low risk for culture positive), 3–5 (intermediate risk) and 6–10 (high risk). Model performance was very good (Hosmer-Lemeshow test, P=0.36). In the validation cohort 11 patients had a total score  $\geq 6$ , all of these fluid collections were infected (0 false positive). 8 patients had a total score  $\leq 2$ , all of these fluid collections were sterile.

**Conclusion:** We introduce a scoring system that can be helpful in stratifying patients into risk categories distinguishing infected from non-infected encapsulated abdominal fluid collections after surgery.

## SS211

**Preoperative planning of DIEP flaps: Gadofosveset trisodium-enhanced MRA compared with standard CTA and intraoperative findings as a reference**

R. E. Bolt, M. Haug, G. Bongartz; Basel

**Purpose:** Accurate localisation of Deep-Inferior-Epigastric-artery-Perforators (DIEP) provides optimal pre-surgical planning for autologous flap breast-reconstruction. Contrast-enhanced MRA (CE-MRA) has potential advantages over previously described CT angiography (CTA) for perforator imaging. Our purpose is to evaluate the accuracy of bloodpool contrast-media enhanced MRA for preoperative mapping of DIEP arteries.

**Methods and Materials:** In a first step, sequence comparison between breath-hold and steady-state acquisition was performed on 10 volunteers and transferred the result to the clinical patient group. Preoperative standard CTA and Gadofosveset Trisodium-enhanced 3D MRA using 3-Tesla scanner (Verio, Siemens, Erlangen) were performed to localize and evaluate the main perforator vessels. The diameter, intramuscular course, and exact position of the fasciae penetration by the distance to the umbilicus of each perforator were recorded. The results of both imaging modalities were compared with intraoperative findings. So far, we included 7 patients into the ongoing study.

**Results:** Bloodpool CE-MRA in steady state was able to demonstrate the main perforator vessels in all patients. Comparison of the variables (diameter, intramuscular course, and position with respect to the umbilicus) for both techniques demonstrated good accordance to intraoperative findings. CTA presented higher resolution and an easier acquisition as compared to MRA which has the major benefit of lacking ionizing radiation.

**Conclusion:** Gadofosveset Trisodium-Enhanced 3.0-T MRA imaging may be used to accurately localize DIEP and to select the optimal perforator to be harvested for DIEP flap reconstructive breast surgery. These preliminary results will be refined until April 2013.



## SS212

**Identification of ferromagnetic ballistic projectiles with dual-energy CT: Implications for MRI safety**

*S. Winklhofer, P. Stolzmann, F. Morsbach, W. Schweitzer, A. Meier, M. Thali, H. Alkadhi, T. D. Ruder; Zürich*

**Purpose:** To assess the utility of dual-energy computed tomography (DECT) to distinguish ferromagnetic from non-ferromagnetic ballistic projectiles to improve magnetic resonance imaging (MRI) safety in patients suffering from firearm injuries.

**Methods and Materials:** Eleven ballistic projectiles including 9 bullets ( $7.8 \pm 4.1$  mm; range 5.7–14.8 mm) and 2 shotgun pellets (2.4 mm, 2.5 mm) were examined in an anthropomorphic thoracic phantom using second generation dual-source CT (Somatom Definition FLASH, Siemens Healthcare). Data acquisition was performed with tube voltages set at 80 kVp, 100 kVp, 120 kVp, and 140 kVp. Two readers independently assessed CT numbers on images reconstructed with extended CT scale. Dual-energy indices (DEI) were calculated from both 80/140 kVp and 100/140 kVp pairs; receiver operating characteristics analyses were fitted to predict ferro-magnetic properties by means of DEI and CT numbers.

**Results:** Out of the 11 projectiles, 5 (45%) were ferromagnetic and 6 non-ferromagnetic (55%). Inter-reader correlation regarding CT numbers was excellent ( $r=0.997$ ,  $p<0.001$ ). DEI calculated from both 80/140 kVp and 100/140 kVp were significantly ( $p<0.10$ ) different between ferromagnetic and non-ferromagnetic ballistic projectiles. Both tube voltage pairs had a 100% discriminative power ( $p<0.10$ ; 95%CI: 0.57–1.00 and 0.58–1.00, respectively) to differentiate between ferromagnetic and non-ferromagnetic ballistic projectiles. CT numbers as assessed on 120 kVp images did not allow for the identification of ferromagnetic projectiles ( $p=0.86$ ).

**Conclusion:** DECT combined with extended CT scale allows for the differentiation of non-ferromagnetic from ferromagnetic projectiles with a 100% power. This technique potentially facilitates MRI in patients with retained bullets who would otherwise have been excluded according to safety recommendations.

## SS213

**Reduction of metal artifacts on CT using model-based iterative reconstruction (MBIR)**

*S. Boudabbous, D. Arditi, E. Paulin, A. Syrogiannopoulou, C. Becker, X. Montet; Genève*

**Purpose:** To reduce artifacts resulting from implanted metal prosthesis on CT images using model-based iterative reconstruction (MBIR).

**Methods and Materials:** A total hip prosthesis, screws and metal plates were scanned in vitro (CT Discovery, GEMS). Images were reconstructed with filtered-back projection (FBP) and MBIR algorithms, and the size of the resulting artifacts on each image series was measured.

CT scans obtained with the same scanner in 30 patients with similar implants were reconstructed with FBP and MBIR. The visibility of the interface between metal and bone and of the neighbouring soft tissue structures was recorded on each set of images and graded on a 3-point scale.

**Results:** In vitro, the mean size of the artifacts was  $1.4 \text{ cm}^2$  with FBP and  $0.25 \text{ cm}^2$  with MBIR. In vivo, the size of the artifacts decreased from  $7.3$  to  $4.04 \text{ cm}^2$  ( $p<0.018$ ) when using MBIR. The interface between metal and bone was better visible on images reconstructed with MBIR than on those with FBP ( $p < 0.05$ ), and the results for soft tissue delineation were similar ( $p<0.05$ ).

**Conclusion:** MBIR may result in a significant reduction of the size of artifacts due to implanted metallic devices, thus improving visibility and assessment of the adjacent structures.

## SS214

**Multidetector computed tomography of the cervical spine: Optimisation of iterative reconstruction strength levels**

*P. Omoumi<sup>1</sup>, F. R. Verdun<sup>2</sup>, Y. Ben Salah<sup>1</sup>, B. Vande Berg<sup>1</sup>, F. Lecouvet<sup>1</sup>, R. A. Meuli<sup>2</sup>, F. Becce<sup>2</sup>; <sup>1</sup>Bruxelles/BE, <sup>2</sup>Lausanne*

**Purpose:** To determine the optimal strength level of iterative reconstructions (IRs) in multidetector computed tomography (MDCT) of the cervical spine.

**Methods and Materials:** Twenty patients investigated by cervical spine MDCT were prospectively studied. Raw data were reconstructed using both filtered back-projection and sinogram-affirmed IR (SAFIRE, strength levels 1–5) techniques. Image noise, signal-to-noise (SNR) and contrast-to-noise (CNR) ratios were measured. Two radiologists independently and blindly evaluated the following anatomical structures at both C3–C4 and C6–C7 levels using a four-point scale: intervertebral discs, content of neural foramina and dural sac, ligaments, soft tissues and vertebrae. They ultimately rated the overall diagnostic image quality using a ten-point scale.

**Results:** As IR strength levels increased, the image noise decreased linearly, while SNR and CNR both increased linearly (all  $p \leq 0.001$ ). For the intervertebral discs, the content of neural foramina and dural sac, and for ligaments, the subjective image quality scores increased linearly with increasing IR strength levels (all  $p \leq 0.03$ ). In contrast, for the soft tissues and vertebrae, the scores decreased linearly with increasing IR strength levels (all  $p < 0.001$ ). The overall diagnostic image quality scores increased linearly with increasing IR strength levels (both  $p < 0.001$ ).

**Conclusion:** The optimal strength level of IRs in cervical spine MDCT depends on the anatomical structure to be analysed. For the intervertebral discs and the content of neural foramina, high IR strength levels are recommended.

## SS215

**Computed tomography of the cervical spine: Comparison of image quality between a standard-dose and a low-dose protocol using filtered back-projection and iterative reconstruction**

*F. Becce<sup>1</sup>, Y. Ben Salah<sup>2</sup>, F. R. Verdun<sup>1</sup>, B. Vande Berg<sup>2</sup>, F. Lecouvet<sup>2</sup>, R. A. Meuli<sup>1</sup>, P. Omoumi<sup>2</sup>; <sup>1</sup>Lausanne, <sup>2</sup>Bruxelles/BE*

**Purpose:** To compare image quality between a standard-dose (SD) and a low-dose (LD) cervical spine CT protocol using filtered back-projection (FBP) and iterative reconstruction (IR).

**Methods and Materials:** Forty patients investigated by cervical spine CT were prospectively randomised into two groups: 1) SD (120 kVp, 275 mAs), 2) LD (120 kVp, 150 mAs), both applying automatic tube current modulation. Data were reconstructed using both FBP and sinogram-affirmed IR. Image noise, signal-to-noise (SNR) and contrast-to-noise (CNR) ratios were measured. Two radiologists independently and blindly assessed the following anatomical structures at C3–C4 and C6–C7 levels, using a four-point scale: intervertebral disc, content of neural foramina and dural sac, ligaments, soft tissues and vertebrae. They subsequently rated overall image quality using a ten-point scale.

**Results:** For both protocols and each disc level, IR significantly decreased image noise and increased SNR and CNR, compared to FBP. SNR and CNR were statistically equivalent between LDIR and SD-FBP protocols. Regardless of the dose and disc level, the qualitative scores with IR compared to FBP, and with LD-IR compared to SD-FBP, were significantly higher or not statistically different for intervertebral discs, neural foramina and ligaments, while significantly lower or not statistically different for soft tissues and vertebrae. The overall image quality scores were significantly higher with IR compared to FBP, and with LD-IR compared to SD-FBP.

**Conclusion:** LD-IR cervical spine CT provides better image quality for intervertebral discs, neural foramina and ligaments, and worse image quality for soft tissues and vertebrae, compared to SD-FBP, while reducing radiation dose by approximately 40%.

## SS216

**Assessing scoliosis and lordosis on lumbar spine CT: Comparison between CT reformats and standing radiographs in adult patients**

*B. Rizk<sup>1</sup>, P. Omoumi<sup>2</sup>, F. Becce<sup>3</sup>, F. Lecouvet<sup>2</sup>, B. Vande Berg<sup>2</sup>; <sup>1</sup>Poitiers/FR, <sup>2</sup>Bruxelles/BE, <sup>3</sup>Lausanne*

**Purpose:** Scoliosis and lordosis need to be evaluated on standing lumbar spine (LS) radiographs. Lumbar spine CT is considered to yield no relevant data regarding LS curvatures. The current study aimed at comparing LS curvature measurements determined on supine CT and on standing radiographs in an adult population.

**Methods and Materials:** Seventy-six consecutive patients (mean age, 66 years; range, 25–89) who underwent LS CT and radiographs within one week in 2011 were retrospectively included. Three independent observers measured modified Cobb angles on coronal and sagittal CT reformats, and on PA and lateral radiographs. Data obtained with CT reformats were compared to those obtained separately on radiographs in the entire population and in two different age groups.

**Results:** Scoliosis: Cobb angles measured on coronal CT reformats and PA radiographs were not statistically different in the entire population and the two age groups ( $p \geq 0.17$ ). Lordosis: Lordosis was statistically significantly greater on lateral radiographs compared to CT in the entire population and patients <70 years old. In the group of patients >70 years old, there was no statistical difference between measurements at standing radiographs and CT. Interobserver reproducibility of measurements was excellent with both techniques (ICC  $\geq 0.92$ ).

**Conclusion:** In the adult population, LS scoliosis can be assessed on coronal CT reformats as on standing PA radiographs whatever the age group. Lumbar spine lordosis needs to be evaluated on standing radiographs except in the group of patients aged >70 years in which sagittal CT reformats yield relevant information.

## SS217

**A reliable and simple measurement to identify an osseous-bridging transitional vertebra on a single slice mid-sagittal MR-image or lateral X-ray**

*M. Farshad, A. Aichmair, A. P. Hughes, R. J. Herzog, N. A. Farshad-Amacker; New York/US*

**Purpose:** Identification of a lumbosacral-transitional vertebra (LSTV) can be challenging and should not be overlooked, as it is biomechanically relevant and might affect surgical decision-making. A simple method to identify an osseous-bridging and therefore mechanically attached vertebra is desirable and was subject of this study.

**Methods and Materials:** 92 LSTV were categorized by a Radiologist according to the Castellvi classification (type 2a+b (n=46); type 3+4 (n=46)). Two independent readers (Radiologist and surgical PGY1 [blinded]) measured the vertical mid-vertebral angle (MVA). The MVA was defined as the angle between the vertical mid-vertebral lines of a segment on a single slice mid-sagittal MR image or lateral x-ray. The MVA of the lowest segment with a developed disc and the next one above were measured and the difference (Diff-MVA) was calculated in all the 92 LSTV and other 94 control non-LSTV subjects in MRI and in lateral X-rays if available.

**Results:** The Diff-MVA was significantly higher in the non-LSTV ( $25 \pm 8^\circ$ ) than in the LSTV subjects (type 2a+b:  $16 \pm 9^\circ$ , type 3a+b:  $9 \pm 11^\circ$ , type 4:  $5 \pm 7^\circ$ ,  $p < 0.05$ ). A Diff-MVA of  $\leq 10^\circ$  clearly identified osseous bridging LSTV (type 3+4) with a sensitivity of 100% and a specificity of 89% on MRI and 94% and 74% on lateral X-ray, respectively. The ICC between the readers was 0.96 (CI 0.96–0.97).

**Conclusion:** The MVA is a simple and reliable method to identify LSTV on a single-slice mid-sagittal MR image or lateral x-ray and correlates with the degree of mechanical connection of the TV. A Diff-MVA  $\leq 10^\circ$  clearly identifies indirectly the osseous bridging of the posterior elements of a non-mobile LSTV.

## SS218

**Does measurement of the femoral antetorsion angle in routine MR arthrography of the hip have an impact on therapeutic decision-making?**

*I. Steurer-Dober, M. Hüllner, M. Beck, B. Allgayer; Luzern*

**Purpose:** To evaluate the impact of femoral antetorsion measurement in routine MR arthrography of the hip on therapeutic decision-making.

**Methods and Materials:** 79 hips of 76 consecutive patients with hip pain (34 male, 45 female; median age, 33 years (range, 14–63 years) underwent routine MR arthrography of the hip including two rapid T1-weighted sequences over the proximal and distal femur for femoral antetorsion measurement. One fellowship-trained musculoskeletal radiologist evaluated femoral antetorsion angle retrospectively. An angle of  $>20^\circ$  was considered pathologic. In patients with a pathologic angle, the referring hip surgeon decided whether knowledge of the femoral antetorsion angle had an impact on therapeutic decision-making. Differences between groups were analyzed by Mann-Whitney test using SPSS.

**Results:** Mean femoral antetorsion angle in all hips was  $14^\circ \pm 10.3$ . In 19 hips (24.1%) antetorsion was pathologic ( $28.7^\circ \pm 6.9$ ). Thereof, in six hips (31.6%) – (7.6% of all evaluated hips) – knowledge of the angle influenced the treatment plan. The antetorsion angle in these six hips was significantly larger than in the remaining 13 hips with a high ( $>20^\circ$ ) antetorsion ( $35.1^\circ \pm 7.9$  vs.  $25.7^\circ \pm 3.8$ ;  $p = .012$ ).

There were no significant differences concerning patient age, gender and laterality in all hips, in hips with pathologic antetorsion, and in those hips with therapeutic consequence.

**Conclusion:** Measurement of the femoral antetorsion angle in routine MR arthrography in patients with hip pain has an impact on therapeutic decision-making in a substantial number of cases. Therefore, it should be included in the routine MR arthrography of the hip.

## SS219

**Instability of the hip joint – Finding at MR arthrography**

*A. Suter, T. Dietrich, M. Maier, C. Dora, C. W. Pfirrmann; Zürich*

**Purpose:** To determine which MR arthrography findings are related to instability of the hip joint.

**Methods and Materials:** 100 patients with MR arthrography using axial traction of the hip were included. Positive joint distraction served as reference standard for instability of the hip joint. Traction was applied during the MR examination with an 8 kg (woman) and 10 kg (men) sandbag, attached to the ankle over a deflection pulley. Fifty patients with joint space distraction were compared to an age and gender matched control group of 50 patients without distraction. Two radiologists assessed the caput-collum-diaphyseal (CCD) angle, lateral and anterior center-edge (CE) angles, alpha angle, acetabular version, acetabular coverage, ligamentum teres, capsular ligaments, iliopsoas tendon, labral tears and cartilage defects.

**Results:** Mean joint space distraction in the study group was  $0.87 \pm 0.6$  mm. Patients with positive joint space distraction had significant smaller lateral CE angles (control group  $38.1 \pm 5.9^\circ$ /study group  $34.6 \pm 7.2^\circ$ ,  $p = 0.014$ ), higher CCD angles ( $131.6 \pm 5.4^\circ/134.1 \pm 6.1^\circ$ ,  $p = 0.024$ ), higher alpha angles ( $53.5 \pm 7.8^\circ/59.2 \pm 10.1^\circ$ ,  $p = 0.002$ ), smaller axial acetabular coverage ( $161.4 \pm 9.9^\circ/153.6 \pm 9.6^\circ$ ,  $p < 0.001$ ), smaller acetabular depth ( $4.1 \pm 2.4$  mm/ $5.8 \pm 2.5$  mm,  $p = 0.001$ ) and a thicker ligamentum teres ( $4.65 \pm 1.36$  mm/ $5.37 \pm 1.76$  mm,  $p = 0.03$ ). The other parameters revealed no significant difference. ICC values for interobserver agreement were 0.62–0.98.

**Conclusion:** Small CE angles, small acetabular coverage, increased CCD angles and a thick ligamentum teres are associated with instability of the hip in our distraction model.

SS220

**Maximising reliability of quantitative muscle MRI slice prescription**

A. Fischmann<sup>1</sup>, J. M. Morrow<sup>2</sup>, C. D. J. Sinclair<sup>2</sup>, T. A. Yousry<sup>2</sup>, J. S. Thornton<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>London/UK

**Purpose:** Quantitative MRI of muscles in longitudinal studies including clinical trials requires reproducible prescription of the position of the axial slices to be analysed. We investigated the effect of slice prescription using scout-image based and surface-anatomy based methods on reliability and of subject limb positioning on distortion of muscle shape.

**Methods and Materials:** Ten healthy subjects were scanned at 3T with a 2D spin-echo T1-weighted acquisition. Imaging was performed at thigh and calf level in two different subject positions and independently repeated by a second operator. Regions-of-interest (ROI) were drawn on three muscles at thigh and calf levels on the axial slice a fixed distance from the knee joint and the axial slice determined by surface anatomy.

**Results:** Test-retest reliability of muscle cross sectional area using the scout image based slice prescription method was superior to the surface-anatomy method on all measures with narrower limits of agreement and higher intra-class correlation coefficients. There was no significant difference in scan-rescan ROI area overlap between the two subject positions, however ROI overlap was significantly reduced ( $p < 0.01$ ) with a changed position on repeat scanning.

**Conclusion:** Slice prescription based on fixed distance from the knee joint on a scout image provided superior reproducibility of slice location than a surface anatomy based method and should be used for longitudinal quantitative MRI studies where analysis of axial sequences is planned. Exact subject positioning will depend on scanner and coil configuration, but should be consistent through a longitudinal study.

SS221

**Whole-body MRI in sarcoidosis: Prevalence of musculoskeletal disease manifestations and correlation with clinical data**

V. Bratu<sup>1</sup>, K. Hostettler<sup>2</sup>, A. Fischmann<sup>2</sup>, M. Tamm<sup>2</sup>, U. Studler<sup>2</sup>; <sup>1</sup>Aarau, <sup>2</sup>Basel

**Purpose:** The objective of this study was to assess the distribution and extent of musculoskeletal changes in patients with sarcoidosis by whole-body MRI (wbMRI) and correlate the findings with laboratory and lung function data.

**Methods and Materials:** Twenty-four consecutive patients with histologically confirmed sarcoidosis were prospectively enrolled in this study. The lung function and the extrapulmonary physician organ severity tool (ePOST) score were assessed for each patient. All patients underwent standard protocol wbMRI at 1.5T. Edema-like and cystic lesions of the axial skeleton, pelvis and lower limbs were recorded. The muscular system was assessed with respect to myopathic or nodular changes. Findings were categorized as improbable (i.e., typical of other common entities), possible and probable (i.e., other common entities unlikely).

**Results:** In total 8/24 (33%) patients showed findings of possible and probable sarcoid origin. Skeletal lesions were seen in 5/24 (21%) patients, one having a disseminated edema-like skeletal manifestation. Muscular findings were seen in 3/24 (13%) patients, one of which had a nodular lesion histologically proven to be a sarcoid nodule. The cases with likely sarcoidotic MR-findings had significantly higher ePOST scores ( $p < 0.02$ ), which confirms a higher extrapulmonary disease activity. The frequency of skeletal findings was significantly higher in patients with reduced total lung capacity, forced vital capacity and  $D_{LCO}$ , respectively ( $p < 0.01$ ).

**Conclusion:** In a sample of sarcoidosis patients, wbMRI depicted musculoskeletal manifestations potentially related to sarcoidosis in 33%. WbMRI might be a useful tool to assess extrapulmonary disease activity in sarcoidosis, while abnormal skeletal MR-findings might be a marker of total disease activity.

SS222

**Radiographic abnormalities compared to treatment outcomes after a single subacromial injection of corticosteroid and anesthetic in patients with shoulder pain**

T. Dietrich, C. K. Peterson, F. Brunner, J. Hodler, C. W. A. Pfirrmann; Zürich

**Purpose:** To compare abnormalities on shoulder radiographs with improvement in pain and shoulder function after subacromial injections.

**Methods and Materials:** Prospective outcomes study including 100 patients having fluoroscopy-guided subacromial injections. Numerical pain rating scale (NRS) data was collected pre- and, along with Patient's Global Impression of Change (PGIC), at 1 day, 1 week and 1 month post-injection. Imaging abnormalities were assessed using the t-test for NRS scores and Mann-Whitney U for PGIC scores.

**Results:** Curved acromion patients had significantly higher NRS change scores and the best PGIC improvement scores at 1 day and 1 week ( $p = 0.04$  and  $0.02$ ). Lateral acromion slope  $> 15^\circ$  had the largest NRS change score at 1 month (4.8). Calcific tendinitis patients were significantly improved at 1 week and 1 month ( $p = 0.012$ ,  $p = 0.017$ ).

**Conclusion:** Curved acromion shape, lateral acromion slope  $> 15^\circ$ , and calcific tendinitis were most significantly linked with improvement 1 month after injection.

## SS212

**Identification of ferromagnetic ballistic projectiles with dual-energy CT: Implications for MRI safety**

*S. Winklhofer, P. Stolzmann, F. Morsbach, W. Schweitzer, A. Meier, M. Thali, H. Alkadhi, T. D. Ruder; Zürich*

**Purpose:** To assess the utility of dual-energy computed tomography (DECT) to distinguish ferromagnetic from non-ferromagnetic ballistic projectiles to improve magnetic resonance imaging (MRI) safety in patients suffering from firearm injuries.

**Methods and Materials:** Eleven ballistic projectiles including 9 bullets (7.8±4.1 mm; range 5.7–14.8 mm) and 2 shotgun pellets (2.4 mm, 2.5 mm) were examined in an anthropomorphic thoracic phantom using second generation dual-source CT (Somatom Definition FLASH, Siemens Healthcare). Data acquisition was performed with tube voltages set at 80 kVp, 100 kVp, 120 kVp, and 140 kVp. Two readers independently assessed CT numbers on images reconstructed with extended CT scale. Dual-energy indices (DEI) were calculated from both 80/140 kVp and 100/140 kVp pairs; receiver operating characteristics analyses were fitted to predict ferro-magnetic properties by means of DEI and CT numbers.

**Results:** Out of the 11 projectiles, 5 (45%) were ferromagnetic and 6 non-ferromagnetic (55%). Inter-reader correlation regarding CT numbers was excellent ( $r=0.997$ ,  $p<0.001$ ). DEI calculated from both 80/140 kVp and 100/140 kVp were significantly ( $p<0.10$ ) different between ferromagnetic and non-ferromagnetic ballistic projectiles. Both tube voltage pairs had a 100% discriminative power ( $p<0.10$ ; 95%CI: 0.57–1.00 and 0.58–1.00, respectively) to differentiate between ferromagnetic and non-ferromagnetic ballistic projectiles. CT numbers as assessed on 120 kVp images did not allow for the identification of ferromagnetic projectiles ( $p=0.86$ ).

**Conclusion:** DECT combined with extended CT scale allows for the differentiation of non-ferromagnetic from ferromagnetic projectiles with a 100% power. This technique potentially facilitates MRI in patients with retained bullets who would otherwise have been excluded according to safety recommendations.

## SS213

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*S. Boudabbous, D. Arditi, E. Paulin, A. Syrogiannopoulou, C. Becker, X. Montet; Genève*

**Purpose:** To reduce artifacts resulting from implanted metal prosthesis on CT images using model-based iterative reconstruction (MBIR).

**Methods and Materials:** A total hip prosthesis, screws and metal plates were scanned in vitro (CT Discovery, GEMS). Images were reconstructed with filtered-back projection (FBP) and MBIR algorithms, and the size of the resulting artifacts on each image series was measured.

CT scans obtained with the same scanner in 30 patients with similar implants were reconstructed with FBP and MBIR. The visibility of the interface between metal and bone and of the neighbouring soft tissue structures was recorded on each set of images and graded on a 3-point scale.

**Results:** In vitro, the mean size of the artifacts was 1.4 cm<sup>2</sup> with FBP and 0.25 cm<sup>2</sup> with MBIR. In vivo, the size of the artifacts decreased from 7.3 to 4.04 cm<sup>2</sup> ( $p<0.018$ ) when using MBIR. The interface between metal and bone was better visible on images reconstructed with MBIR than on those with FBP ( $p<0.05$ ), and the results for soft tissue delineation were similar ( $p<0.05$ ).

**Conclusion:** MBIR may result in a significant reduction of the size of artifacts due to implanted metallic devices, thus improving visibility and assessment of the adjacent structures.

## SS214

**Multidetector computed tomography of the cervical spine: Optimisation of iterative reconstruction strength levels**

*P. Omoumi<sup>1</sup>, F. R. Verdun<sup>2</sup>, Y. Ben Salah<sup>1</sup>, B. Vande Berg<sup>1</sup>, F. Lecouvet<sup>1</sup>, R. A. Meuli<sup>2</sup>, F. Becce<sup>2</sup>; <sup>1</sup>Bruxelles/BE, <sup>2</sup>Lausanne*

**Purpose:** To determine the optimal strength level of iterative reconstructions (IRs) in multidetector computed tomography (MDCT) of the cervical spine.

**Methods and Materials:** Twenty patients investigated by cervical spine MDCT were prospectively studied. Raw data were reconstructed using both filtered back-projection and sinogram-affirmed IR (SAFIRE, strength levels 1–5) techniques. Image noise, signal-to-noise (SNR) and contrast-to-noise (CNR) ratios were measured. Two radiologists independently and blindly evaluated the following anatomical structures at both C3–C4 and C6–C7 levels using a four-point scale: intervertebral discs, content of neural foramina and dural sac, ligaments, soft tissues and vertebrae. They ultimately rated the overall diagnostic image quality using a ten-point scale.

**Results:** As IR strength levels increased, the image noise decreased linearly, while SNR and CNR both increased linearly (all  $p\leq0.001$ ). For the intervertebral discs, the content of neural foramina and dural sac, and for ligaments, the subjective image quality scores increased linearly with increasing IR strength levels (all  $p\leq0.03$ ). In contrast, for the soft tissues and vertebrae, the scores decreased linearly with increasing IR strength levels (all  $p<0.001$ ). The overall diagnostic image quality scores increased linearly with increasing IR strength levels (both  $p<0.001$ ).

**Conclusion:** The optimal strength level of IRs in cervical spine MDCT depends on the anatomical structure to be analysed. For the intervertebral discs and the content of neural foramina, high IR strength levels are recommended.

## SS215

**Computed tomography of the cervical spine: Comparison of image quality between a standard-dose and a low-dose protocol using filtered back-projection and iterative reconstruction**

*F. Becce<sup>1</sup>, Y. Ben Salah<sup>2</sup>, F. R. Verdun<sup>1</sup>, B. Vande Berg<sup>2</sup>, F. Lecouvet<sup>2</sup>, R. A. Meuli<sup>1</sup>, P. Omoumi<sup>2</sup>; <sup>1</sup>Lausanne, <sup>2</sup>Bruxelles/BE*

**Purpose:** To compare image quality between a standard-dose (SD) and a low-dose (LD) cervical spine CT protocol using filtered back-projection (FBP) and iterative reconstruction (IR).

**Methods and Materials:** Forty patients investigated by cervical spine CT were prospectively randomised into two groups: 1) SD (120 kVp, 275 mAs), 2) LD (120 kVp, 150 mAs), both applying automatic tube current modulation. Data were reconstructed using both FBP and sinogram-affirmed IR. Image noise, signal-to-noise (SNR) and contrast-to-noise (CNR) ratios were measured. Two radiologists independently and blindly assessed the following anatomical structures at C3–C4 and C6–C7 levels, using a four-point scale: intervertebral disc, content of neural foramina and dural sac, ligaments, soft tissues and vertebrae. They subsequently rated overall image quality using a ten-point scale.

**Results:** For both protocols and each disc level, IR significantly decreased image noise and increased SNR and CNR, compared to FBP. SNR and CNR were statistically equivalent between LDIR and SD-FBP protocols. Regardless of the dose and disc level, the qualitative scores with IR compared to FBP, and with LD-IR compared to SD-FBP, were significantly higher or not statistically different for intervertebral discs, neural foramina and ligaments, while significantly lower or not statistically different for soft tissues and vertebrae. The overall image quality scores were significantly higher with IR compared to FBP, and with LD-IR compared to SD-FBP.

**Conclusion:** LD-IR cervical spine CT provides better image quality for intervertebral discs, neural foramina and ligaments, and worse image quality for soft tissues and vertebrae, compared to SD-FBP, while reducing radiation dose by approximately 40%.



## SS216

**Assessing scoliosis and lordosis on lumbar spine CT: Comparison between CT reformats and standing radiographs in adult patients**

B. Rizk<sup>1</sup>, P. Omoum<sup>2</sup>, F. Becce<sup>3</sup>, F. Lecouvet<sup>2</sup>, B. Vande Berg<sup>2</sup>;  
<sup>1</sup>Poitiers/FR, <sup>2</sup>Bruxelles/BE, <sup>3</sup>Lausanne

**Purpose:** Scoliosis and lordosis need to be evaluated on standing lumbar spine (LS) radiographs. Lumbar spine CT is considered to yield no relevant data regarding LS curvatures. The current study aimed at comparing LS curvature measurements determined on supine CT and on standing radiographs in an adult population.

**Methods and Materials:** Seventy-six consecutive patients (mean age, 66 years; range, 25–89) who underwent LS CT and radiographs within one week in 2011 were retrospectively included. Three independent observers measured modified Cobb angles on coronal and sagittal CT reformats, and on PA and lateral radiographs. Data obtained with CT reformats were compared to those obtained separately on radiographs in the entire population and in two different age groups.

**Results:** Scoliosis: Cobb angles measured on coronal CT reformats and PA radiographs were not statistically different in the entire population and the two age groups ( $p \geq 0.17$ ). Lordosis: Lordosis was statistically significantly greater on lateral radiographs compared to CT in the entire population and patients <70 years old. In the group of patients >70 years old, there was no statistical difference between measurements at standing radiographs and CT. Interobserver reproducibility of measurements was excellent with both techniques (ICC  $\geq 0.92$ ).

**Conclusion:** In the adult population, LS scoliosis can be assessed on coronal CT reformats as on standing PA radiographs whatever the age group. Lumbar spine lordosis needs to be evaluated on standing radiographs except in the group of patients aged >70 years in which sagittal CT reformats yield relevant information.

## SS217

**A reliable and simple measurement to identify an osseous-bridging transitional vertebra on a single slice mid-sagittal MR-image or lateral X-ray**

M. Farshad, A. Aichmair, A. P. Hughes, R. J. Herzog,  
 N. A. Farshad-Amacker; New York/US

**Purpose:** Identification of a lumbosacral-transitional vertebra (LSTV) can be challenging and should not be overlooked, as it is biomechanically relevant and might affect surgical decision-making. A simple method to identify an osseous-bridging and therefore mechanically attached vertebra is desirable and was subject of this study.

**Methods and Materials:** 92 LSTV were categorized by a Radiologist according to the Castellvi classification (type 2a+b (n=46); type 3+4 (n=46)). Two independent readers (Radiologist and surgical PGY1 [blinded]) measured the vertical mid-vertebral angle (MVA). The MVA was defined as the angle between the vertical mid-vertebral lines of a segment on a single slice mid-sagittal MR image or lateral x-ray. The MVA of the lowest segment with a developed disc and the next one above were measured and the difference (Diff-MVA) was calculated in all the 92 LSTV and other 94 control non-LSTV subjects in MRI and in lateral X-rays if available.

**Results:** The Diff-MVA was significantly higher in the non-LSTV ( $25 \pm 8^\circ$ ) than in the LSTV subjects (type 2a+b:  $16 \pm 9^\circ$ , type 3a+b:  $9 \pm 11^\circ$ , type 4:  $-5 \pm 7^\circ$ ,  $p < 0.05$ ). A Diff-MVA of  $\leq 10^\circ$  clearly identified osseous bridging LSTV (type 3+4) with a sensitivity of 100% and a specificity of 89% on MRI and 94% and 74% on lateral X-ray, respectively. The ICC between the readers was 0.96 (CI 0.96–0.97).

**Conclusion:** The MVA is a simple and reliable method to identify LSTV on a single-slice mid-sagittal MR image or lateral x-ray and correlates with the degree of mechanical connection of the TV. A Diff-MVA  $\leq 10^\circ$  clearly identifies indirectly the osseous bridging of the posterior elements of a non-mobile LSTV.

## SS218

**Does measurement of the femoral antetorsion angle in routine MR arthrography of the hip have an impact on therapeutic decision-making?**

L. Steurer-Dober, M. Hüllner, M. Beck, B. Allgayer; Luzern

**Purpose:** To evaluate the impact of femoral antetorsion measurement in routine MR arthrography of the hip on therapeutic decision-making.

**Methods and Materials:** 79 hips of 76 consecutive patients with hip pain (34 male, 45 female; median age, 33 years (range, 14–63 years) underwent routine MR arthrography of the hip including two rapid T1-weighted sequences over the proximal and distal femur for femoral antetorsion measurement. One fellowship-trained musculoskeletal radiologist evaluated femoral antetorsion angle retrospectively. An angle of  $>20^\circ$  was considered pathologic. In patients with a pathologic angle, the referring hip surgeon decided whether knowledge of the femoral antetorsion angle had an impact on therapeutic decision-making. Differences between groups were analyzed by Mann-Whitney test using SPSS.

**Results:** Mean femoral antetorsion angle in all hips was  $14^\circ \pm 10.3$ . In 19 hips (24.1%) antetorsion was pathologic ( $28.7^\circ \pm 6.9$ ). Thereof, in six hips (31.6%) – (7.6% of all evaluated hips) – knowledge of the angle influenced the treatment plan. The antetorsion angle in these six hips was significantly larger than in the remaining 13 hips with a high ( $>20^\circ$ ) antetorsion ( $35.1^\circ \pm 7.9$  vs.  $25.7^\circ \pm 3.8$ ;  $p = .012$ ).

There were no significant differences concerning patient age, gender and laterality in all hips, in hips with pathologic antetorsion, and in those hips with therapeutic consequence.

**Conclusion:** Measurement of the femoral antetorsion angle in routine MR arthrography in patients with hip pain has an impact on therapeutic decision-making in a substantial number of cases. Therefore, it should be included in the routine MR arthrography of the hip.

## SS219

**Instability of the hip joint – Finding at MR arthrography**

A. Suter, T. Dietrich, M. Maier, C. Dora, C. W. Pfirrmann; Zürich

**Purpose:** To determine which MR arthrography findings are related to instability of the hip joint.

**Methods and Materials:** 100 patients with MR arthrography using axial traction of the hip were included. Positive joint distraction served as reference standard for instability of the hip joint. Traction was applied during the MR examination with an 8 kg (woman) and 10 kg (men) sandbag, attached to the ankle over a deflection pulley. Fifty patients with joint space distraction were compared to an age and gender matched control group of 50 patients without distraction. Two radiologists assessed the caput-collum-diaphyseal (CCD) angle, lateral and anterior center-edge (CE) angles, alpha angle, acetabular version, acetabular coverage, ligamentum teres, capsular ligaments, iliopsoas tendon, labral tears and cartilage defects.

**Results:** Mean joint space distraction in the study group was  $0.87 \pm 0.6$  mm. Patients with positive joint space distraction had significant smaller lateral CE angles (control group  $38.1 \pm 5.9^\circ$ /study group  $34.6 \pm 7.2^\circ$ ,  $p = 0.014$ ), higher CCD angles ( $131.6 \pm 5.4^\circ$ / $134.1 \pm 6.1^\circ$ ,  $p = 0.024$ ), higher alpha angles ( $53.5 \pm 7.8^\circ$ / $59.2 \pm 10.1^\circ$ ,  $p = 0.002$ ), smaller axial acetabular coverage ( $161.4 \pm 9.9^\circ$ / $153.6 \pm 9.6^\circ$ ,  $p < 0.001$ ), smaller acetabular depth ( $4.1 \pm 2.4$  mm/ $5.8 \pm 2.5$  mm,  $p = 0.001$ ) and a thicker ligamentum teres ( $4.65 \pm 1.36$  mm/ $5.37 \pm 1.76$  mm,  $p = 0.03$ ). The other parameters revealed no significant difference. ICC values for interobserver agreement were 0.62–0.98.

**Conclusion:** Small CE angles, small acetabular coverage, increased CCD angles and a thick ligamentum teres are associated with instability of the hip in our distraction model.



SS220

**Maximising reliability of quantitative muscle MRI slice prescription**

A. Fischmann<sup>1</sup>, J. M. Morrow<sup>2</sup>, C. D. J. Sinclair<sup>2</sup>, T. A. Yousry<sup>2</sup>, J. S. Thornton<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>London/UK

**Purpose:** Quantitative MRI of muscles in longitudinal studies including clinical trials requires reproducible prescription of the position of the axial slices to be analysed. We investigated the effect of slice prescription using scout-image based and surface-anatomy based methods on reliability and of subject limb positioning on distortion of muscle shape.

**Methods and Materials:** Ten healthy subjects were scanned at 3T with a 2D spin-echo T1-weighted acquisition. Imaging was performed at thigh and calf level in two different subject positions and independently repeated by a second operator. Regions-of-interest (ROI) were drawn on three muscles at thigh and calf levels on the axial slice a fixed distance from the knee joint and the axial slice determined by surface anatomy.

**Results:** Test-retest reliability of muscle cross sectional area using the scout image based slice prescription method was superior to the surface-anatomy method on all measures with narrower limits of agreement and higher intra-class correlation coefficients. There was no significant difference in scan-rescan ROI area overlap between the two subject positions, however ROI overlap was significantly reduced ( $p < 0.01$ ) with a changed position on repeat scanning.

**Conclusion:** Slice prescription based on fixed distance from the knee joint on a scout image provided superior reproducibility of slice location than a surface anatomy based method and should be used for longitudinal quantitative MRI studies where analysis of axial sequences is planned. Exact subject positioning will depend on scanner and coil configuration, but should be consistent through a longitudinal study.

SS221

**Whole-body MRI in sarcoidosis:****Prevalence of musculoskeletal disease manifestations and correlation with clinical data**

V. Bratu<sup>1</sup>, K. Hostettler<sup>2</sup>, A. Fischmann<sup>2</sup>, M. Tamm<sup>2</sup>, U. Studler<sup>2</sup>; <sup>1</sup>Aarau, <sup>2</sup>Basel

**Purpose:** The objective of this study was to assess the distribution and extent of musculoskeletal changes in patients with sarcoidosis by whole-body MRI (wbMRI) and correlate the findings with laboratory and lung function data.

**Methods and Materials:** Twenty-four consecutive patients with histologically confirmed sarcoidosis were prospectively enrolled in this study. The lung function and the extrapulmonary physician organ severity tool (ePOST) score were assessed for each patient. All patients underwent standard protocol wbMRI at 1.5T. Edema-like and cystic lesions of the axial skeleton, pelvis and lower limbs were recorded. The muscular system was assessed with respect to myopathic or nodular changes. Findings were categorized as improbable (i.e., typical of other common entities), possible and probable (i.e., other common entities unlikely).

**Results:** In total 8/24 (33%) patients showed findings of possible and probable sarcoid origin. Skeletal lesions were seen in 5/24 (21%) patients, one having a disseminated edema-like skeletal manifestation. Muscular findings were seen in 3/24 (13%) patients, one of which had a nodular lesion histologically proven to be a sarcoid nodule. The cases with likely sarcoidotic MR-findings had significantly higher ePOST scores ( $p < 0.02$ ), which confirms a higher extrapulmonary disease activity. The frequency of skeletal findings was significantly higher in patients with reduced total lung capacity, forced vital capacity and  $D_{LCO}$ , respectively ( $p < 0.01$ ).

**Conclusion:** In a sample of sarcoidosis patients, wbMRI depicted musculoskeletal manifestations potentially related to sarcoidosis in 33%. WbMRI might be a useful tool to assess extrapulmonary disease activity in sarcoidosis, while abnormal skeletal MR-findings might be a marker of total disease activity.

SS222

**Radiographic abnormalities compared to treatment outcomes after a single subacromial injection of corticosteroid and anesthetic in patients with shoulder pain**

T. Dietrich, C. K. Peterson, F. Brunner, J. Hodler, C. W. A. Pfirrmann; Zürich

**Purpose:** To compare abnormalities on shoulder radiographs with improvement in pain and shoulder function after subacromial injections.

**Methods and Materials:** Prospective outcomes study including 100 patients having fluoroscopy-guided subacromial injections. Numerical pain rating scale (NRS) data was collected pre- and, along with Patient's Global Impression of Change (PGIC), at 1 day, 1 week and 1 month post-injection. Imaging abnormalities were assessed using the t-test for NRS scores and Mann-Whitney U for PGIC scores.

**Results:** Curved acromion patients had significantly higher NRS change scores and the best PGIC improvement scores at 1 day and 1 week ( $p = 0.04$  and  $0.02$ ). Lateral acromion slope  $> 15^\circ$  had the largest NRS change score at 1 month (4.8). Calcific tendinitis patients were significantly improved at 1 week and 1 month ( $p = 0.012$ ,  $p = 0.017$ ).

**Conclusion:** Curved acromion shape, lateral acromion slope  $> 15^\circ$ , and calcific tendinitis were most significantly linked with improvement 1 month after injection.

SS229

### Clinical evaluation of an automatic tube voltage selection in chest CT angiography

T. Niemann<sup>1</sup>, S. Henry<sup>2</sup>, J.-B. Faivre<sup>2</sup>, K. Yasunaga<sup>2</sup>, S. Bendaoud<sup>2</sup>, J. Remy<sup>2</sup>, M. Rémy-Jardin<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Lille/FR

**Purpose:** To evaluate the clinical impact of automatic tube voltage selection in adult chest CT angiography.

**Methods and Materials:** 93 consecutive patients, referred for a follow-up chest CT angiographic (CTA) examination, were prospectively evaluated with a scanning protocol aimed at comparing subjective and objective image quality between two successive CTAs acquired in similar technical conditions except for the kilovoltage selection: (a) the initial examination (i.e., T0 scan) was systematically obtained at 120 kVp and 90 ref mAs; (b) the follow-up examination (i.e., T1 scan) was obtained with an automatic selection of the kilovoltage using the CARE kV system (Siemens Healthcare) that proposes optimized kV and mA settings according to the planned examination type which was preset for optimized CTA in the present study.

**Results:** At T1, 90 patients were scanned with reduced tube voltage, resulting in significant dose-length-product reduction (87.27 vs 141.88 mGy.cm;  $p < 0.0001$ ). There was a significant increase in CNR between T0 and T1 with a mean level of attenuation within the pulmonary trunk of  $470.1 \pm 127.6$  HU at T1 (T0:  $299.2 \pm 70.1$  HU). The increase in objective image noise at T1 did not alter the diagnostic value of lung and mediastinal images which was rated using a 4-point scale ranging from 1 (excellent) to 4 (poor) (T0:  $1.47 \pm 0.24$ ; T1:  $1.73 \pm 0.39$ ).

**Conclusion:** The automatic tube voltage selection reduced by 38.5% the radiation dose delivered during chest CT angiograms while improving the contrast-to-noise ratio of the examinations.

SS230

### CT-based clinical staging for malignant pleural mesothelioma is unreliable for the assessment of local tumor invasion and lymph node involvement

T. D. L. Nguyen-Kim, I. Schmitt-Opitz, P. Kestenholz, R. Hunziker, F. Martina, W. Weder, T. Frauenfelder; Zürich

**Purpose:** Computed tomography (CT) is the most commonly used imaging-modality for malignant pleural mesothelioma (MPM) staging, although visualization of tumor extent remains challenging. The purpose was to assess the reliability of clinical staging for MPM based on preoperative CT scan as a function of different observer and compared to pathological staging.

**Methods and Materials:** 62 patients with proven MPM and preoperative available CT scans were included. 34 patients (55%) underwent talc pleurodesis and all underwent induction chemotherapy prior to surgery. The CT scans were performed over a median of 16 days (0–28) before surgery using intravenous contrast and had a maximum slice thickness of 2 mm. Three experienced observers blinded to any clinical information (two chest radiologists and one thoracic surgeon) independently assessed clinical T and N stages. Inter-rater reliability was assessed by using analysis of variance. The clinical staging was correlated with definitive pathological staging. A kappa statistic was used to assess the agreement of tumor staging between observers.

**Results:** T stage was estimated correctly in 48–71% with a good interobserver reliability ( $\kappa = 0.64$ – $0.71$ ). T-stage was underestimated in 22, 25 and 37%, whereas overestimation was rather low (7–15%). Regarding N-status, a correct staging was performed in 58–68%, again with good inter-observer agreement ( $\kappa = 0.61$ ,  $0.65$ ,  $0.71$ ). Lymph node staging was also rather under-categorized (16–27%) by all readers. A more advanced N status was only assigned in 13–16% of the cases.

**Conclusion:** The present data set confirms that CT scan based clinical staging results in an underestimation of mesothelioma stage, especially T stage, which is the most important assessment-factor of tumor resectability. More precise imaging techniques should be evaluated in comparative studies for a better prediction of mesothelioma stage of disease.

SS231

### Non-contrast-enhanced preoperative assessment of lung perfusion in patients with non-small-cell lung cancer using fourier-decomposition magnetic resonance imaging

G. Sommer<sup>1</sup>, G. Bauman<sup>2</sup>, M. Koenigkam-Santos<sup>2</sup>, C. Draenkow<sup>2</sup>, C.-P. Heussel<sup>2</sup>, H.-U. Kauczor<sup>2</sup>, H.-P. Schlemmer<sup>2</sup>, M. Puderbach<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Heidelberg/DE

**Purpose:** Knowledge about lung function impairment is important for predicting functional outcome and optimizing surgery in NSCLC patients. Fourier-decomposition MRI (FD-MRI) can assess regional lung perfusion without contrast agents. This study evaluates FD-MRI for preoperative assessment of lung perfusion in NSCLC patients with dynamic contrast-enhanced MRI (DCE-MRI) as standard of reference.

**Methods and Materials:** Fifteen patients were examined at 1.5T. Time-resolved images of the lungs were acquired using a 2D-bSSFP sequence. Fourier-decomposition was used to detect and separate periodic changes of lung proton density caused by respiratory and cardiac cycles. Perfusion-weighted images were calculated by pixel-wise integration of the cardiac spectral line. FD- and DCE-data were analyzed visually for perfusion defects. Perfusion proportions of pulmonary lobes were calculated quantitatively by segmentation analyses. FD-MRI perfusion signal per lung volume was compared to quantitative velocity-encoded flow measurements.

**Results:** Sensitivity, specificity and accuracy of FD-MRI for visual detection of perfusion defects by individual readers were 84%, 92%, and 91%. Perfusion quantification provided high linear correlation between FD-MRI and DCE-MRI for both lungs (right/left:  $r = 0.96/0.97$ ) and both upper lobes (right/left:  $r = 0.93/0.91$ ), but was compromised by cardiac pulsation artifacts in the lower lobes (right/left:  $r = 0.57/0.64$ ) and middle lobe ( $r = 0.46$ ). Average FD-MRI perfusion signal per lung volume correlated well with average pulmonary arterial blood flow ( $r = 0.75$ ).

**Conclusion:** Non-contrast-enhanced assessment of regional lung perfusion in NSCLC patients with FD-MRI represents an attractive alternative to DCE-MRI in cases, where the administration of contrast media is clinically problematic. Further investigation must address the problem of cardiac pulsation artifacts and validate the technique in larger cohorts.

SS232

### Assessing lung transplantation ischemic-reperfusion injury by micro-computed-tomography and ultra-short echo-time MRI in a mouse model

M. Wurnig, Y. Tsushima, W. Jungraithmayr, A. Boss; Zürich

**Purpose:** Ischemic/reperfusion-injury (I/R-injury) is a common early complication after lung transplantation. The purpose of this study was to compare ultra-short echo-time (UTE) sequences in magnetic resonance imaging (MRI) with a micro-computed-tomography (micro-CT) reference standard for detection of I/R-injury in a lung transplantation mouse model.

**Methods and Materials:** Six mice (C57BL/6) with syngeneic transplanted left lung received donor grafts exposed to 6h cold ischemia. Imaging was performed within 24h after transplantation with high-resolution-micro-CT (tube-voltage: 50 kV, current 500 mA, aluminium-filter 0.5 mm, voxel-size  $35 \times 35 \times 35 \mu\text{m}^3$ ) and small-animal-MRI at 4.7 Tesla with a linearly-polarized whole-body mouse-coil. The imaging protocol comprised of 3D-UTE sequences with different echo-times (TR 8 ms, TE 50/75/100/500/1500/3000/4000/5000  $\mu\text{s}$ , voxel-size  $350 \times 350 \times 350 \mu\text{m}^3$ ). Calculated spin-densities and  $T2^*$ -transverse-relaxation-times (MRI) of lung parenchyma were compared to HU-density (micro-CT). ROC-curves and AUC-values were calculated for comparison of diagnostic power. All samples underwent histological examination.

**Results:** Both, UTE-sequences and micro-CT, showed excellent depiction of pulmonary infiltration due to I/R-injury. Measured parametrical values were: Not-transplanted right lung: mean HU  $-416 \pm 120$ ; mean spin-density  $1655 \pm 440$ ; mean  $T2^*$   $895 \pm 870 \mu\text{s}$ . Transplanted left lung: mean HU  $29 \pm 35$ ; mean spin-density  $2310 \pm 300$ ; mean  $T2^*$   $4550 \pm 3230 \mu\text{s}$ . Slight infiltration could better be discriminated with micro-CT, whereas in strong infiltration a better contrast was provided by UTE-MRI. AUC-values: HU-density 0.99, spin-density 0.89,  $T2^*$  0.96, combination spin-density and  $T2^*$  0.98.

**Conclusion:** Results show that MR imaging of the lung has compared to micro-CT a similar diagnostic power regarding the detection of I/R-injury after lung transplantation. Due to complementary properties in the evaluation of dense and slight infiltration, the combination of both modalities seems beneficial.

SS233

**Mediastinal tuberculous lymphadenopathy:  
Effect of HIV seropositivity***S. V. Kashikar, A. A. Sachan, A. K. A. Bari; Wardha/IN*

**Purpose:** In developing countries like India, extrapulmonary tuberculosis occurs in as many as 60% of HIV-infected patients with tuberculosis. The clinical and radiologic manifestations of intrathoracic tuberculous lymphadenitis are variable and depend on the site of the lymphadenopathy and the immune status of the patient. We evaluated the differences in the clinical and radiologic manifestations and spectra of mediastinal tuberculous lymphadenitis in adult patients (with and those without HIV infection).

**Methods and Materials:** 36 patients (21 men, 15 women; mean age, 41.5±8.9 years) were found to have intrathoracic tuberculous lymphadenitis. Of these patients, 12 (8 men, 4 women; mean age, 37±5.7 years) were HIV-seropositive. ChestCTscans were evaluated for involved lymph node stations, long-axis diameter of involved lymph nodes, presence of central necrosis in enlarged nodes, shape and conglomeration and other associated pulmonary-pleural findings.

**Results:** The number of involvement of lymph node stations were more in HIV-seropositive patients (mean number of involved nodal stations, 6.4 versus 3.1;  $p < 0.001$ ). Although small sized nodes were seen (mean long-axis diameter, 15 mm versus 25 mm;  $p=0.003$ ), they were more commonly conglomerated and were more frequently associated with lung consolidation, pleural effusion, extrathoracic lymph node and organ involvement ( $p < 0.05$ ) than in HIV-negative patients. The sole finding of tuberculous lymphadenitis was seen in 7 of 24 (29.16%) HIV-negative patients and in 4 of 12 (33.33%) HIV-positive patients.

**Conclusion:** HIV positive cases had multifocal involvement of lymph node stations, pulmonary, pleural and extrathoracic sites of involvement more than seen in seronegative tuberculous patients.

SS234

**MDCT of the neck in children: Radiation exposure**

*I. M. O. Borzani, E. Ruggieri, S. Milano, V. Minotto, M. Campoleoni, P. R. Biondetti; Milan/IT*

**Purpose:** Dose concerns remain a central issue in children, especially when sensitive organs are located within the scanned region. When cervical region needs to be scanned the thyroid gland is always directly irradiated. The aim of this study is to evaluate radiation dose related to neck CT in young patients (<17 y.o.) with focus on thyroid radiation exposure.

**Methods and Materials:** Between January 2009 and December 2011 we performed 34 CT examinations of the neck in 25 patients ≤17 y.o. (mean age 4,6 range 0–17) divided in 3 age groups: G1: 21 scans (0–3 y.o.), G2: 10 scans (4–13 y.o.), G3: 3 scans (14–17 y.o.). The software CT-EXPO was used to calculate the doses, correcting the results according to patient neck size.

**Results:** Two main different protocols were used (100–120 kVp) all with SmartmA. All the parameters related to patient exposure showed great variability. We focused on the dose to the thyroid: the average was 7.7 mSv without significant differences among age groups: G1: 7,9 mSv; G2: 7,32 mSv; G3: 7,4 mSv. Within the two younger age groups it's more noticeable the dose differences due to the energy beam as the only parameter that can substantially change the dose impact.

**Conclusion:** Scanning protocols can vary widely without significant changes in the average dose to the thyroid. Beam energy has high influence on the dose and could be lowered in young pts without losing image quality.

SS235

**Grey matter alterations in children born preterm**

*J. Schneider, A. Datta, N. Bechtel, T. Waltz, C. Neuhaus, N. Oser; Basel*

**Purpose:** Preterms are at risk of neurodevelopmental impairment. We investigated cognitive and motor achievements and grey matter volume (GMV) alterations in children born preterm.

**Methods and Materials:** We enrolled 19 healthy term controls and 29 preterms (26–32 gestational age) with normal perinatal brain ultrasounds. Preterms were grouped into a low weight group (LWG<1500 g, N=15) and a high weight group (HWG>1500 g, N=14). All children (8.1–13.3 years) underwent neuromotor (ZNM) and neuropsychological (WISC-IV) assessments, and structural brain MRI (3DT1). Voxel-based morphometry (VBM) was performed.

**Results:** No motor deficits were detected in LWG and HWG. Processing speed and IQ were significantly lower in LWG compared to controls. Only LWG had significantly lower total brain and total GMV than controls but LWG and HWG showed higher GMV in specific areas: right precentral gyrus in Brodman area 4 (BA 4), left orbitofrontal (BA 44, 45), left cerebellar areas (6, 7, 8). LWG had significantly higher GMV in fusiform gyrus (BA 37) compared to controls. LWG and HWG showed lower GMV in visual areas (BA 17, 18, 19).

**Conclusion:** We demonstrate significant differences in GMV between preterms and controls. Despite normal language skills, preterms showed increased GMV in BA 44, 45, suggesting successful local language reorganisation. Although preterms showed normal ZNM, fine motor deficits in processing speed were present. Hence, significantly greater GMV in primary right motor and left cerebellar areas suggest incomplete compensation. Decreased GMV in visual areas in preterms without visual deficits suggest defective maturation of the visual system.

SS236

**MRI assessment of inflammatory activity and mandibular growth following intra-articular TMJ steroid injection in children with JIA**

*N. Lochbühler, R. K. Saurenmann, L. Müller, C. J. Kellenberger; Zürich*

**Purpose:** To assess whether steroid injection (STI) in temporomandibular joints (TMJ) of patients with juvenile idiopathic arthritis (JIA) improves TMJ arthritis and restores normal mandibular growth.

**Methods and Materials:** 33 consecutive children (23 girls) between 2 and 10 years of age (median age 5.1y) with new MRI diagnosis of TMJ arthritis and consecutive STI were retrospectively studied. Intra-articular or extra-articular location of the STI (performed without image guidance) was immediately checked with T2w images. Inflammatory activity was scored (grades 0–3) on fat-saturated T2w and contrast-enhanced T1w images initially and at follow-up MRI around 3 months after STI, and regularly after 6–12 months. Mandibular ramus length was measured on 3D-FSPGR projection images. Degree of inflammation and mandibular growth rates were compared between TMJs following extra-articular and intra-articular STI (t-test).

**Results:** TMJ inflammation improved in 56% of joints after intra-articular STI (n=76) compared to only 17% after extra-articular STI (n=57), with mean inflammatory grades improving from 1.51 to 0.71 (p<0.001) and 1.33 to 1.21 (p=0.04), respectively. Whereas mean mandibular growth rates were normal (0.0068 mm/d) in TMJs without inflammation or STI (n=7), they were reduced at the first and second MRI follow-up in inflamed TMJs following extra-articular STI (0.0046 mm/d; 0.0015 mm/d) and negative following intra-articular STI (–0.0042 mm/d, –0.0013 mm/d) (p<0.01). 12 TMJs (18%), all having received high cumulative intra-articular steroid doses, developed progressive bony deformation and intra-articular ossifications.

**Conclusion:** Although intra-articular steroid injections in temporomandibular joints reduce the inflammatory activity depicted on contrast-enhanced MRI, mandibular growth remains impaired and even appears to be negatively affected by steroid injections.

SS237

**Pediatric computed tomography of the chest: Scan assessment of a two-year cohort and estimated cancer risk associated with diagnostic irradiation**

*T. Niemann<sup>1</sup>, L. Colas<sup>2</sup>, J.-B. Faivre<sup>2</sup>, T. Santangelo<sup>2</sup>, H.-W. Roser<sup>1</sup>, J. Remy<sup>2</sup>, M. Rémy-Jardin<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Lille/FR*

**Purpose:** The objective of this study is to demonstrate a method to evaluate the lifetime attributable risk (LAR) of cancer incidence/mortality due to a single diagnostic low dose chest CT in a two-year patient cohort.

**Methods and Materials:** A two-year cohort of 522 pediatric chest CT acquired using a dedicated low dose scan protocol were analysed retrospectively (291 males, 231 females).

Patient specific estimations of the radiation doses received by individual organs were correlated with the BEIR VII results. Additional correlation was provided for natural occurring risks.

**Results:** LAR of cancer incidence/mortality following one chest CT was calculated for cancer of the stomach, colon, liver, lung, breast, uterus, ovaries, bladder, thyroid and for leukaemia.

Absolute LAR of cancer incidence remains low for all age and sex categories, being highest in female neonates (0.34%). Summation of all cancer sites analysed raised the relative LAR of organ cancer incidence up to 3.55% in female neonates (2.05% in males).

**Conclusion:** Using dedicated scan protocols, absolute LAR of cancer incidence and mortality for a single chest CT is estimated low for all pediatric scans, being highest for female neonates. Summation of relative risks increases the LAR substantially. Risk estimates are crucial for utility analysis in pediatric chest imaging.



SS238

**Is pediatric chest CT achievable at 70 kV?**

*T. Niemann<sup>1</sup>, T. Santangelo<sup>2</sup>, F. Molinar<sup>2</sup>, J.-B. Faivre<sup>2</sup>, J. Remy<sup>2</sup>, M. Rémy-Jardin<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Lille/FR*

**Purpose:** To evaluate image quality of pediatric chest CT acquired at 70 kV.

**Methods and Materials:** 130 consecutive children undergoing chest CT were prospectively evaluated with a 70-kV scanning protocol. All scanning parameters were kept similar to those usually selected for standard 80-kV protocols, except the milliamperage. Always selected according to the patient's weight, refmAs were increased by a factor of 1.6 to maintain comparable levels of radiation dose between newly introduced 70-kV and routine 80-kV protocols. Image quality at 70 kV (Group 1) was compared to that of a paired pediatric population (Group 2) based on the age, weight and administration of contrast, previously scanned at 80 kV on the same CT unit and stored in our database. Group 1 and 2 images were reconstructed with FBP.

**Results:** Objective noise in Group 1 was significantly lower than that measured in Group 2 (9.9±6.3 HU vs 11.3±6.6 HU; p=0.03). Subjective image quality of lung and mediastinal images in Group 1 did not significantly differ from that of Group 2 (p=0.18). In Group 1, the mean dose-length-product was 15.4±2.3 mGy.cm (<1 yr; mean weight: 5.3kg) (n=35); 18.3±2.1 mGy.cm (1–5 yr; mean weight: 13.4 kg) (n=44), 24.4±3.9 mGy.cm (5–10 yr; mean weight: 24.7 kg) (n=33), 31.7±4.7 mGy.cm (10–15 yr; mean weight: 33.1 kg) (n=16) and 30.5±9.2 mGy.cm (15–17 yr; mean weight: 34 kg) (n=2).

**Conclusion:** Pediatric chest CT at 70 kV provides similar objective and subjective image quality to that achievable at 80 kV

SS239

**Neonatal perfusion imaging with arterial spin labeling**

*R. O'Gorman<sup>1</sup>, M. Makki<sup>1</sup>, W. Dai<sup>2</sup>, D. Alsop<sup>2</sup>, C. Hagmann<sup>1</sup>, B. Latal<sup>1</sup>, W. Knirsch<sup>1</sup>, C. J. Kellenberger<sup>1</sup>, I. Scheer<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Boston/US*

**Purpose:** To optimise a MRI protocol for neonatal perfusion imaging with arterial spin labelling (ASL).

**Methods and Materials:** Perfusion images were acquired from 29 neonates (age: 3 days–4 months), with a background-suppressed pseudocontinuous arterial spin labelling (pCASL) sequence, using a 3T GE whole-body MRI scanner. The patient group included 20 preterms scanned at term-equivalent age, five control infants, and four patients with congenital heart disease (CHD), scanned during natural sleep. Arterial blood velocities of carotid and vertebral arteries were measured with peripherally gated cine phase-contrast velocity mapping in 8 neonates. Numerical simulations were performed in order to optimise the efficiency of the labelling scheme for the arterial velocities seen in neonates.

**Results:** In healthy neonates, perfusion was increased in the basal ganglia and sensorimotor areas, but the high sensorimotor perfusion was only seen with a longer post-tagging delay of 2 seconds. The optimised labelling scheme yielded an improvement in perfusion SNR of up to 40% in neonates with slow arterial blood velocities. Neonates with CHD demonstrated low perfusion, as reported previously (1).

**Conclusion:** Cerebral perfusion maps can be acquired successfully from unsedated neonates using pCASL, but the labelling scheme and acquisition parameters should be adapted for use in neonates.

References: 1. Licht et al. J Thoracic and Cardiovascular Surgery 128:6;841–847

SS240

**Split renal function and urinary tract obstruction in children assessed by magnetic resonance urography in comparison with MAG3 scintigraphy**

*C. J. Kellenberger, I. Burger, M. Makki; Zürich*

**Purpose:** To assess accuracy of dynamic contrast-enhanced magnetic resonance urography (MRU) for measuring split renal function (SRF) and obstruction in children compared to dynamic <sup>99m</sup>Tc-mercaptoacetyltriglycine (MAG3) scintigraphy.

**Methods and Materials:** In 11 children (age range 3 m–16 y) undergoing both procedures within 1 year (median <2 months), MRU was performed at 1.5 Tesla with a T1-weighted, low flip angle (12°) fast gradient recalled echo (FGRE) sequence following iv-hydration, iv-Lasix, and 0.1 mmol/kgBW gadolinium. SRF was determined by volumetry of the kidneys, area under the curve (AUC) and Patlak methods; obstruction was assessed qualitatively on excretory curves and by renal transit time (RTT), and compared to MAG3 findings using Pearson correlation and weighted kappa statistics. Signal intensity (SI) of different gadolinium concentrations [Gd] was measured in vitro for low flip angle and FGRE sequences with higher flip angles.

**Results:** Obstruction was overdiagnosed by MRU and agreed poorly with MAG3 scintigraphy (K: 0.23 for qualitative assessment, 0.32 for RTT). For SRF assessment, renal volume measurements alone correlated best with MAG3 scintigraphy (R=0.89), whereas correlation worsened adding Patlak (R=0.74) or AUC (R=0.67). Because of T2\*-effects, the linearity between SI and [Gd] was maintained only up to 2 mmol/l for flip angle 12°, whereas higher flip angles (≥30°) improved linearity >7 mmol/l.

**Conclusion:** Dynamic MRU using low flip angle FGRE does not correlate with MAG3 scintigraphy for assessing urinary tract obstruction and has no added value over renal volume measurements for SRF. Using a higher flip angle could improve results by increasing linearity of SI up to [Gd] expected to occur in kidneys.

SS241

**Early MRI in the management of scaphoid fractures in children**

*A. Kanavaki, A. Dhoub, L. Merlini, S. Hanquinet; Genève*

**Purpose:** Scaphoid fractures are the most common carpal bones fractures in the pediatric population. Although the place of MRI in the diagnosis of scaphoid fractures has been recognized in adults, little is reported in pediatric literature on this subject. The aim of our study is to show the role of the MRI in the early diagnosis and management of these fractures in children where the scaphoid bone is partly cartilaginous.

**Methods and Materials:** We reviewed the wrist x-rays and MRIs of 45 children (from 7 to 15 years old, median: 12 yo) with clinical suspicion of scaphoid fracture. All MRIs were performed in a 1.5 T machine and our protocol consisted of a coronal T1, coronal STIR, axial T2 and 3D TRUFI sequences.

**Results:** MRI findings were compared to initial radiographs. In 9 cases the x-ray and MRI were positive for fracture. From the 33 children with a negative x-ray the MRI was positive for 15 of them. Three children had a suspicion of scaphoid fracture on x-ray not proved on MRI. The treatment was readapted when MRI was positive for scaphoid or other fractures whereas the period of immobilization was shortened in cases of a negative MRI.

**Conclusion:** Clinical and radiological diagnosis of scaphoid fractures in children is difficult, probably because in this population the scaphoid is partly cartilaginous. Early MRI is important for depiction and exclusion of scaphoid fractures leading to a more adapted treatment and management of this injury. MRI avoids useless irradiation related to repeated control x-rays of non-existent fractures.

SS242

**Fiber tracking of Mega Corpus Callosum: A preliminary study***L. Merlini, A. Dhoub, A. Kanavaki, S. Hanquinet; Genève*

**Purpose:** Mega corpus callosum (MCC) is a rare finding, usually as part of specific genetic syndromes. Our aim is to report a series of MCC, to describe associated anomalies and when possible, to perform fiber tracking (FT) of CC in order to identify an objective sign of pathologically thick CC.

**Methods and Materials:** We record all cases retrieved by the search engine of our database from 2002 to 2012 when the specified keyword was "thick and/or mega" corpus callosum. Measurements of area of the corpus callosum (CCA) were acquired with Osirix system, from 3D T1-weighted midsagittal spin-echo images and compared to means values in the literature. FT was performed with TrackVis software.

**Results:** MCC was mentioned in 10 cases (2 F, 8 M, 3 months – 15 year-old). Three had megalencephaly and polymicrogyria, one hippocampal malformation and left cerebellum atrophy, one molar tooth malformation (Joubert Syndrome), one white matter abnormalities (infantile Refsum), one absence of olfactory bulbous (Kallman syndrome) three had no other abnormalities (William syndrome NF1). CCA was superior to 10 cm<sup>2</sup> in 5 patients and all of them had associated anomalies. FT was performed in 8 patients: an abnormal longitudinal fiber bundle in the dorsal part of the CC was present in all cases with CCA above 10 cm<sup>2</sup> and absent in the other.

**Conclusion:** The spectrum of malformations associated with mega-corpus callosum is broad and yet to be defined. CCAs superior to 10 cm<sup>2</sup> are invariably associated to other malformation and to pathological FT findings.

SS243

**Perfusion abnormalities in neonatal hypoxic ischemic encephalopathy***R. O'Gorman, C. Sabandal, V. Bernet, C. Hagmann, C. J. Kellenberger, I. Scheer; Zürich*

**Purpose:** To investigate cerebral perfusion abnormalities in neonates with hypoxic ischemic encephalopathy (HIE).

**Methods and Materials:** Perfusion images were acquired from nine patients with suspected HIE (age 5–9 days) with a pseudocontinuous arterial spin labelling (pCASL) sequence, using a 3T GE whole-body MRI scanner. Three infants were scanned after hypothermia. The structural MRI protocol included axial, coronal, and sagittal T2-weighted fast spin echo images, axial T1-weighted spin echo and gradient echo images, and diffusion tensor images. HIE grade was assessed from the structural images using a standardised scoring system with scores ranging from 0 (normal) to 3 (severe) for white matter abnormalities, scores of 0–2 for PLIC or basal ganglia (BG) abnormalities, and a score of 0 or 1 for the presence of infarcts. A total HIE injury score was calculated for each patient from the sum of the individual injury scores. Perfusion was measured across the whole brain and in regions of interest in the basal ganglia and thalamus, using the automatic anatomical labelling (AAL) regions to mask the perfusion images, after normalisation of the AAL template to the perfusion images for each patient. Correlations between perfusion and HIE injury score were assessed in SPSS.

**Results:** One patient with severe HIE demonstrated luxury perfusion in the basal ganglia, thalamus, and diffuse cortical regions. For the patients without apparent luxury perfusion, thalamic perfusion correlated negatively with the HIE severity score ( $\rho = -0.76$ ,  $p < 0.005$ ).

**Conclusion:** Cerebral perfusion abnormalities indicative of HIE severity can be seen in infants with perinatal asphyxia using ASL.

SS244

**Diagnostic accuracy of pelvic sonography in central precocious puberty – a meta-analysis***A. Spiessberger, E. Stranzinger, R. Wolf; Bern*

**Purpose:** To determine the diagnostic accuracy of four commonly used characteristics of pelvic trans-abdominal ultrasound in the diagnosis of central precocious puberty in girls: ovarian volume, uterine volume, uterine artery pulsatility index and endometrial reflex.

**Methods and Materials:** A meta-analysis was conducted, comprising the following original research data: for ovarian volume 9 original articles (177 patients, 253 control), uterine volume 6 original articles (158 patient, 213 control), endometrial echo 3 original articles (106 patients, 80 control), uterine artery pulsatility index 2 original articles (25 patients, 56 control). Cut-off values of uterine and ovarian volume, as defined by the authors of all original articles were plotted in an age-dependent fashion and interpolated. Pooled sensitivity and specificity of positive endometrial echo and uterine pulsatility index below 2 as diagnostic markers of puberty were calculated.

**Results:** Ovarian volume cut-off values failed to show an age-dependent increase, as reflected by a low coefficient of determination (0.0006). In contrast uterine volume cut-off values showed an age-dependent increase (coefficient of determination 0.27), the sensitivity of this cut-off line is  $\geq 82\%$ , specificity  $\geq 89\%$ . Regarding a positive endometrial reflex pooled values were: sensitivity 67%, specificity 89%; Pooled values for a uterine artery pulsatility index below 2 were: sensitivity 90%, specificity 98%.

**Conclusion:** To discriminate between prepubertal and pubertal hormonal status in girls one should not rely on measurement of ovarian volume, while uterine volume, a positive endometrial echo and a low uterine artery pulsatility index ( $< 2$ ) are suitable in making a diagnosis.

NSS151

**Effect of emaciation and obesity on small animal internal radiation dosimetry***T. Xie, H. Zaidi; Genève*

**Purpose:** Rats are widely used in molecular imaging-driven biomedical research and as such radiation dose to animals became a concern. The weight of animals might change through emaciation or obesity as a result of their use in various research experiments including different diet types. In this work, we evaluate the effect of emaciation and obesity induced changes in body weight on internal radiation dose.

**Methods and Materials:** A systematic literature review was performed to determine normal anatomical parameters for rat and evaluate how organ change with variations in body weight. The ROBY anatomical model was modified to produce a normal adult rat and mildly, moderately and severely emaciated and obese rats. Monte Carlo simulations were performed using MCNPX to estimate absorbed fractions (AF), specific absorbed fractions (SAF) and S-values for different positron-emitting radionuclides in the different models.

**Results:** SAFs and S-values for most source-target combinations between the various models were very close, except the case where the intestine and the total body are considered as source regions. For the intestine irradiating other organs of the obese model, the SAFs for organs in the anterior region of the splanchnocoel increase slightly whereas the SAFs for organs in the posterior region of the splanchnocoel decrease. For the total body irradiating other organs, the SAFs and S-values were inversely related to the body weight.

**Conclusion:** The effect of obesity on internal radiation dose is insignificant in most conditions. Emaciation increases the cross-absorbed dose to organs from surrounding tissues, which might be a notable issue in small animal internal dosimetry.

NSS152

**Image quality assessment of time-of-flight and point-spread-function corrections in the PET/CT Discovery-690***S. Gnesin, J. Delacoste, P. Martinez, M. Pappon, S. Baechler, J. Prior, F. Verdun; Lausanne*

**Purpose:** Last generation commercial PET devices incorporate the time of flight (TOF) information and the point spread function (PSF) correction to potentially improve the quality and the quantitative accuracy of PET images. The purpose of this study was to investigate the impact of TOF-based reconstruction algorithms and PSF correction using clinical PET reconstruction setting.

**Methods and Materials:** In this work, we characterized the performances of TOF and PSF corrections in terms of recovery coefficients (RCs), image noise estimated by the coefficient of variation (COV), and contrast. The study was performed on a GE Discovery 690 PET/CT (GE Healthcare) where 18F-FDG filled standard NEMA IEC body phantoms were imaged using clinical reconstruction setting. We also explored the possible quantitative bias induced by the use of the PSF correction.

**Results:** TOF (as compared to non-TOF reconstructions) increased the cold sphere contrast (+15%) and improves the algorithm convergence in cold regions (lung inserts). No appreciable benefit of the TOF was found in terms of COV. PSF correction (as compared to non-PSF corrected images) reduced partial volume effects and enhances the spatial resolution. This results in improved RCs and contrast in particular for small (<10 mL) hot sphere. A significant COV reduction (~20%) was also reported. Quantitative bias (potentially affecting SUV quantification) was observed at the edge of large (>10 mL) hot lesions.

**Conclusion:** Our study shows that using both TOF and PSF corrections improves image resolution, contrast and noise regardless lesion size. Further investigation is required to better characterize artifacts.

NSS153

**Radiation exposure of routine clinical SPECT/CT investigations obtained with integrated flat panel CT***K. Tornquist, S. Matijasevic, M. Del Sol Perez-Lago, K. Strobel; Luzern*

**Purpose:** To evaluate and quantify the radiation exposure of routine clinical SPECT/CT investigations obtained with integrated flat panel CT.

**Methods and Materials:** The combined radiation exposure of the radionuclide and additional radiation burden from the flat panel CT examination of routine SPECT/CT protocols used in our department were calculated by the product of the k value and dose-length-product (DLP). The routine protocols include CT protocols for attenuation correction and anatomic correlation only (CT AC) and CT protocols for dedicated CT interpretation (CT AC+).

**Results:** The mean overall (CT+radionuclide) radiation exposure was 6,6 mSv (range 0,7–16,3 mSv). The mean additional radiation exposure of the CT part was 0,44 mSv (range 0,1–1,2 mSv) in the CT AC group and 3,7 mSv (range 0,4–12,3) in the CT AC+ group. Radiation exposure of CT AC+ protocols of peripheral skeleton were markedly lower (mean 1 mSv, range 0,5–1,5 mSv) compared to body CT AC+ protocols 5,1 mSv (range 0,4–12,3 mSv). The mean increase of radiation exposure by adding a CT to the SPECT study was 17% (range 2,5–30%) in the CT AC group and 82,5% (range 10–307,5%) in the CT AC+group. We adapted e.g. the protocol for pelvic bone SPECT/CT by reducing tube current from 80 to 30 resulting in a CT dose reduction from 12,3 to 4,6 mSv without significant loss of image quality.

**Conclusion:** The additional effective dose of the flat panel CT part of routine SPECT/CT protocols can vary significantly between 0,1 mSv and 12,3 mSv. Knowledge about radiation exposure can help to optimize the routine protocols.

NSS154

**A novel PET quantification method determining the background subtracted lesion activity with simple histogram analysis is superior to total lesion glycolysis***I. Burger<sup>1</sup>, H. A. Vargas<sup>2</sup>, J. L. Humm<sup>1</sup>, B. J. Beattie<sup>2</sup>, M. Gonen<sup>2</sup>, S. M. Larson<sup>2</sup>, R. C. Schmidt<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>New York/US*

**Purpose:** For assessment of the overall tracer uptake in a lesion, the total lesion glycolysis (TLG) has been proposed. The current ways for TLG calculation, fail to incorporate local background activity. We therefore developed a new histogram based method determine the background subtracted lesion (BSL) activity. It was the purpose of this study to evaluate BSL and compare it with TLG in phantom studies.

**Methods and Materials:** Two PET phantoms were filled and scanned according to the guidelines and subsequently the chambers in both phantoms were filled with 5 increasing FDG concentrations. Volumes of interest (VOIs) were placed over each chamber in the phantoms. TLG was calculated using SUV<sub>2.5</sub> (TLG<sub>2.5</sub>) and SUV over 42% of SUV<sub>max</sub> (TLG<sub>42</sub>). The histogram for each VOI was built and BSL was calculated. All values were compared to the FDG activity injected into each chamber, by calculating the slope (s) and concordance correlation coefficients (CCC).

**Results:** The correlation between the injected activity and BSL was higher (CCC=0.998), then for TLG<sub>42</sub> (CCC=0.906) or TLG<sub>2.5</sub> (CCC=0.996). Also the slopes showed that BSL correlated nearly perfect with the injected activity (s=1.018) compared to an underestimation with TLG<sub>42</sub> (s=0.695) and slight underestimation with TLG<sub>2.5</sub> (s=0.948).

**Conclusion:** The proposed histogram based analysis BSL correlated better with the reference injected activity in both phantom studies for all activity ratios and chamber sizes.

## NSS155

**Impact of free 18-fluoride fraction in FDG PET/CT bone imaging**

*A. Alqarni, S. Balogova, J. Rose, J. N. Talbot; Paris/FR*

**Purpose:** Following administration January/2011 of a commercial preparation of FDG containing between 5 and 10% of fluoride ( $^{18}\text{F}$ ), our aim was to evaluate by means of a retrospective study the consequences of this content of free  $^{18}\text{F}$  on the visual and semi-quantitative approaches of the skeletal uptake on PET/CT.

**Methods and Materials:** Two groups of 30 patients (princeps and control) were matched for pathology, age, sex and glycaemia. The group "princeps" received the FDG preparation containing more than 5% of fluoride ( $^{18}\text{F}$ ). All examinations were done according to the standard protocol of FDG PET/CT. The  $\text{SUV}_{\text{max}}$  was determined in six regions of interest (ROI) in visually normal bone. For pathologic foci, we calculated a ratio of  $\text{SUV}_{\text{max}}$  between the focus and healthy bone (T/NTR).

**Results:** The analysis of normal bone showed, for the spine, a significant difference in  $\text{SUV}_{\text{max}}$  between the two groups and a significant correlation with the time elapsed between FDG preparation and injection. Concerning the pathologic foci, the T/NTR of two groups were significantly different ( $P = 0.04$ ).

**Conclusion:** a slight increase of the  $\text{SUV}_{\text{max}}$  in the healthy spine of patients who received more than 5% of fluoride ( $^{18}\text{F}$ ). The pathologic foci showed a T/NTR lower in the group princeps; however metastases were detected in both groups. Thus, a preparation of FDG close to the end of its shelf life can be used without real consequences for the quality of images for a given patient; in contrast, an accurate quantification of the FDG uptake in the spine requires a minimal proportion of fluoride ( $^{18}\text{F}$ ).



## NSS245

**Glucagon-like peptide-1 receptor SPECT/CT for the preoperative localization of insulinomas**

K. Antwi<sup>1</sup>, E. Christ<sup>2</sup>, F. Forrer<sup>3</sup>, S. Ederer<sup>4</sup>, M. Behe<sup>4</sup>, H. Maecke<sup>4</sup>, W. Weber<sup>5</sup>, J. C. Reubi<sup>6</sup>, D. Wild<sup>4</sup>; <sup>1</sup>Münchenstein, <sup>2</sup>Bern, <sup>3</sup>Bruderholz, <sup>4</sup>Basel, <sup>5</sup>Freiburg/DE

**Purpose:** The surgical removal of insulinomas is hampered by the difficulty to localize them using conventional radiological procedures. Angiography and intra-arterial calcium stimulation and venous sampling (ASVS) have shown to improve sensitivity but are invasive. Human insulinoma cells exhibit high density of glucagon-like peptide-1 (GLP-1) receptors that can be used for in vivo receptor imaging. The aim of this study was to evaluate the diagnostic value of GLP-1 receptor imaging with a radiolabeled GLP-1 receptor agonist, <sup>111</sup>In-DTPA-exendin-4, in 30 patients with neuroglycopenic symptoms.

**Methods and Materials:** Thirty patients with neuroglycopenic symptoms due to endogenous hyperinsulinemic hypoglycemia were consecutively enrolled in this prospective multicenter study. CT or MRI was performed using a standard protocol. <sup>111</sup>In-DTPA-exendin-4 was administered intravenously at a dose of 90–130 MBq (about 10 µg peptide). Whole-body planar images and SPECT/CT of the abdomen were performed at 4, 24 and in some patients between 72 and 96 hours. Diagnosis was confirmed by histology after surgical removal.

**Results:** Only Patients who had surgery (n=25) were included in this evaluation (confirmation of diagnosis). GLP-1 receptor imaging showed a significantly higher performance (sensitivity 95%, PPV 78%) than CT or MRI (sensitivity 50%, PPV 100%,  $P < 0.001$ ). <sup>111</sup>In-DTPA-exendin-4 SPECT/CT detected 18 insulinomas and five additional positive lesions (3 islets hyperplasia, 2 uncharacterized lesions). One patient with malignant insulinoma showed a false negative result.

**Conclusion:** GLP-1 receptor imaging defines a novel non-invasive method that may replace the invasive approach (ASVS) to localize occult benign insulinomas.

## NSS246

**Prognostic value of the 18FDG PET: Derived functional parameters in primary mediastinal diffuse large B-cell lymphoma (PMBLCL)**

L. Ceriani<sup>1</sup>, E. Zucca<sup>1</sup>, M. Martelli<sup>2</sup>, P. L. Zinzani<sup>3</sup>, A. J. M. Ferreri<sup>4</sup>, U. Vitolo<sup>5</sup>, C. Stelitano<sup>6</sup>, E. Brusamolino<sup>7</sup>, G. Cabras<sup>8</sup>, P. Johnson<sup>9</sup>, L. Giovannella<sup>1</sup>; <sup>1</sup>Bellinzona, <sup>2</sup>Roma/IT, <sup>3</sup>Bologna/IT, <sup>4</sup>Milano/IT, <sup>5</sup>Torino/IT, <sup>6</sup>Reggio Calabria/IT, <sup>7</sup>Pavia/IT, <sup>8</sup>Cagliari/IT, <sup>9</sup>Southampton/UK

**Purpose:** To assess the prognostic value of a) the metabolic activity as measured with maximum Standard Uptake Value (SUV<sub>max</sub>), b) the metabolic tumor burden as measured with metabolic tumor volume (MTV) and c) the total lesion glycolysis (TLG) estimated on baseline 18 FDG PET-CT, in a subgroup of patients with PMBLCL enrolled in the IELSG-26 trial.

**Methods and Materials:** SUV<sub>max</sub>, MTV and TLG were measured following a standard protocol in 65 patients. All patients received R-CHOP (-like) or R-MACOP-B (-like) regimens. 51 also underwent consolidation radiotherapy. Cut-off value of MTV, TLG and SUV<sub>max</sub> were calculated using the receiver operating characteristic (ROC) curve. Univariate and multivariate models were used to analyze their effect on the progression-free-survival (PFS) and overall-survival (OS).

**Results:** The PFS and OS rates were 92% and 82%, respectively, as assessed in a median follow-up of 37 months (range 12–45) after PET-CT. At multivariate analysis, including also the main clinical parameters, the TLG ( $p=.001$ ) and IPI score ( $p=.03$ ) were shown to predict longer PFS while only TLG predicted longer OS periods ( $p=.007$ ). The 5-year PFS and OS for patients with low TLG were 100% vs. 62% and 70% for those with high TLG ( $p<.001$ ).

**Conclusion:** Baseline whole-body metabolic tumor burden as measured with TLG is an independent prognostic tool and may be used to refine risk stratification in patients with PMBLCL. Our study also suggests that TLG is a better prognostic measure than other PET-derived functional parameters. These results need to be confirmed in the overall population enrolled in IELSG-26-trial.

## NSS247

**Diagnostic performance of 18F-FET vs. 18F-FDG PET in patients with brain tumor: Systematic review and meta-analysis**

V. Dunet, J. Prior; Lausanne

**Purpose:** For the past decade <sup>18</sup>F-FET and <sup>18</sup>F-FDG-PET have been used for the assessment of patients with brain tumor (BT). However, direct comparison studies only reported limited numbers of patients. We aimed at comparing the diagnostic performance of <sup>18</sup>F-FET and <sup>18</sup>F-FDG in BT.

**Methods and Materials:** We examined studies from January 1977 to January 2012 using the MEDLINE and EMBASE databases. To be included, studies should: (1) use <sup>18</sup>F-FET and <sup>18</sup>F-FDG-PET for the assessment of patients with isolated brain lesion; and (2) use histology as the gold standard. Analysis was performed on a per patient basis. Study quality was assessed with STARD criteria.

**Results:** Five studies (119 patients) were included. For the diagnosis of BT, <sup>18</sup>F-FET PET demonstrated a sensitivity of 0.88 (95% confidence interval [CI]:0.76–0.94) and specificity of 0.61 (CI:0.22–0.90), with an AUC of 0.88 (CI:0.85–0.91), a positive likelihood ratio (LR+) of 2.3 (CI:0.8–6.3) and negative likelihood ratio (LR-) of 0.2 (CI:0.1–0.44), while <sup>18</sup>F-FDG PET demonstrated a sensitivity of 0.37 (CI:0.27–0.49) and specificity of 0.80 (CI:0.32–0.97), with an AUC of 0.40 (CI:0.36–0.44), a LR+ of 1.9 (CI:0.3–11.5) and LR- of 0.78 (CI:0.48–1.3). Sensitivity, accuracy (AUC) and LR- were significantly better for <sup>18</sup>F-FET PET. Mean STARD score was 19±2.

**Conclusion:** <sup>18</sup>F-FET demonstrated significantly better performance than <sup>18</sup>F-FDG for brain tumor diagnosis. The use of <sup>18</sup>F-FET PET for the assessment of brain tumor should thus be extended.

## NSS248

**Prevalence and clinical significance of focal incidentally detected parotid lesions on FDG-PET/CT**

V. Soubeyran<sup>1</sup>, C. Duc<sup>1</sup>, R. Giger<sup>2</sup>, K. Sandu<sup>1</sup>, C. Constantin<sup>1</sup>, E. Kamel<sup>1</sup>; <sup>1</sup>Sion, <sup>2</sup>Bern

**Purpose:** The aim of this study is to investigate the prevalence and the clinical significance of incidentally detected parotid lesions in oncology patients undergoing FDG-PET/CT.

**Methods and Materials:** From October 2009 to January 2012, 1098 patients underwent whole body FDG-PET/CT for evaluation of suspected or known cancer without any clinical history or symptoms of parotid pathology. Incidental detection of focal parotid FDG accumulation that exceeded background activity was considered pathological. Correlative ultrasonographic (US) and fine needle aspiration cytology (FNAC) was requested for all patients.

**Results:** Among the studied patient population, 17 (1.55%) were identified with focal incidental FDG accumulation in the parotid gland (mean SUV max, 6.4±3). Ultrasonographic examination of the studied lesions revealed hypoechogenic round or oval formations with varying degree of vascularity. Of those 17 patients, FNAC revealed Warthin-tumors in 16 (1.5%) of them who presented with upper aerodigestive tract cancer (n=15) and long history of smoking (n=16), whereas one nonsmoker patient with lymphoma had disease extension to his parotid.

**Conclusion:** Focal parotid lesions incidentally found on FDG PET/CT in asymptomatic patients has a prevalence of 1.55%. In patients with upper aerodigestive tract cancer and/or long history of smoking, the diagnosis of Warthin-tumor of the parotid should be raised. US examination and FNAC is a reasonable second step to further investigate such lesions.

## NSS249

**Abdominal binding improves FDG-PET/CT evaluation of juxtadiaphragmatic lesions**

*E. Kamel, V. Soubeyran, C. Constantin, J.-P. Coppey, V. Bettschart; Sion*

**Purpose:** To investigate the role of abdominal binding in reducing the respiratory motion artifacts and their negative contribution on FDG PET/CT interpretation of juxtadiaphragmatic lesions.

**Methods and Materials:** Twenty five patients who presented with primary or metastatic lesions in the liver, spleen or lung bases were recruited. After the routine whole body acquisition, each patient was provided with a conventional abdominal binder appropriate to his size before undergoing a second free breathing upper abdominal PET/CT acquisition. The floating organ artifact that results from breathing during helical CT acquisition was analyzed. Artifacts that showed a path length longer than 1cm were considered clinically relevant. The percentage differences (% diff) of the  $SUV_{max}$  and lesion volume (LV) between both acquisitions were also calculated and compared.

**Results:** Before abdominal binding, we observed that clinically relevant breathing artifacts occurred in whole body PET/CT of 19/25 (76%) patients. These artifacts were persisted in only 5/25 (20%) patients after abdominal binding. All lesions showed a significant increase in their post-binding measured  $SUV_{max}$  (mean post binding increase in  $SUV_{max}$ ,  $27\% \pm 0.13$ ,  $p < 0.01$ ). Furthermore, there was a significant reduction in the measured volume of all lesions after abdominal binding (mean post binding decrease in LV,  $26\% \pm 0.2$ ,  $p < 0.01$ ). Interestingly, 3 metastatic lesions in the liver ( $n=2$ ) and the spleen ( $n=1$ ) were exclusively visualized after abdominal binding.

**Conclusion:** Abdominal binding significantly improves FDG PET/CT interpretation of juxtadiaphragmatic lesions. This simple approach does not require any patient training before the CT acquisition to match the free breathing PET dataset.

## NSS250

**Prevalence and malignancy risk of focal areas of incidental F-18-FDG uptake in the colon-rectum: A meta-analysis**

*G. Treglia<sup>1</sup>, S. Taralli<sup>2</sup>, C. Caldarella<sup>2</sup>, S. Annunziata<sup>2</sup>, L. Ceriani<sup>1</sup>, L. Giovannella<sup>1</sup>; <sup>1</sup>Bellinzona, <sup>2</sup>Rome/IT*

**Purpose:** To meta-analyze published data about the prevalence and malignancy risk of focal areas of incidental F-18-FDG uptake detected by PET or PET/CT in the colon-rectum (focal colorectal incidentalomas [FCIs])

**Methods and Materials:** A comprehensive literature search of studies published through July 2012 regarding FCIs detected by PET or PET/CT was performed. Pooled prevalence of patients with FCIs and risk of malignant or premalignant FCIs after colonoscopy or histopathology verification were calculated. Furthermore, separate calculations for geographic areas were performed. Finally, average standardized uptake values (SUV) in malignant, premalignant and benign FCIs were reported.

**Results:** Thirty-two studies comprising 89,061 patients evaluated by F-18-FDG-PET or PET/CT were included. The pooled prevalence of FCIs was 3.6% (95% confidence interval [95% CI]: 2.6–4.7%). Overall, 1,044 FCIs underwent colonoscopy or histopathology evaluation. Pooled risk of malignant or premalignant lesions was 68% (95%CI: 60–75%). Risk of malignant and premalignant FCIs in Asia-Oceania was lower compared to Europe and America. A significant overlap in average SUV between malignant, premalignant and benign FCIs was found.

**Conclusion:** FCIs are observed in a not negligible number of patients who undergo F-18-FDG-PET or PET/CT with a high risk of malignant or premalignant lesions. SUV is not reliable as a tool to differentiate between malignant, premalignant and benign FCIs. Further investigation is warranted whenever FCIs are detected by F-18-FDG-PET or PET/CT.

## NSS301

**Targeted radionuclide therapy of FR-positive cancer in combination with 5-fluorouracil as a radiosensitizing agent**

C. Müller, J. Reber, C. Schlup, R. Schibli, Villigen

**Purpose:** Folate receptor (FR) targeted radionuclide therapy has recently been developed in our group. For this purpose we used a  $^{177}\text{Lu}$ -labeled DOTA-folate conjugate with an albumin binding entity (cm09) which provides excellent tumor targeting characteristics and pharmacokinetics. With the aim to further improve the therapeutic efficacy the combined application of  $^{177}\text{Lu}$ -cm09 and 5-fluorouracil (5-FU) as a radiosensitizing agent was investigated.

**Methods and Materials:** The folate conjugate (cm09) was radiolabeled with  $^{177}\text{Lu}$  ( $E_{\text{av}}=134$  keV,  $T_{1/2}=6.7$  d) at a specific activity of 20 MBq/nmol. MTT assays were performed to investigate inhibition of FR-positive IGROV-1 cell viability by  $^{177}\text{Lu}$ -cm09 alone in combination with 5-FU. In vivo therapy studies were performed with IGROV-1 tumor bearing nude mice which received either only  $^{177}\text{Lu}$ -cm09 (10 MBq) or a combination with 5-FU (4 x 1 mg).

**Results:** In vitro concentration dependent inhibition of the viability was observed upon exposure of IGROV-1 cells to  $^{177}\text{Lu}$ -cm09 and 5-FU. If  $^{177}\text{Lu}$ -cm09 was applied in combination with 5-FU (30  $\mu\text{M}$ ) inhibition was significantly more pronounced ( $\text{IC}_{50}=2.5$  MBq/mL) than if it was applied as a single agent ( $\text{IC}_{50}=5.5$  MBq/mL). In vivo tumor growth was delayed in mice which received  $^{177}\text{Lu}$ -cm09. However, at the dose applied in this study 5-FU did not enhance the antitumor effect.

**Conclusion:** The radiosensitizing potential of 5-FU in combination with  $^{177}\text{Lu}$ -cm09 was successfully demonstrated in vitro. However, the in vivo studies require further optimization with regard to the dose and application protocol of 5-FU. Corresponding experiments are currently ongoing in our laboratories.

## NSS302

**Long-term investigation of nephrotoxicity in mice after administration of therapeutic radiofolates**

S. Haller, J. Reber, R. Schibli, C. Müller, Villigen

**Purpose:** Recently, we developed a radiofolate ( $^{177}\text{Lu}$ -cm09) which showed high uptake in folate receptor (FR)-positive tumors in mice. Hence, for the first time it was possible to successfully perform radionuclide therapy using folic acid as the targeting agent. Nevertheless, a risk of nephrotoxicity persists. Therefore, it was our aim to investigate potential long-term nephrotoxicity of  $^{177}\text{Lu}$ -cm09.

**Methods and Materials:** The study was performed over three months with two groups of nude mice ( $n=6$  per group) after the administration of therapeutic amounts of  $^{177}\text{Lu}$ -cm09 (20 MBq or 30 MBq). Kidney function was monitored by performing quantitative SPECT using  $^{99\text{m}}\text{Tc}$ -DMSA. Body weight was measured weekly and blood was taken every month for studying kidney plasma parameters such as creatinine and blood urea nitrogen.

**Results:** Three months after application of  $^{177}\text{Lu}$ -cm09, analysis of the  $^{99\text{m}}\text{Tc}$ -DMSA SPECT scans revealed first evidence for impairment of kidney function. Whereas renal uptake of  $^{99\text{m}}\text{Tc}$ -DMSA was only slightly reduced in mice which received 20 MBq of  $^{177}\text{Lu}$ -cm09, application of 30 MBq of  $^{177}\text{Lu}$ -cm09 resulted in a significant reduction of renal uptake to about 60% of controls (100%). Body weight loss and increased kidney plasma parameters of these mice confirmed radiotoxic effects in the kidneys.

**Conclusion:** These first results of an on-going *in vivo* study suggest that application of high radioactivity amounts of  $^{177}\text{Lu}$ -cm09 result in reduced kidney function over time. Hence, optimization of the radiofolate's distribution profile and measures for nephroprotection will be crucial for a potential clinical application of radiofolate therapy.

## NSS303

**Long-term follow-up after  $^{131}\text{I}$ -tositumomab therapy for relapsed or refractory indolent non-Hodgkin's lymphoma: An update at 12 years**F. Buchegger<sup>1</sup>, C. Antonescu<sup>2</sup>, C. Helg<sup>3</sup>, M. Kosinski<sup>4</sup>, J. Prior<sup>4</sup>, A. Bischof Delaloye<sup>4</sup>, N. Ketterer<sup>4</sup>; <sup>1</sup>Genève, <sup>2</sup>Fribourg, <sup>3</sup>Genolier, <sup>4</sup>Lausanne

**Purpose:** Advanced stage indolent non-Hodgkin's lymphoma cannot be cured by conventional therapy. However, in patients with localized stage I/II disease treated by radiotherapy recurrence rates were very low after 10 years progression free survival (JCO 1996; 14:1282)

**Methods and Materials:** In the frame of the Coulter/GlaxoSmithKline open-label phase II study of  $^{131}\text{I}$ -tositumomab we treated in Switzerland 12 indolent and 4 transformed, relapsed/refractory lymphoma patients between 1999 and 2001. The 16 patients had had a mean of 3.1 (range 1–6) chemotherapy/antibody treatments.

**Results:** Three patients, all with transformed lymphoma, progressed after RIT, 5 patients had a partial response (PR) and 8 complete responses (CR or CRu). Out of a total of 9 relapsed/progressive patients, 6 had a rather short survival of 0.3 to 5.2 years while 3 responded well to further treatment and are alive a mean of 12.1 years after RIT. Among the 8 CR/CRu patients, 1 relapsed while another developed a myelodysplastic syndrome (MDS) 34 months after RIT (74 months after initial CHOP) and died 6 months later. Six of 8 CR/CRu remain disease free a mean of 11.7 (range 9.6–12.8) years after RIT. Besides the MDS, side effects were mostly mild or transient.

**Conclusion:** Particularly long lasting, complete remissions were observed after a single course of RIT in half of the patients with recurrent indolent lymphoma. Relapse/progression after RIT ( $N=9$ ) was connected with short survival in 6 patients and long lasting survival in 3. This efficient therapy, unfortunately, is only commercialized in the USA. Support: Swiss Cancer League

## NSS304

**Feasibility of a voxelwise DaTSCAN image analysis in patients with radiological features of normal pressure hydrocephalus**

L. C. Maina, G. Allali, H. Zaidi, S. Armand, O. Ratib, F. Assal, V. Garibotto; Genève

**Purpose:** The diagnostic analysis of 123I-FP-CIT (DaTSCAN) images is usually performed by visual assessment and regions-of-interests (ROIs) approaches. Voxelwise analyses are a powerful tool, investigating subregional changes and association with clinical parameters; however, the normalization to a standard reference space might be complex for patients with relevant anatomical abnormalities, such as ventricular enlargement occurring in normal pressure hydrocephalus (NPH).

Our aim was to test the performance of spatial normalization to a customized template in a population including patients with radiological features of NPH.

**Methods and Materials:** We studied 20 patients with parkinsonian syndrome, including 6 with radiological features of NPH. Among these, 14 had a normal DAT density (4 NPH) and 6 reduced DAT (2 NPH), based on concordant visual and ROIs assessment, chosen as gold standard. All original SPECT images were normalized to a customized template, locally obtained using a previously validated procedure (Kas et al., 2007).

**Results:** All studies could be successfully normalized to the customized template, including the 6 patients with NPH. A jackknife analysis validated the "control" group at a statistical threshold of  $p<0.05$ . The analysis of NPH patients gave 4 true negative 1 true positive and 1 false negative result, the latter in a patient with focal caudate DAT reduction associated with a small vascular lesion.

**Conclusion:** Voxelwise analysis of DaTSCAN images is a promising tool also for the investigation of patients with radiological features of NPH as comorbidity, allowing accurate normalization, and not introducing false positive findings.

## NSS305

**Added value of Rb-82 cardiac PET quantitation of myocardial blood flow over semi-quantitative analysis to select patients eligible for invasive coronary angiography**

*J.-A. Collinot, E. Deshayes, V. Michiels, O. Müller, M. Pappon, J. Prior; Lausanne*

**Purpose:** To determine whether myocardial blood flow (MBF) quantitation derived from Rb-82 cardiac PET could improve the selection of patients eligible for invasive coronary angiography (ICA) as compared to semi-quantitative analysis using summed difference score (SDS).

**Methods and Materials:** 40 consecutive patients with suspected or known CAD who performed cardiac Rb-82 PET/CT and ICA within 60 days, without cardiovascular events in between. Rest and adenosine-induced stress MBF (sMBF) were computed, as well as myocardial flow reserve (MFR=stress/rest MBF). Flow parameters were divided in 3 groups: G1=abnormal MFR<1.5 & sMBF<2 mL/min/g; G2=intermediate abnormalities 1.5≤MFR<2 & sMBF<2 mL/min/g and G3=normal MFR≥2 or sMBF≥2 mL/g/min. Stenosis severity was classified as non-significant (<50%), intermediate (50%≤stenosis<70%) and severe (≥70%).

**Results:** In patients with abnormal or intermediate flow abnormalities, 21/22 and 6/7 had at least one vessel with severe stenosis, respectively. Among patients without perfusion abnormalities, 9/11 had no significant coronary lesion. Moreover using semi-quantitative analysis criteria only (SDS≥7), 10 patients would benefit from ICA against 27 patients with sMBF & MFR quantitation. At ICA, 29/40 (73%) patients had at least one vessel with severe stenosis, with 27/29 (93%) in abnormal or intermediate abnormalities groups. Likewise, 52/84 (62%) of vessels analyzed in patients of abnormal or intermediate abnormalities groups had a significant stenosis.

**Conclusion:** Patients with normal flow parameters could avoid ICA. Patients with 3-vessels low MFR and sMBF would benefit from ICA, as they are likely to present a severe stenosis (≥70%) in at least one vessel. MBF and MFR quantitation improves patient referral to ICA as compared to semi-quantitative analysis alone.

## NSS306

**Performance of planar scintigraphy, CT alone and SPECT/CT in patients with bone lesions in the pelvis**

*L. Michel, K. Tornquist, M. Pérez-Lago, K. Strobel; Luzern*

**Purpose:** To evaluate the performance of flat-panel SPECT/CT in patients with bone lesions in the pelvis in comparison with planar bone scintigraphy (PS) and CT alone (CT).

**Methods and Materials:** 70 patients (39 female, 31 male, mean age 65, range 13–91 years) with suspicion for bone lesions in the pelvis were investigated with PS and combined SPECT/CT. Retrospectively, PS, CT and SPECT/CT were separately reviewed. Lesions were attached to six entities (trauma / malignant tumor or metastases / inflammation / degenerative / benign tumor / normal variant). Additionally, certainty in diagnosis was graded on a 4-point scale: 1=unclear; 2=probably correct, 3=fairly correct; 4 certainly correct.

**Results:** PS was positive in 62 of 70 patients (89%), SPECT/CT in 90% (63/70) and CT in 66% (46/70). PS showed overall 103, CT 88 and SPECT/CT 112 lesions. Taking SPECT/CT results as reference standard sensitivity, specificity and accuracy for malignant pelvic bone lesions were 68%, 88%, 81% for PS and 73%, 98%, 90% for CT on a patient based analysis. Compared with PS, SPECT/CT changed the diagnostic entity in 24 of 70 patients (34%), compared with CT in 22 of 70 patients (31%). The mean certainty rate in diagnosis for PS was 2,7 (range 1–4), for CT 3,1 (range 2–4) and 3,8 (range 2–4) for SPECT/CT.

**Conclusion:** In patients with bone lesions in the pelvis SPECT/CT changes diagnoses of approximately one third of patients compared with planar scintigraphy or CT alone. SPECT/CT's markedly increases the diagnostic certainty in lesions characterization.



PO01

### The role of multidetector computer tomography (MDCT) before transcatheter aortic valve implantation (TAVI)

*T. D. L. Nguyen-Kim, S. Baumüller, W. Maier, M. Gessat, T. Frauenfelder; Zürich*

**Learning Objectives:** – To know the indication for TAVI

– To show a dedicated CT-Protocol

– To enhance the anatomic details of the aortic annulus to demonstrate the relevant measurements

**Background:** With the rise of average life-expectancy in the western community the occurrence of degenerative aortic stenosis is continuously increasing with an actual prevalence of 4.8% in patients >75 years. Although conventional surgical aortic valve replacement (AVR) presents still the standard of care TAVI has evolved as an alternative for patients with severe aortic stenosis, who do not qualify for AVR due to their multiple comorbidities or high risk for surgery. TAVI allows a clearly less invasive implantation of a new aortic valve without requirement of sternotomy or cardiopulmonary bypass.

**Imaging Findings or Procedure Details:** The goal of this educational poster is to demonstrate the relevant indication for TAVI. To evaluate the aortic root and the vascular periphery MDCT is the method of choice. A dedicated CT-protocol enables a one-stop imaging of the aortic valve and the periphery. Preprocedural planning includes a precise assessment of the aortic root and evaluation of the vascular periphery, whereas the correct definition of the aortic annulus is most crucial. The precise preprocedural planning of valve-sizing avoids coronary occlusion and other complications as aortic insufficiency or stent migration. Furthermore the correct evaluation of the vascular periphery allows preinterventional definition of access as strong tortuosity can make transcatheter access to the aortic root impossible.

**Conclusion:** Preprocedural planning with MDCT is crucial for the evaluation of the aortic root and the vascular periphery to guide sizing.

PO02

### Coronary artery stent imaging with CT using an integrated electronics detector and iterative reconstructions: First experience

*F. Morsbach<sup>1</sup>, J. von Spiczak<sup>1</sup>, S. Winklhofer<sup>1</sup>, T. Frauenfelder<sup>1</sup>, S. Leschka<sup>2</sup>, D. C. Maintz<sup>3</sup>, A. C. Bunck<sup>3</sup>, P. Stolzmann<sup>1</sup>, H. Alkadhi<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>St. Gallen, <sup>3</sup>Köln/DE*

**Purpose:** To evaluate the quality of coronary stent lumen delineation with CT using a detector with integrated electronics.

**Methods and Materials:** Twelve different coronary stents were placed in plastic tubes and filled with contrast agent at an attenuation of 250 HU. The phantom was imaged with a 128-section dual-source CT machine equipped with conventional detector and with a detector with integrated electronics. Integrated electronics in the detector result in reduced electronic noise, which can translate to a decrease in image noise and enables higher spatial resolution reconstruction. Images were reconstructed with filtered back projection (slice thickness 0.6 mm/increment 0.4 mm), sinogram-affirmed iterative reconstruction (0.6 mm/0.4 mm), and, for data acquired with the integrated detector, with higher spatial resolution and iterative reconstruction (0.5 mm/0.3 mm). Two blinded, independent readers assessed image quality, measured noise, in-stent diameter, and in-stent attenuation, and evaluated image sharpness by generating signal intensity-profiles across stent struts.

**Results:** Inter-reader agreement for image quality-assessment was substantial ( $\kappa=0.798$ ). Both readers rated best image quality in datasets from the integrated detector at highest spatial resolution (0.5 mm/0.3 mm) and iterative reconstruction. Image noise was significantly lower in datasets scanned with the integrated detector ( $P<0.001$ ), being lowest in the images with 0.6 mm slice thickness for iterative reconstruction. Differences between measured and true in-stent diameters and in-stent attenuation increases were smallest, and image sharpness highest in datasets from the integrated detector at highest spatial resolution (0.5 mm/0.3 mm) using iterative reconstructions ( $P<0.001$ ).

**Conclusion:** CT coronary stent imaging is significantly improved using a detector with integrated electronics at 0.5 mm slice thickness combined with iterative reconstructions.

PO03

### CT-perfusion in patients with symptomatic peripheral arterial disease (PAD): Change of perfusion parameters after interventional revascularization and correlation with pre-interventional angiographic parameters

*M. Hüllner<sup>1</sup>, M. Banya<sup>2</sup>, K. Strobel<sup>2</sup>, P. Veit-Haibach<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Luzern*

**Purpose:** 1. To assess the change of CT-perfusion (CTP) parameters blood flow (BF), blood volume (BV), mean transit time (MTT) after interventional revascularization in patients with symptomatic peripheral arterial disease (PAD). 2. To correlate the change of CTP parameters with pre-interventional angiographic parameters.

**Methods and Materials:** Thirty-five patients (median age 72 years, range 48–87 years) with symptomatic PAD were prospectively included. All patients were referred for interventional revascularization of an occlusion or a high-grade stenosis. A CTP scan of the calf was performed before and after intervention. BF, BV and MTT of muscle tissue were calculated. A non-parametric test was performed to analyze the difference between CTP parameters pre/post intervention. Delta ( $\Delta$ ) pre/post was correlated with angiographic parameters, degree of collateralization, and length of stenosis or occlusion by Spearman's correlation coefficient.

**Results:** Mean pre-interventional BF, BV and MTT was 7.4 mL/100 mL tissue\*min<sup>-1</sup>, 0.7 mL/100 mL tissue, and 7.4 s. Mean post-interventional BF, BV and MTT was 11.0 mL/100 mL tissue\*min<sup>-1</sup>, 1.3 mL/100 mL tissue, and 7.6 s. The change of BF and BV was statistically significant ( $p$ -values 0.011, 0.015, respectively). Mean length of occlusion/stenosis was 6.0 cm (14 short (<2 cm), 10 medium (2–10 cm), 11 long segment lesions (>10 cm)). Degree of collateralization was good in 12, medium in 15, and poor in 8 patients. A moderate to strong correlation was found between  $\Delta$ BF and lesion length (0.54). No correlation was found between degree of collateralization and CTP parameters.

**Conclusion:** CTP parameters increase after therapeutic revascularization, and partly correlate with lesion length. CTP might serve as a semi-quantitative, non-operator dependent and non-invasive method to assess the success of revascularization in PAD.

PO04

### CT-perfusion in patients with symptomatic peripheral arterial disease (PAD): Correlation of perfusion parameters with hemodynamic parameters, differentiation of occlusion and high-grade stenosis

*M. Hüllner<sup>1</sup>, M. Banya<sup>2</sup>, K. Strobel<sup>2</sup>, P. Veit-Haibach<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Luzern*

**Purpose:** 1. To investigate the correlation of hemodynamic parameters with CT-perfusion (CTP) parameters blood flow (BF), blood volume (BV), mean transit time (MTT) in patients with symptomatic peripheral arterial disease (PAD). 2. To investigate the ability of CTP to differentiate between occlusion and high-grade stenosis.

**Methods and Materials:** Thirty-five patients (median age 72 years, range 48 to 87 years) with symptomatic PAD (28 occlusion, 7 high-grade stenosis) were prospectively included. All patients were referred for interventional revascularization of an occlusion or a high-grade stenosis. Prior to intervention, a CTP scan of the calf was performed. BF, BV, and MTT of muscle tissue were calculated and compared by non-parametric test. Perfusion parameters were correlated with hemodynamic parameters ankle-brachial pressure index (ABI), ankle blood pressure (ABP), and segmental pulse oscillography (SPO) of the calf by Spearman's correlation coefficient.

**Results:** Mean BF, BV and MTT was 7.7 mL/100 mL tissue\*min<sup>-1</sup>, 0.7 mL/100 mL tissue, and 7.2s. Values were different in occlusion/stenosis (BF 8.1/6.3, BV 0.8/0.5, MTT 7.3/6.8), however not statistically significant. The mean ABI was 0.60, mean ABP 84 mmHg, median SPO level was severe (3/3). Moderate to strong inverse correlations were found between BV and ABI (-0.52) and ABP (-0.58) in occlusion. No significant correlation was found between CTP and hemodynamic parameters in high-grade stenosis.

**Conclusion:** CT-perfusion parameters showed partly moderate to strong correlations with hemodynamic parameters. A differentiation between high-grade stenosis and occlusion by CTP parameters was not possible. CTP might serve as a semiquantitative, non-operator dependent and non-invasive method to assess PAD.

## PO05

**Implementing non-invasive cardiac imaging in clinical routine of a peripheral hospital**

*G. Bodendörfer, J. Burnand, L. Risse, P. Zukowski, L. Bugnard, A. Jaff, Riaz*

**Purpose:** Noninvasive cardiac Imaging by CT and MRI (C-CT and CMRI) in recent years has established evidence of reliability, comparability and added value as compared to invasive Catheter – Coronary – Angiography (CCA). Their implementation appears an important asset to keep a clinical service up-to-date.

**Methods and Materials:** Redesigning our service we installed appropriate equipment (256-slice I CT and a 1.5 T MRI Ingenia, Philips, NL). We scheduled a 9-month delay for MRI, the modality being new at our hospital. We readily assumed C-CT, experienced on a 64-slice scanner.

**Results:** Routine CT-applications started on October 1, 2011. Facing kind of non-appreciation of scientific evidence and the new opportunities locally available, we critically reviewed indications for chest-CT, offering Triple-Rule-Out (TRO) exams to patients with equivocal/cardiovascular presentation. Prospective ECG-triggering allowed whole chest doses <3mSv yielding cardiac interventions and otherwise quick triage in >50 cases as yet. C-MRI started with voluntaries by 3 selected technicians, simulating stress-MRI early 2012 and clinical adenosine-stress in summer 2012. MRI is utmost popular among cardiologists – all contrary to C-CT.

**Conclusion:** Modern noninvasive cardiac imaging is feasible, also in smaller institutions - at least with the upper grade – modern CT and MRI installations, foreseen the pertinent specifications, not too expensive in primary acquisition and the commitment of the radiologists concerned. Interdisciplinary cooperation is highly appreciated but may by times result from a learning process, wherein radiologists have to invest their facilities and proficiency. Otherwise radiology might be at risk of being non-applied, customized and/or filleted.

PO06

**Percutaneous endovascular biopsy for intra-vascular lesions***A. Pomoni<sup>1</sup>, F. Tobalem<sup>2</sup>, R. A. Meuli<sup>2</sup>, S. D. Qanadli<sup>2</sup>; <sup>1</sup>Pully, <sup>2</sup>Lausanne*

**Learning Objectives:** To illustrate an overview regarding definition, preparation, risks and complications as well as a step- by- step description of the Percutaneous Endovascular Biopsy procedure.

**Background:** Percutaneous Endovascular Biopsy is a relatively rare and rather underused procedure. It is a minimally invasive procedure that takes place in an angiography suite performed by specially trained interventional radiologists.

**Imaging Findings or Procedure Details:** The procedure is performed under local anesthesia. The puncture site is usually the common femoral vein. Under fluoroscopic guidance and through a sheath and a guiding wire, a Bi-Pal biopsy device is by then gently advanced up to the level of the mass. After confirming the position of the tip of the biopsy forceps, adequate specimens are obtained (2–3) for pathological diagnosis. Our experience consisted on 12 biopsies performed on 12 patients establishing a spectrum of 2 leiomyosarcomas of the superior vena cava and 2 of the inferior vena cava, 1 rhabdomyosarcoma of the left pulmonary artery, 1 intimal sarcoma of the right pulmonary artery, 1 lymphoma of the right ventricle, 1 metastatic lesion to the inferior vena cava from an hepatocellular carcinoma, 1 myxoma of the right ventricle, 2 thrombus of the pulmonary trunk and 1 sarcoma of the abdominal aorta. No complications were encountered.

**Conclusion:** Percutaneous Endovascular Biopsy is a safe and efficient procedure that aims to establish early diagnosis in malignant tumors of the heart and the great vessels.

PO07

**Percutaneous image guided C-spine procedures***F. Massari<sup>1</sup>, A. W. Vandergrift<sup>1</sup>, G. Bonaldi<sup>2</sup>, E. Pravata<sup>3</sup>, A. Cianfoni<sup>3</sup>; <sup>1</sup>Charleston SC/US, <sup>2</sup>Bergamo/IT, <sup>3</sup>Lugano*

**Learning Objectives:** Aim of this educational exhibit is to offer an overview on neuroradiological armamentarium in the minimally invasive percutaneous image-guided procedures on the cervical spine.

**Background:** Spinal neuro-interventional radiology, through the use of fluoroscopic and/or CT imaging guidance offers a wide variety of percutaneous procedures on the cervical spine, for tissue diagnosis, drainage of fluid collections, pain management, discography and

**PO08**  
**Endovascular angioplasty of the isolated obstruction of internal iliac artery for buttock claudication***A. Chouiter<sup>1</sup>, T.-L. C. Lu<sup>2</sup>, F. Doenz<sup>2</sup>, S. D. Qanadli<sup>2</sup>; <sup>1</sup>Neuchâtel, <sup>2</sup>Lausanne*

**Purpose:** Vascular obstruction of the internal iliac artery is a common feature in patients with peripheral arterial disease. However, rarely the lesion is isolated and responsible for buttock claudication. The aim is to report clinical results of symptomatic isolated internal iliac obstruction (IIIO) treated with percutaneous angioplasty.

**Methods and Materials:** From September 2010 to September 2011, we retrospectively reviewed our series of thirteen patients with buttock claudication treated with angioplasty for the IIIO. Demographics, technical success, clinical outcome and complications are presented.

**Results:** A total of fourteen arteries were treated. Twelve patients were treated by unilateral recanalization of the internal iliac artery and one patient necessitated a bilateral angioplasty. Only one patient was treated with balloon angioplasty alone, all the others were treated with stent implantation. There was 100% technical success and no complication observed. All patients presented a successful clinical outcome with the relief of the symptoms at 3, 6 and 12 months follow-up.

**Conclusion:** Percutaneous endovascular treatment of IIIO is a safe and effective procedure. Patient selection however is mandatory. Larger series and long term follow up are required to clearly define the role and the benefit of the procedure.

PO09

**Operator radiation doses during CT-guided spine procedures***A. Cianfoni<sup>1</sup>, H. E. Hawk<sup>2</sup>, E. Pravata<sup>1</sup>, M. U. Manzoor<sup>2</sup>, Z. Rumboldt<sup>2</sup>, W. Huda<sup>2</sup>; <sup>1</sup>Lugano, <sup>2</sup>Charleston SC/US*

**Purpose:** To quantify the radiation dose incident on operators during CT-guided interventional spine procedures.

**Methods and Materials:** Data were prospectively obtained on 26 consecutive CT-guided spine procedures, encompassing a variety of different interventions. Intermittent low-dose limited-coverage CT-scanning was performed using a "step and shoot" mode to visualize needle advancement. The operator wore an electronic direct dosimeter above

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PO10

**Radiofrequency (RF) electrodes for magnetic resonance (MR) guided RF-ablation at 3.0T:  
Do ultra-short echo time (UTE) sequences provide less artifacts?**

*D. Schmidt<sup>1</sup>, S. Clasen<sup>2</sup>, D. Nanz<sup>1</sup>, P. L. Pereira<sup>3</sup>, A. Boss<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Tübingen/DE, <sup>3</sup>Heilbronn/DE*

**Purpose:** To evaluate systematically ultra-short echo time (UTE) sequences and their artifacts in MR compatible RF electrodes for MR guided RFA at 3.0T.

**Methods and Materials:** Three different MR compatible RF applicators including one internally cooled single electrode, one internally cooled cluster electrode and one expandable electrode were tested in a phantom study at 3.0 Tesla. UTE was performed for each electrode with variable echo times (TE 0.14–2.5 ms) at different angles (0°, 45° and 90°). As reference, T2-weighted fast spin echo (FSE) and gradient echo (GE) sequences, which are used for MR-guided interventions, were also tested at the same angles. Qualitative and quantitative analysis of all three sequences were performed by determining the width of tip artifacts, shaft artifacts and global visualization.

**Results:** Qualitative analysis showed that all RF applicator were well visualized at 3.0T. Quantitative analysis for UTE showed that artifact-induced widening of the shaft and tip was mainly influenced in all electrodes through: a) use of longer echo times b) increasing the angle between the RF electrode and main magnetic field, or c) combination of both. For all RF electrodes the artifact-induced widening of the shaft and tip was minimized by decreasing the echo time of UTE compared to the reference MR sequences. Strong b1 artifacts were similar for all tested MR sequences and RF applicator's with an acceptable visualization for clinical practice.

**Conclusion:** UTE created satisfactory artifacts for all three MR compatible RF applicators at 3.0T and enabled a distinct control of artifact size.

PO11

**Endovascular treatment of isolated internal iliac artery aneurysms**

*A. Chouiter<sup>1</sup>, F. Glauser<sup>2</sup>, F. Doenz<sup>2</sup>, P. Tozzi<sup>2</sup>, S. D. Qanadli<sup>2</sup>; <sup>1</sup>Neuchâtel, <sup>2</sup>Lausanne*

**Purpose:** The isolated internal iliac artery aneurysm (IIIA) is a rare but dangerous condition. The aim of this study was to evaluate the efficacy and safety of endovascular treatment of IIIA.

**Methods and Materials:** From December 2006 to February 2012, 7 patients, mean age 76 years (range: 64 to 85 years) underwent endovascular treatment for IIIA. All patients were male. The median (range) size of aneurysm at diagnosis was 5.4 (3.1–8.3) cm. All The IIIA were asymptomatic and discovered as incidental finding. Four patients had IIIA located on the left side. One patient had bilateral IIIA. Endovascular treatment consisted of embolization (coils or vascular plugs) and/or stents.

**Results:** Three patients had distal embolization followed by stent-grafting of the common iliac artery, two patients were treated by stent-grafting of IIIA and embolization (distal and proximal) only in the last three patients using coils and/or vascular plugs. There was no intra-operative complication. The mean follow-up period was 19.8 months (range, 1–46). One patient died during the follow-up (44 months), not related to vascular repair. Re-intervention occurred in two patients: one patient treated with stent-grafting after 22 months for type 2 endoleak (embolization), and the other one with an incomplete exclusion of the IIIA (stent-grafting) treated with embolization.

**Conclusion:** Endovascular treatment of IIIA is a safe and efficient minimally invasive treatment with low complication rate.

PO12

**Popliteal artery recanalization using SUPERA stent:  
A retrospective study**

*A. Chouiter<sup>1</sup>, S. Derrouis<sup>1</sup>, F. Glauser<sup>2</sup>, S. D. Qanadli<sup>2</sup>; <sup>1</sup>Neuchâtel, <sup>2</sup>Lausanne*

**Purpose:** The aim of this study was to evaluate efficacy, safety, and mid-term patency of a popliteal artery recanalization with implantation of a self-expanding interwoven nitinol stent in patients with intermittent claudication or chronic critical limb ischemia.

**Methods and Materials:** From April 2010 to November 2011, sixteen patients were treated for an atherosclerotic disease of the popliteal artery (total occlusion in 31% of patients) with implantation of a SUPERA stent because of elastic recoil, residual stenosis, or flow-limiting dissection after percutaneous transluminal angioplasty. The patients were followed for up to 12 months by Doppler ultrasound examinations, ankle-brachial index and assessments of Leriche and Fontaine class.

**Results:** Technical success was achieved in 100% of procedures. Primary patency rate was 81% at 12 months. Two in stent restenosis were successfully dilated by drug eluting balloon. One occlusion occurred leading to an amputation in a patient with extensive disease in below the knee and superficial femoral arteries.

**Conclusion:** Percutaneous endovascular treatment of atherosclerotic disease of the popliteal artery with implantation of a SUPERA stent is a safe and clinically effective procedure.



PO13

**New techniques in breast imaging***C. Lutchmaya-Flick, C. Nakajo, R. A. Meuli, J.-Y. Meuwly; Lausanne***Learning Objectives:** To present an overview of the literature concerning new breast imaging techniques permitting a 3D-analysis of the breast.**Background:** Since 1960 we represent the breast, a tridimensional organ, in two dimensions.**Imaging Findings or Procedure Details:** To obtain a real 3D-image of the breast as a volume, the breast has to be explored without compression and the patient has to be positioned in ventral decubitus. There are four experimental techniques using this approach: Cone-Beam Breast CT (CBBCT), Breast UltraSound Tomography (BUST), Dedicated breast PET/CT (DbPET/CT) and MAMmography with Molecular Imaging PET (MAMMI PET). In CBBCT there is a higher resolution of contrast counterbalancing the lower spatial resolution, so that the results of CBBCT are similar to mammography. Advantages are less projections and constructed images, limitations are the worse visualization of the axilla and the elevated dose. In BUST the information obtained seem to be equivalent to MRI. Disadvantage of DbPET/CT is a considerable irradiation of the breast associated with limited resolution. Therefore, MAMMI PET has been developed, using a ring of detector. This technique shows promising first results concerning detection of breast lesions.**Conclusion:** At present, some promising 3-D imaging techniques of the breast exist. However, clinical trials using these new techniques are limited and larger studies have to be performed for obtaining a definitive proof of their utility.

PO14

**MRI-guided vacuum-assisted breast biopsy: Comparison to the stereotactic and sonographically guided technique***T. Imschweiler<sup>1</sup>, H. Haueisen<sup>2</sup>, G. Kampmann<sup>3</sup>, L. Rageth<sup>4</sup>, B. Seifert<sup>4</sup>, C. Rageth<sup>4</sup>, B. Freiwald<sup>5</sup>, R. A. Kubik-Huch<sup>5</sup>; <sup>1</sup>Dachsen/CH, <sup>2</sup>Aarau, <sup>3</sup>Sorengo, <sup>4</sup>Zürich, <sup>5</sup>Baden***Purpose:** The purpose of the study was to analyze the development of MRI-guided vacuum-assisted biopsies (VAB) in Switzerland and to compare the procedure with stereotactic and sonographic VAB.**Methods and Materials:** In Switzerland, all VAB must be entered in a central database for documentation and quality purposes on behalf of the Swiss Federal Office of Public Health. We performed a retrospective analysis of all VAB performed between 2009 and 2011, with reference to the indication, diagnostic result, success rate and complication rate, among other things. During this period a total of 9113 vacuum-assisted biopsies were performed in Switzerland, of which 557 (6%) were MRI-guided.**Results:** MRI-guided VAB showed the highest growth rate (97%) of all procedures over the investigation period. The technical success rate of MRI-guided VAB was 98.4%. An average of 15 ( $\pm 5$ ) cylinders per interventions was obtained. For MRI-guided procedures, the complication rate was 8%, whereby these complications mainly involved hemorrhages that did not require intervention. The malignancy rate of MRI-guided VAB was 26% (137; 88 invasive Ca; 49 DCIS), high risk lesions (B3 classification) were diagnosed in 107 cases (20%).**Conclusion:** MRI-guided vacuum-assisted biopsy is the fastest growing method of vacuum-assisted biopsies in Switzerland and is a safe procedure.

PO15

**Contrast-enhanced ultrasound: Retrospective analysis of two years use in a university hospital***V. Lenoir, T. de Perrot, S. Terraz, P.-A. Poletti; Genève***Learning Objectives:** Identify the value of ultrasound imaging with contrast enhancement in a University Hospital.**Background:** The hospital database was searched over a period of 2 years to obtain all ultrasound examinations performed with contrast enhancement. The reports are sorted by target organ and diagnostics.**Imaging Findings or Procedure Details:** 97 contrast enhanced ultrasounds were performed in 95 patients (59 men, 36 women, 19–91 years). All examinations were performed with Philips ultrasound devices (CX50 xMatrix and iU22 xMatrix) with use of Sonovue<sup>®</sup>. 8 target organs were explored including the liver (56%), other “full” organs as the spleen, kidneys, pancreas or male genitals (40%) and vascular structures (stents and TIPS, 6%). 105 diagnoses were noted in the radiological reports, among them liver nodules (23%) or post-traumatic lesions (19%) were analyzed. 39% confirmed the absence of pathology (the absence of parenchymal traumatic or nontraumatic lesion) and permeability of grafts anastomoses. Only 3% of the examinations were not conclusive after contrast injection.**Conclusion:** Contrast enhanced ultrasound provides a useful diagnostic tool in the management of patients in a University Hospital. In many situations, this imaging modality allowed to obtain a rapid diagnostic result for the clinicians.

PO16

**Dose reduction in abdominal CT with a model-based iterative reconstruction algorithm: A phantom study***D. B. Husarik<sup>1</sup>, H. Alkadhi<sup>1</sup>, G. D. Puipe<sup>1</sup>, C. S. Reiner<sup>1</sup>, N. Chuck<sup>1</sup>, Z. Szucs-Farkas<sup>2</sup>, S. Schindera<sup>3</sup>; <sup>1</sup>Zürich, <sup>2</sup>Biel, <sup>3</sup>Basel***Purpose:** To compare diagnostic accuracy, qualitative and quantitative image quality on full and reduced radiation dose abdominal CT reconstructed with two different algorithms—filtered back projection (FBP) and model-based iterative reconstruction (MBIR).**Methods and Materials:** A custom built phantom simulating the liver during the portal-venous phase containing 43 simulated hypovascular lesions in three sizes (5–15 mm) and three tumor-to-liver contrast levels (10–50 HU) was placed in a water filled cylindrical container mimicking an intermediate size patient. Imaging was performed at 120 kVp and four radiation-dose-levels (100%=188 mAs, 50=95 mAs, 25%=48 mAs and 10%=20 mAs). Each acquisition was reconstructed with FBP and MBIR. Contrast-to-noise-ratios (CNR) and image noise were measured. Qualitative image analysis consisted of lesion detection and subjective image quality scores (5-point Likert scale with 1=worst, 5=best for: confidence, image noise and overall image quality). Results were compared between the eight datasets.**Results:** CNR on MBIR images was significantly higher (mean 246%, 151–383%) and image noise was significantly lower (69%, 59–78%) than on FBP images at the same radiation dose ( $P<.05$ ). On 10% dose MBIR images, CNR ( $3.3\pm0.3$ ) was significantly higher and image noise ( $15\pm1$ HU) was significantly lower than on full dose FBP images (CNR:  $2.5\pm0.1$ ; image noise:  $21\pm1$ HU) ( $P<.05$ ). Qualitative results slightly improved on MBIR images compared to FBP images at the same radiation dose and were similar on 50% dose MBIR images (sensitivity: 84%; confidence: 3.6; image noise: 4; image quality: 5) compared to full dose FBP images (sensitivity 86%; confidence: 3.8; image noise: 4; image quality: 5).**Conclusion:** Model based iterative reconstruction for abdominal CT allows a 50% reduction in radiation dose, without compromising diagnostic accuracy, qualitative or quantitative image parameters.

PO17

**MR imaging appearances of cholangiocarcinoma in patients with primary sclerosing cholangitis***S. Schindera<sup>1</sup>, H.-J. Jang<sup>2</sup>, T. Kim<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Toronto/CA***Purpose:** To assess the appearances of cholangiocarcinoma in patients with primary sclerosing cholangitis (PSC) on MR imaging.**Methods and Materials:** A retrospective review yielded 11 PSC patients with confirmed cholangiocarcinoma by pathology. Patients underwent MR imaging including dual-echo in- and opposed-phase T1-weighted, T2-weighted, MR cholangiography and dynamic contrast-enhanced T1-weighted imaging. Three patients were on surveillance for cholangiocarcinoma with MR imaging. MR images were interpreted by two radiologists based on signal intensity, enhancement pattern, location, size and tumor growth pattern. Clinical outcomes of the patients were also reviewed.**Results:** Seven patients had an intrahepatic (5 mass-forming type and 2 mass-forming and periductal-infiltrating type) (mean diameter, 5.4 cm; range, 3.6–8.8 cm), and 4 patients had an extrahepatic cholangiocarcinoma (periductal-infiltrating type) (mean length, 3.5 cm; range, 2.0–5.5 cm). All tumors were hypointense on T1-weighted MR images, and 10 tumors were hyperintense on T2-weighted MR images. Typical enhancement features of the mass-forming type included a rim-like, irregular enhancement during the arterial phase and progressive centripetal enhancement (100% patients). In the periductal-infiltrating type, a homogenous hyper-enhancement during all enhancement phases (100% of patients) was observed. Liver transplantation and partial hepatectomy were performed in 2 and 1 patient, respectively. The remaining 8 patients had palliative treatment. Only one patient survived without tumor recurrence.**Conclusion:** In the setting of PSC, intrahepatic cholangiocarcinoma occurs slightly more frequently than extrahepatic cholangiocarcinoma. Imaging appearances of the different morphological types of cholangiocarcinoma-complicated PSC do not differ from the known description of cholangiocarcinoma in general.

PO18

**Intrahepatic cholangiocarcinoma: Diffusion-weighted MR imaging findings***R. Duran<sup>1</sup>, A. Pomoni<sup>2</sup>, F. Becce<sup>1</sup>, A. Denys<sup>1</sup>, R. A. Meuli<sup>1</sup>, S. Schmidt<sup>1</sup>; <sup>1</sup>Lausanne, <sup>2</sup>Pully***Purpose:** Apparent diffusion coefficients (ADCs) of focal liver lesions have been reported to be different in their mean values and malignant lesions demonstrate lower ADC values than benign lesions. Data regarding the diffusion-weighted MR imaging (DWI) features in intrahepatic cholangiocarcinoma (ICCA) are lacking. The aim of our study is to report the DWI findings in ICCA.**Methods and Materials:** Nineteen patients (10 men, mean age 63.5 years) with ICCA pathologically proven were retrospectively included. All patients underwent 3T MR imaging between August 2008 and August 2011 with our standard protocol including DWI (b-values: 50, 300 and 600 s/mm<sup>2</sup>). In consensus, two radiologists evaluated lesion characteristics, such as size, signal intensity and contrast enhancement. DWI features were assessed including mean, maximal and minimal ADC values.**Results:** The maximum diameter of ICCA lesions was 71.2 mm; range 22–193 mm. The mean ( $\pm$ SD) ADC value of ICCA measured  $1.30\pm0.24 \times 10^{-3}$  mm<sup>2</sup>/s. No significant correlation was found between the different contrast enhancement patterns and the lesion's ADCs (all  $p>0.05$ ).**Conclusion:** The mean ADC value of ICCA is relatively low, consistent with a malignant origin. However, being slightly higher than previously reported ADC values of other malignant liver lesions, DWI may be a helpful adjunct to narrow the differential diagnosis.

## PO19

**Active contrast media extravasation on CT-angiography in patients with acute colonic hemorrhage: Imaging features and further management**

*N. V. Nguyen, P. Bize, A. Denys, R. A. Meuli, S. Schmidt; Lausanne*

**Purpose:** Diagnostic performance and widespread availability of CT-angiography allow its use as primary diagnostic technique in the evaluation of acute colonic bleeding. Our goal is to evaluate the influence of specific CT-angiography features and clinical parameters on further patients' management.

**Methods and Materials:** The hospital's database yielded 25 patients (17 men, average age 67) with acute colonic bleeding and contrast medium extravasation detected by CT angiography from 2004–2012. In consensus, two radiologists retrospectively reviewed corresponding CT images. Patients' hemodynamic parameters (shock index) at admission during treatment (transcatheter arterial embolization or surgery) and outcome were also retrieved.

**Results:** The most frequent bleeding locations were the ileo-caecal region (n=7), followed by the ascendant colon (n=6), the sigmoid and descendant colon (n=5, each). Densities of active contrast medium extravasation ranged from 76 to 334 Hounsfield units (average 200). The most frequent bleeding causes were diverticular (n=10) and vascular (n=6). Angiography was performed in 11 patients (44%), 9 patients are followed by selective embolization then subsequent surgery is in 4 cases (16%). Direct surgery was in 10 patients (40%). Four patients (16%) were treated conservatively. Colonoscopy, performed in 13 patients (52%), was never therapeutic. One patient (4%) died despite embolization and surgery. The values of the initial shock index including the evolution was very heterogeneous, regardless if angiography, surgery or both were performed.

**Conclusion:** Surgery and angiography with embolization are both able to treat active colonic hemorrhage successfully, while the latter is slightly more frequent and mostly without subsequent need of surgery.

## PO20

**Correlation between global small-bowel motility in MRI and local disease activity in patients with Crohn's disease**

*S. Bickelhaupt<sup>1</sup>, J. M. Froehlich<sup>1</sup>, R. Cattin<sup>2</sup>, S. Raible<sup>2</sup>, U. Bill<sup>3</sup>, H. Bouquet<sup>3</sup>, M. A. Patak<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Biel, <sup>3</sup>Bern*

**Purpose:** Crohn's disease (CD) is an inflammatory bowel disease (IBD) characterized by local severe inflammation. Previous studies revealed reduced small-bowel motility in affected tissue measured at the terminal ileum. The aim was to evaluate the influence of local disease activity on global small-bowel motility in patients with CD based on histopathology.

**Methods and Materials:** 15 healthy individuals (11 male, 4 female; mean 44 years) and 15 patients with histopathologically proven active CD (10 female, 4 male; mean 37 years) were included in this IRB-approved retrospective study. MRI (1.5 T, Siemens Sonata) was performed after a 1 h preparation of 1000 cc mannitol solution (3%). Cine T2–2D-FIESTA (TR283.3/TE1.89/FOV400/1 mm slice) motility acquisitions were performed in apnea. Image analysis for assessment of gastric motility was performed using a dedicated MR motility assessment software (Motasso) in 3 randomly chosen areas of the small-bowel outside the known CD-affected hot spots. The main characteristics (frequency, amplitude, diameter) were compared using Student's t-test and one-way ANOVA.

**Results:** 3 randomly chosen regions of interest were analyzed with Motasso in each participant. Patients with active-CD revealed both significantly ( $p<0.01$ ) reduced contraction-frequency (active-CD: 2.86/min; healthy: 4.53) and contraction-amplitude (6.71 mm; 10.14 mm) compared to healthy individuals. Mean bowel-lumen diameter was only slightly, but significantly ( $p=0.04$ ) larger in patients with active-CD (16.91 mm) compared to healthy participants (14.79 mm).

**Conclusion:** Small-bowel motility in patients with active-CD seems to be globally influenced by the local activity of the disease. Both contraction-frequency and contraction-amplitude were significantly reduced compared to healthy individuals, while the mean lumen-diameter was slightly increased.

## PO21

**Computed tomography perfusion imaging for the prediction of response and survival to transarterial radioembolization of liver metastases**

*F. Morsbach<sup>1</sup>, T. Pfammatter<sup>1</sup>, C. S. Reiner<sup>1</sup>, M. Fischer<sup>1</sup>, B.-R. Sah<sup>1</sup>, S. Winklhofer<sup>1</sup>, E. Klotz<sup>2</sup>, T. Frauenfelder<sup>1</sup>, A. Knuth<sup>1</sup>, B. Seifert<sup>1</sup>, N. Schäfer<sup>1</sup>, H. Alkadhi<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Forchheim/DE*

**Purpose:** To evaluate prospectively, in patients with liver metastases, the ability of CT perfusion to predict the morphologic response and survival after transarterial radioembolization (TARE).

**Methods and Materials:** Thirty-three patients (mean age  $64\pm 13$  years) underwent dynamic, contrast-enhanced CT perfusion within one hour before treatment planning catheter angiography, for calculation of the arterial perfusion (AP) of liver metastases. Treatment response to TARE was evaluated morphologically on follow-up imaging (mean 116 days) based on RECIST (Version 1.1). Pretreatment CT perfusion was compared between responders and non-responders. Correlation between AP and change in tumor size was calculated, including receiver operating characteristics (ROC) and logistic regression analysis. Survival was assessed with Kaplan-Meier curves, and survival predictors with Cox proportional hazard model.

**Results:** A significant difference in AP was found on pretreatment CT perfusion between responders and non-responders to TARE ( $P=0.002$ ). Change in tumor size on follow-up imaging correlated significantly and negatively with AP prior to TARE ( $r=-0.62$ ,  $P=0.001$ ). A change of one standard deviation in AP was associated with an odds ratio of 55 (95% CI: 2–1266,  $P=0.013$ ). A cut-off AP of 16 ml/100 ml/min was associated with a sensitivity of 100% (95% CI: 70%–100%) and specificity of 87% (95% CI: 62%–96%) for predicting therapy response. ROC analysis of AP in relation to treatment response revealed an area-under-the-curve of 0.963 (95% CI: 0.894–1.000,  $P<0.001$ ). A significantly higher one-year survival after TARE was found in patients with a pretreatment  $AP\geq 16$  ml/100 ml/min ( $P=0.012$ ), being a significant, independent predictor of survival (hazard ratio 0.039,  $P=0.016$ ).

**Conclusion:** AP of liver metastases as determined by pretreatment CT perfusion imaging enables prediction of short-term morphologic response and one-year survival to TARE.

## PO22

**PLIF, ALIF and TLIF: What the radiologist should know**

N. Meunier Carus Vincent, E. Tessitore, D. A. Djema, S. Haller, K.-O. Löfblad, V. Cuvincius; Genève

**Learning Objectives:** We propose to discuss main anatomical, physiological, surgical and radiological data about the fused lumbar spine.

**Background:** Better understanding of spine biomechanics and numerous advances in spinal instrumentation devices and fusion techniques increased the use of lumbar fusion. A fundamental question for the spinal surgeon and for the radiologist is to recognize the proper indication for fusion surgery, such as acute overt instability, chronic overt instability, anticipated instability and covert instability. Various techniques exist, such as PLIF, ALIF and TLIF (posterior, anterior, respectively transforaminal lumbar interbody fusion).

**Imaging Findings or Procedure Details:** PLIF involves laminectomy, discectomy, cage placement and posterior fixation with transpedicular titanium screws and rods; eventually, bone grafts are used to favor the consolidation. ALIF involves an anterior approach for discectomy, cage placement and eventually bone grafts. TLIF is similar to PLIF, but it uses a postero-lateral approach (uni- or bilateral) for discectomy. Post-surgery imaging findings are performed to verify the position of screws and cages; remote follow-up is necessary to verify proper fixation and material integrity.

**Conclusion:** Radiologists should be aware of surgical techniques for lumbar fusion in order to recognize the proper indications and to ensure an adequate follow-up.

## PO23

**Interobserver variability of SPECT/CT, MRI, CT, bone scan and plain radiographs in patients with unspecific wrist pain**

L. Werner<sup>1</sup>, M. Hüllner<sup>2</sup>, K. Strobel<sup>1</sup>, A. Bürkert<sup>1</sup>, M. Pérez-Lago<sup>1</sup>, U. von Wartburg<sup>1</sup>, B. Seifert<sup>2</sup>, P. Veit-Haibach<sup>2</sup>; <sup>1</sup>Luzern, <sup>2</sup>Zürich

**Purpose:** To investigate the interobserver variability of SPECT/CT, MRI, CT, bone scan and plain radiographs in patients with unspecific wrist pain.

**Methods and Materials:** Thirty-two patients (median age 38 years, range 18–73 years; 19f, 13m) with unspecific pain of the hand or wrist were evaluated retrospectively. The diagnosis was made by the referring hand surgeon. All patients were imaged by plain radiographs, planar early-phase imaging (bone scan) and late-phase SPECT/CT imaging including CT, and MRI. Two experienced readers analyzed the images based on a standardized read-out protocol. The interobserver variabilities were determined for detecting the relevant lesion, its location and type, and etiology of the underlying pathology. Kappa values were calculated for all analyzed imaging characteristics. The diagnostic accuracy of each modality was calculated according to the standard of reference (complete clinical examination and imaging) and a mean follow-up of 20 months.

**Results:** Accuracy of plain radiographs, bone scan and CT was generally poor for both readers, but there was partly good agreement on lesion detection (plain radiographs 0.73, CT 0.87) and location (plain radiographs 0.69, bone scan 0.63, CT 0.87), and type of pathology (CT 0.74). The other modalities with higher diagnostic accuracy yielded generally high agreement, with SPECT/CT showing mostly superior results (lesion detection: SPECT/CT 0.93, MRI 0.72; lesion localization: SPECT/CT 0.91, MRI 0.75; etiology: SPECT/CT 0.85, MRI 0.74), while MRI yielded better results concerning determination of the type of pathology (MRI 0.75, SPECT/CT 0.69).

**Conclusion:** SPECT/CT may be a reliable diagnostic tool with consistent image reading in patients with unspecific pain of the wrist.

## PO24

**Visualization of the coracoacromial ligament by ultrasound and MRI: Comparison between asymptomatic volunteers and patients with shoulder impingement**

T. Dietrich, M. Jonczyk, F. M. Buck, C. W. A. Pfirrmann; Zürich

**Purpose:** To assess the coracoacromial ligament (CAL) in volunteers and patients with subacromial impingement on ultrasound and MRI

**Methods and Materials:** Twenty-nine asymptomatic volunteers and 29 patients with subacromial impingement were included. Two radiologists obtained ultrasound images. The thickness of the CAL was measured at three positions on longitudinal ultrasound images (17-MHz linear transducer) and at its midportion on sagittal oblique T1-weighted MR images. Anterior bulging of the CAL was evaluated on ultrasound images. Student's t-test, Fisher's exact test and intraclass correlation coefficient (ICC) served for statistics.

**Results:** Thickness of the CAL at its midportion was between  $1.34 \pm 0.23$  mm and  $1.54 \pm 0.35$  mm on ultrasound and MR images in asymptomatic volunteers and impingement patients (ICC for interobserver agreement: 0.35–0.76). The thickness of the CAL at a distance of 5 mm to the coracoid process and a distance of 5 mm to the acromion was between  $1.76 \pm 0.44$  mm and  $2.05 \pm 0.58$  mm (ICC: 0.84–0.94). We did not observe significant differences of the thickness of the CAL at any position in impingement patients compared to asymptomatic volunteers. Anterior bulging of the CAL was present in 3 asymptomatic volunteers compared to 10 patients and was almost statistically significant ( $p=0.056$ ).

**Conclusion:** The coracoacromial ligament is well accessible for Ultrasound. Thickness or length of the CAL revealed no significant differences in volunteers compared to patients with impingement. Normal thickness of the CAL at its midportion is less 1.8 mm. Anterior bulging of the CAL is common in subacromial impingement patients.

## PO25

**CT metal artifact reduction in internally fixated proximal humeral fractures: Comparison between monoenergetic extrapolation of dual energy and iterative artifact reduction algorithms**

S. Winklhofer<sup>1</sup>, F. Morsbach<sup>1</sup>, P. Stolzmann<sup>1</sup>, E. Benninger<sup>2</sup>, C. Spross<sup>2</sup>, B. Jost<sup>2</sup>, M. Thal<sup>1</sup>, H. Alkadhi<sup>1</sup>, R. Guggenberger<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>St. Gallen

**Purpose:** To assess the value of monoenergetic extrapolations from dual-energy computed tomography (DECT) and standard filtered back projections (FBP) from single-energy computed tomography (SECT) compared to a new iterative metal artifact reconstruction algorithm (IMAR) for artifact reduction in internally fixated humeral fractures.

**Methods and Materials:** In this cadaveric study, artifacts in seven internally fixated human proximal humeral fractures of 5 subjects were examined with SECT and DECT. Postprocessing included routinely used FBP algorithm, a new IMAR algorithm and monoenergetic extrapolation of DECT images. Image analysis included quantitative assessment of image artifacts (HU measurements) as well as evaluation of image quality and osteosynthesis material and visualization of screw position in FBP, IMAR, and DECT using a five-point Likert scale.

**Results:** HU values of streak artifacts were significantly ( $P<0.05$ ) different between FBP ( $115.7 \pm 222.4$ ) and IMAR ( $68.7 \pm 106.3$ ), and between FBP and monoenergetic DECT ( $10.1 \pm 146.1$ ). Between IMAR/DECT no significant differences were found ( $P=0.30$ ). Artifact scores improved significantly from FBP (3.9) to IMAR (2.0;  $P<0.001$ ) and DECT (2.6;  $P<0.05$ ), whereas no significant differences were seen between IMAR and DECT ( $P=0.10$ ). Visualization scores of osteosynthesis material differed significantly ( $P<0.05$ ) between FBP (2.9) and IMAR (2.3) and between IMAR and DECT (1.4). Screw position of 57/57 screws was identically rated in FBP and IMAR, but different between IMAR and DECT in 11 cases, with a subjectively better visualization in DECT.

**Conclusion:** IMAR algorithm in SECT as well as monoenergetic extrapolations from DECT allow for an improved image quality, a reduction of artifacts and better assessment of screw-position compared to standard FBP in SECT.



## PO26

**Muscle imaging and operative success of lumbar disc herniation – a pilot study**

H.-L. Platzöder, G. Jost, C. Zweifel, M. Gloor, T. Haas, D. Fischer, C. Stippich, A. Fischmann; Basel

**Purpose:** To assess muscular changes in patients with unilateral lumbar disc protrusion using quantitative MRI and to relate these changes to the measurable clinical features.

**Methods and Materials:** In 10 patients with unilateral lumbar disk herniation at a single level, clinical examination and 3T MRI were performed before and 6–8 weeks after disk removal. Axial slices of the thighs and calves were acquired at 3T. Fat fractions were calculated using 2-Point (2PD) and 3-Point Dixon methods and T2 values were calculated with a multi-echo TSE sequence.

**Results:** Six patients showed complete remission at follow up with remaining symptoms in 4 patients. Cross sectional area of both thighs and calves were significantly lower ( $p < 0.05$ ) in the involved leg and increased over the study period in the thigh ( $p < 0.05$ ) and in the involved leg of the calf. Fat fraction was significantly higher in the involved thigh ( $p < 0.05$ ) and decreased over the study period ( $p < 0.05$ ) in thighs and calves. In the non-involved leg fat fraction of the thighs and calves remained constant. The difference was especially pronounced in the subgroup without improvement. T2 values increased over the study period in the thighs and calves of the involved legs ( $p < 0.05$ ), especially in the calves of patients with persistent symptoms, while changes in patients with improvement showed no significant changes.

**Conclusion:** Quantitative MRI might be useful as a quantitative tool to confirm operative success. Future larger trials should be performed to confirm our findings.

PO27

**Neuroimaging of ophthalmoplegia**

E. Pravata<sup>1</sup>, A. Cianfoni<sup>1</sup>, C. Colosimo<sup>2</sup>, J. R. Hesselink<sup>3</sup>; <sup>1</sup>Lugano, <sup>2</sup>Rome/IT, <sup>3</sup>San Diego/US

**Learning Objectives:** To outline the different categories of diseases encountered in patients with ophthalmoplegia, based on their location along the oculomotor pathways, and the most appropriate imaging for the given scenarios. And to cover basic anatomical and clinical concepts about ophthalmoplegia, to help understand pathophysiology of ophthalmoplegia and to provide the neuroradiologist with the necessary knowledge to discuss clinical cases with the referring clinician.

**This abstract has been withdrawn**

PO28

**Radiolucent lesions of the mandible:****How to make the correct diagnosis**

R. Kohler, L. Avril, A. Terzic, B. Imholz, P. Scolozzi, T. Lombardi, M. Becker; Genève

**Learning Objectives:** After reading this poster, the reader will be able to:

1. provide a differential diagnosis for radiolucent mandibular lesions on the basis of their clinical presentation, location, and morphologic features.
2. describe the characteristic imaging findings in common and less common entities
3. identify those lesions where biopsy is indicated for definitive histology

**Background:** A variety of radiolucent mandibular lesions seen on orthopantomography develop from both odontogenic and nonodontogenic structures. They represent a broad spectrum of lesions with a varying degree of malignant potential. The purpose of this educational poster is to review the clinical presentation, the imaging findings and the histological features of common and uncommon radiolucent mandibular lesions and to provide a systematic approach for the differential diagnosis.

**Imaging Findings or Procedure Details:** The clinical presentation, characteristic imaging findings and histology of a variety of radiolucent mandibular lesions are discussed including periapical cysts, follicular (dentigerous) cysts, odontogenic keratocystic tumors, solitary bone cysts, Stafne cysts, ameloblastomas, Pindborg tumors, osteoblastomas, histiocytosis, focal osteomyelitis, osteonecrosis, intraosseous squamous cell carcinoma, mucoepidermoid carcinoma and metastases. Special emphasis is put on all considerations to make the correct diagnosis, such as patient age, lesion prevalence, location within the mandible, relationship to dental structures, border contour, effect on adjacent structures and characteristic findings at CT, cone beam CT and MRI.

**Conclusion:** Knowledge of the characteristic features of radiolucent mandibular lesions enables a correct diagnosis in most cases and is crucial for the identification of those lesions where biopsy is indicated for definitive histology.

PO29

**Liliequist membrane anatomy and development of suprasellar cysts**

J. Forget, R. A. Meuli, P. Hagmann, P. Maeder; Lausanne

**Learning Objectives:** A knowledge of the radio-anatomy of Liliequist Membrane (LM) allows a better understanding of suprasellar cysts development and can improve the outcome of surgical endoscopic ventriculostomy.

**Background:** LM is a remnant of the medial part of primary tentorium cerebelli, located under the floor of the 3d ventricle between dorsum sellae, mammillary bodies and pons. It separates the interpeduncular, prepontic and chiasmatic cisterns. Arachnoid membranes at this location are highly variable as LM can consist of one or two leaves, or be absent. Suprasellar cysts develop within the membrane or between the two leaves, leading to various kinds of cysts. In addition the presence of an imperforated membrane can be the cause of unsuccessful ventriculocisternostomy.

**Imaging Findings or Procedure Details:** Sagittal T2 sequences or flow sequence are essential to visualize the CSF flow on post-operative MRI scans but not sufficient to visualize arachnoid membranes. Appropriate MRI examination of LM should include 3D Fourier transformation constructive interference in steady state (CISS) to determine the exact anatomy and particularly to visualize if the mesencephalic leaf has a free border or is imperforated. The position of the basilar trunk in respect to brainstem is a cue to distinguish between cysts developing between two leaves or intraarachnoid cysts developing within the diencephalic leaf.

**Conclusion:** The choice of appropriate neuroimaging techniques allows determining the etiology of suprasellar cysts due to imperforated LMs. MRI evaluation should always include 3D CISS sequences to fully visualize the LM and TSE or flow sequences to attest the fenestration of both 3d ventricle's floor and LM.

PO30

**CT brain perfusion for acute stroke**

T. Bader; Luzern

**Learning Objectives:** This poster shows experiences with CT perfusion for acute stroke in our department.

**Background:** Acute stroke is a complex diagnostic challenge occurring on a daily basis in our department. After ruling out hemorrhage and demarcated areas of old ischemic defects with nonenhanced computed tomography (CT) it is important to identify acute vessel occlusion and areas of decreased perfusion in brain tissue. For the former, CT angiography is usually used. For the latter CT perfusion imaging and Magnetic Resonance Imaging (MRI) perfusion are the only two options. As time is the "brain tissue saving factor" and MRI is time-consuming and not always immediately available in our department, we decided to perform CT perfusion for patients who are considered for thrombolytic therapy.

**Imaging Findings or Procedure Details:** Most important parameters in CT perfusion are mean transit time (MTT) and cerebral blood volume (CBV). MTT is most sensitive for ischemic areas, with an increased MTT in ischemic areas. CBV indicates the core of an ischemic area or an old brain defect (e.g. after infarction) if it is explicitly reduced.

**Conclusion:** CT perfusion is an important tool in the diagnosis of acute stroke.

PO31

### Assessing brain activity with f-MRI during observation (active and passive) and mental imagery of different postural tasks

W. Taube, M. Keller, M. Mouthon, C. Leukel, J.-M. Annoni, H.-M. Hoogewoud; Fribourg

**Purpose:** After immobilization, patients show impaired postural control and increased risk of falling. Previous studies assessing behavioral changes showed that imaginary balance training during the period of immobilization improved balance in elderly people. This study focuses on brain activity during imagination as well as observation of different postural tasks.

**Methods and Materials:** fMRI scans were obtained on 16 healthy volunteers on a 3T GE scanner in three conditions: a) mental imagery, b) active observation, or c) passive observation of a video displaying either i) a static (quiet standing) or ii) a dynamic (medio-lateral perturbation) postural task. During mental imagery (a), subjects had to imagine themselves either standing (i) or to mentally counteract a mediolateral perturbation (ii). In the active observation condition (b), subjects had to imagine being the person on the video whereas in the passive observation condition (c) they should simply watch.

**Results:** Mental imagery and active observation activated the putamen, the cerebellum, and the supplementary motor area (SMA). For the SMA and the cerebellum, the activity was generally higher in the perturbation condition than during stable stance. Passive observation did not significantly activate cerebellum, putamen or SMA.

**Conclusion:** Our results propose that I) motor imagery and active motor observation activate brain regions important for balance control, whereas passive watching does not II) subjects display higher brain activation in the more challenging postural task. Best training effects should be expected when subjects imagine or actively observe challenging postural tasks.

PO32

### Fetal brain MR and US-imaging correlation in prenatal and postnatal studies

M. Hauser<sup>1</sup>, P. Hagmann<sup>2</sup>, L. Alamo<sup>2</sup>, R. Meuli<sup>2</sup>, P. Maeder<sup>2</sup>; <sup>1</sup>Genève, <sup>2</sup>Lausanne

**Purpose:** The aim of our study is to review the indications for fetal brain MR imaging and to correlate the MRI findings with the 20 weeks morphologic ultrasound examination and post-natal brain imaging when available. We want also to estimate how the fetal brain MRI findings have influenced the management and outcome of the pregnancy and child.

**Methods and Materials:** This is a retrospective study of all fetal brain MRI done in our institution (CHUV, Lausanne) over 12 years since the beginning of routine use of this technique. We will monitor the stage of the pregnancy at the time of MRI and review all the fetal brain images obtained for quality, biometrics and abnormalities. A comparison will be done with the ultrasound report. The postnatal MRI or eventual autopsy data when available will be compared with the prenatal images.

**Results:** 68 fetal MRI in 70 fetuses. Good correlation rate of between MRI and US findings. 8 post natal MRI.

**Conclusion:** Since last 15–20 years, prenatal ultrasonography is the standard examination to monitor pregnancy but MRI indication to confirm potentially serious anomalies and find out occult pathologies is more and more frequent. The relatively narrow time window between the 20 weeks ultrasound and the 24 weeks Swiss deadline for therapeutic abortion puts some pressure on MRI quality and reliability at a relatively early stage of fetal development.

In case of complement of the pregnancy, MRI is also helpful to prepare the neonatologist and the parents to the specific needs of the child.

PO33

### Diffusion tensor imaging and tractography of the trigeminal nerve: Feasibility and first clinical applications

L. Avril, C.-T. Pham, R. Kohler, M.-I. Vargas, A. Terzic, S. Haller, K.-O. Lövsblad, M. Viallon, M. Becker; Genève

**Purpose:** To assess the feasibility and potential clinical applications of diffusion tensor imaging (DTI) and tractography in the normal and pathologic trigeminal nerve.

**Methods and Materials:** Fifty-two patients with unilateral trigeminal nerve impairment underwent 3T MRI with high-resolution anatomic sequences and with additional DTI. Symptoms included neuralgia (n=21), hypoesthesia (n=7), dysesthesia (n=7) and trigeminal pain (n=15). Maps of fractional anisotropy (FA) and tractography of the cisternal portion, Gasserian ganglion, ophthalmic (V1), maxillary (V2) and mandibular (V3) divisions were obtained. The DTI images of the 52 symptomatic and 52 normal, contralateral trigeminal nerves were evaluated by two experienced readers.

**Results:** Tractography was of good quality and clearly delineated the intracranial trigeminal nerve (cisternal portion and Meckel's cave) in all 104 nerves. Regarding the extracranial branches, due to field inhomogeneity and small nerve size, tractography was feasible in 98% of V3, 44% of V2, and only in 4% of V1. Tractography revealed fiber-displacement in neuro-vascular conflicts and benign tumors (n=34), fiber-displacement and encasement in osteomyelitis and adenoid cystic carcinoma (n=11), and fiber-disruption in squamous cell carcinoma, sarcoma and adenoid-cystic carcinoma (n=7). In fiber-displacement±encasement, treatment was successful without sequelae. In fiber disruption, symptoms persisted after treatment.

**Conclusion:** DTI with tractography of the trigeminal nerve is routinely feasible in the cisternal portion, Meckel's cave and V3, partly feasible in V2 and rarely feasible in V1. It may reliably reveal displacement, encasement or disruption of fibers due to pathological processes located within or along the trigeminal nerve.

PO34

### Metal artifact reduction from dental hardware in carotid CT angiography using iterative reconstructions

F. Morsbach<sup>1</sup>, M. Wurnig<sup>1</sup>, D. Kunz<sup>1</sup>, A. Krauss<sup>2</sup>, B. Schmidt<sup>2</sup>, S. Kollias<sup>1</sup>, H. Alkadhi<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Forchheim/DE

**Purpose:** To determine the value of an algorithm for reduction of metal artifacts from dental hardware in patients undergoing carotid CT angiography using iterative reconstructions.

**Methods and Materials:** Twenty-four consecutive patients with dental hardware underwent contrast-enhanced carotid CT angiography using a 128-section dual-source CT machine. Datasets were reconstructed with standard filtered back projection (FBP) and using a metal artifact reduction algorithm employing normalization and a frequency split approach with iterative reconstructions (IFS). Three blinded, independent readers measured CT attenuation values in the internal carotid artery on axial source images at the level of the carotid bulb and at the level of the dental artifacts, and evaluated subjective image quality and degrees of artifacts on all datasets. Subjective image quality and artifact degree were additionally evaluated on multi-planar reformations (MPR) and maximal intensity projections (MIP) of the carotid arteries. Statistical analysis included student's t-test for paired samples and Wilcoxon signed-rank test.

**Results:** CT attenuation values of the internal carotid artery on images with metal artifacts were significantly higher in FBP datasets (324±104 HU) as compared to those reconstructed with IFS (278±114HU; P<0.001) or at the carotid bulb level on FBP images (293±106 HU; P=0.006). Image quality was rated by all readers higher on axial source-, MPR and MIP images. Readers found significantly less artifacts impairing diagnostic confidence of the internal carotid artery (P<0.05 each).

**Conclusion:** The MAR algorithm with iterative reconstructions allows for a significant reduction of artifacts and increased diagnostic confidence from dental hardware in carotid CT angiography. Also CT attenuation measurements are more accurate when using the algorithm.

## PO35

**Dynamic contrast enhancement magnetic resonance perfusion on the spinal cord and adjacent lesions**

*V. Cuvinciuc, M. Viallon, S. Haller, M. I. Vargas, D. Arditi, D. A. Djema, K.-O. Lövdahl; Genève*

**Purpose:** Demonstrate the feasibility and clinical utility of dynamic contrast enhancement (DCE) T1 magnetic resonance perfusion on the spinal cord and adjacent lesions.

**Methods and Materials:** We have performed DCE perfusion in 14 patients with various spinal cord and adjacent lesions, such as fibrillary astrocytoma, spinal cord glioblastoma, hemangioblastomas, meningiomas, schwannoma, bone metastases and benign compression fractures. T1 mapping was based on two T1 acquisitions with different flip angles. The dynamic acquisition was performed in a sagittal plane with a T1 VIBE sequence and temporal resolution of 9.5 seconds. The pharmacokinetic modeling is based on a two-compartment model that allows for calculation of permeability parameters ( $k^{trans}$ ,  $k_{ep}$ ), leakage space (volume of extracellular extravascular compartment –  $v_e$ ) and contrast volume within the region of interest (initial area under the curve – iAUC).

**Results:** The analysis of the normal spinal cord shows inter-patient reproducible values of DCE perfusion parameters (mean  $k^{trans} \approx 0.02 \text{ min}^{-1}$ , mean iAUC  $\approx 1.094 \text{ mM} \times \text{s}$ ). For meningiomas, mean  $k^{trans}$  values of  $0.134 \text{ min}^{-1}$  are similar to literature data for head meningiomas. Schwannoma seems to have higher  $k^{trans}$  values (mean  $0.505 \text{ min}^{-1}$ ). iAUC values are similar between schwannomas and meningiomas. Hemangioblastomas have highly elevated iAUC values ( $\approx 41.764 \text{ mM} \times \text{s}$ ), compatibles with their hypervascularity.

**Conclusion:** These initial results show the feasibility and potential clinical utility of DCE-MR perfusion of the spinal cord and adjacent lesions. This sequence, relatively easy to implement, offers a new insight into the pathology of a region difficult to explore with other quantitative imaging techniques.

## PO36

**Modulation of primary motor cortex activation in patients with tumors of the central region**

*M. Tozakidou<sup>1</sup>, H. Wenz<sup>2</sup>, J. Reinhardt<sup>1</sup>, E. Nennig<sup>2</sup>, K. Riffel<sup>2</sup>, M. Blatow<sup>1</sup>, C. Stippich<sup>1</sup>; <sup>1</sup>Basel, <sup>2</sup>Heidelberg/DE*

**Purpose:** To study changes in primary motor cortex (M1) activation in brain tumor patients.

**Methods and Materials:** We evaluated contra- and ipsilateral M1 activation in 87 patients with tumors of the central region using BOLD fMRI during unilateral voluntary movements of the contralesional hand. The results were compared to data obtained from 16 healthy volunteers.

**Results:** In volunteers M1 activation contralateral to the movement was dominant and weak M1-coactivation was observed. Brain tumors induced significant changes in 31 patients (36%) by means of reduction of contralateral M1 activation in 16 patients and equalization or inversion of M1 lateralisation to the ipsilateral hemisphere in 15 patients.

**Conclusion:** This study corroborates in a large patient group the idea that brain tumors affecting M1 lead to functional reorganization of cortical motor systems and in particular equalize hemispheric M1 lateralization. However, it is not yet clear whether these changes are only an epiphenomenon or reflect recovery of brain function.

## PO37

**Clinical language fMRI at 1.5T and 3T – A 12 year experience**

*A. J. de Vere-Tyndall, M. Blatow, J. Reinhardt, C. Stippich; Basel*

**Purpose:** Presurgical localization and lateralization of speech centers with fMRI has gained significant importance in brain tumor patients. We retrospectively assessed and compared the activation rates of speech centers at 1.5T and 3T over a twelve year period.

**Methods and Materials:** Activation rates of fMRI activation of Broca (B) and Wernicke (W), as well as their anatomical homologues in the right hemisphere (BR, WL) were assessed in 307 patients, using established covert and overt word and sentence generation paradigms\*. Significant activation was defined as present BOLD signal using an FDR of  $<0.05$ .

**Results:** 1197 speech paradigms were performed in 307 patients. 476 (39.8%) were performed at 1.5T and 721 (60.2%) at 3T field strength. 1147 paradigms (95.8%) showed significant BOLD-activation in at least one language center. 63% of patients showed significant activation in all 4 paradigms for Broca, 60% for Wernicke, 53% for BR and 41% for WR. At 1.5T, activation rates varied from 48% (WR, covert word generation) to 83% (Broca, covert sentence generation). At 3T activation rates ranged from 76% (WR, covert sentence generation) to 98% (Wernicke, overt word generation). With the exception of locating WR using covert sentence generation, activation rates were significantly higher at 3T compared to 1.5T.

**Conclusion:** With an overall activation rate of 95.8% standardized presurgical language fMRI provided very robust localization of essential language centers in a large cohort of brain tumor patients. When available language fMRI should be performed at 3T providing significantly better results compared to 1.5T.

\*Stippich et al., Radiology 2007

## PO38

**Brachial plexus MR imaging at 3 Tesla**

*X. Boulanger, J.-B. Ledoux, C. Beigelman; Lausanne*

**Learning Objectives:** To get familiar with technical aspects of brachial plexus MR imaging at 1.5 and 3T for optimal evaluation of non-traumatic and traumatic brachial plexopathies.

**Background:** MRI is today the modality of choice for the evaluation of brachial plexus (BP) because of its high resolution, multiplanar capabilities and excellent soft-tissue contrast. It is a particularly challenging topic in constant evolution that requires a thorough understanding of anatomic peculiarities as well as knowledge of normal and pathologic imaging appearance.

**Imaging Findings or Procedure Details:** Assessment of BP has been made until recently with 1.5T MR imaging. New 3T 3D sequences ensure an improvement in image quality in a shorter acquisition time compared to the standard 2D protocol with an isotropic resolution, this despite an increased RF field inhomogeneity. In addition, an improved fat suppression is obtained with STIR sequences. Assessment of BP may be obtained in optimal orientations and along its entire length by using adequate coils. A combined use of 3D T1 FSE and 3D T2 STIR sequences allows an optimal evaluation in less than 30 minutes. Gadolinium injection remains required for assessment of tumoral, infectious or inflammatory involvement. In case of traumatic plexopathy, 3D T2 W MR myelography allows a better visualization of pre and postganglionic nerve tracts injuries. The diffusion weighted neurography sequence with tractography could give additional information regarding possible displacement, infiltration or interruption of nerve tracts.

**Conclusion:** Nowadays 3T MR imaging with new 3D sequences improve the evaluation brachial plexopathies leading to a higher diagnostic confidence.



PO39

**The clinical and radiological presentation of swimming induced pulmonary edema***H. S. Grünig; Luzern*

**Learning Objectives:** The clinical and radiological presentation of swimming induced pulmonary edema (SIPE) is rarely reported and the pathophysiological mechanism is unknown. With this poster we would like to present the typical findings of SIPE.

**Background:** Working next to a well-known lake gives us the opportunity to document several cases of SIPE.

**Imaging Findings or Procedure Details:** The radiological findings of pulmonary edema in combination with acute onset of cough, shortness of breath and occasionally hemoptysis in well experienced swimmers is the typical presentation of SIPE. The clinical symptoms and classic pattern on the chest x-ray typically disappear between 24 to 48 hours.

**Conclusion:** The clinical and radiological presentation of SIPE is not well known and sometimes difficult to distinguish from pulmonary edema caused by aspiration or near-drowning. For the correct management of patients with breathing problems during swimming exercising, it's important to know the typical findings of SIPE.

PO40

**Pleural thickening interpretation guide***L. Perrin, C. Beigelmann; Lausanne*

**Learning Objectives:** Learning Objectives: to recognize typical pleural plaques as well as pitfalls and differential diagnosis.

**Background:** Typical pleural plaques are related to asbestos exposure.

**Imaging Findings or Procedure Details:** Their recognition has a crucial socio-economical importance and this requires the exact knowledge of the complex anatomy of the pleural space. The possibility of dependent pleural thickening simulating plaques must be known. In addition, there are several significant differential diagnosis that may mimic pleural plaques. This includes environmental diseases as silicosis, but also sarcoidosis or more severe lesions, especially pleural metastases. Peculiar parenchymal anomalies adjacent to pleural thickening will help to recognize involvement of the visceral pleura. The latter is not specific of asbestos exposure and will be related to a history of tuberculosis or any history of pleural effusion.

PO41

**Miliary tuberculosis: The difference in HRCT findings in HIV-seropositive and HIV-seronegative patients in a rural Indian setting***S. V. Kashikar, A. K. A. Bari, A. A. Sachan; Wardha/IN*

**Purpose:** We retrospectively reviewed the HRCT findings of 20 HIV-seropositive and 20 HIV-seronegative patients with miliary tuberculosis. We aimed to compare the radiological differences in HRCT findings of miliary tuberculosis in patients with and without HIV infection.

**Methods and Materials:** This study was done to compare the CT findings of miliary TB in patients with and without HIV infection and to analyze any correlation between the CT features and the level of immunosuppression in patients. 14 men and 6 women (age range 26–60 years) were seropositive. They all had a positive result from a Western blot or enzyme-linked immunosorbent assay (ELISA) for HIV. The control group consisted of 20 patients (9 men and 11 women) with miliary TB with HIV-seronegative status from a Western blot or ELISA (age range, 20–68 years). All patients (HIV-seropositive and –seronegative patients) with randomly distributed small and micronodules in both lungs were included in this study.

**Results:** The CT findings of interlobular septal thickening ( $p=0.003$ ), grade 1 ground-glass opacity ( $p=0.018$ ) and extrathoracic involvement ( $p=0.007$ ) were more prevalent in the HIV-seropositive patients. Cavitation ( $p=0.002$ ) and large nodules ( $p=0.03$ ) were less commonly seen in the seropositive patients.

**Conclusion:** In conclusion, an earlier diagnosis of immune status in patients with miliary tuberculosis can be reached by recognizing the differences in the radiological findings between HIV-seropositive and seronegative patients and thus help to initiate prompt treatment.

PO42

**CT-perfusion in lung cancer: Relation of perfusion parameters to tumor type and clinical tumor stage***M. Hüllner<sup>1</sup>, T. Collen<sup>2</sup>, K. Strobel<sup>2</sup>, P. Gut<sup>2</sup>, P. Veit-Haibach<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Luzern*

**Purpose:** To investigate the relation of tumor type and clinical tumor stage to CT-perfusion (CTP) parameters (blood flow (BF), blood volume (BV), mean transit time (MTT) in patients with lung cancer.

**Methods and Materials:** Fifty-four patients (median age 65 years, range 42 to 79 years, 12 female, 42 male) with suspected lung cancer were referred for baseline staging PET/CT. A CTP scan of the lung tumor was performed, and post-processed with a commercially available perfusion software. BF, BV, and MTT of the tumor tissue were calculated and compared by non-parametric tests depending on tumor type and clinical tumor stage.

**Results:** According to biopsy, 5 patients had a SCLC, 40 NSCLC (23 adenocarcinoma (AC), 9 squamous cell carcinoma (SCC), 7 large cell carcinoma (LCC), 1 neuroendocrine carcinoma and 9 patients had non-neoplastic lesions. The clinical tumor stage was T1 in 8 patients, T2 in 26, T3 in 5 and T4 in 6. Mean BF, BV and MTT in NSCLC/SCLC was 35.9/35.5 mL/100 mL\*min<sup>-1</sup>, 8.5/8.6 mL/100 mL, and 14.1/12.4 s. These differences were statistically not significant. Mean BF, BV and MTT in NSCLC subtypes AC/SCC/LCC was 31.9/30.5/56.9 mL/100 mL\*min<sup>-1</sup>, 9.3/5.3/9.9 mL/100 mL, and 14.1/16.3 /11.8 s. The difference of BF in NSCLC subtypes was statistically significant ( $p=0.048$ ). Mean BF, BV and MTT in stage T1/T2/T3/T4 was 33.8/37.8/25.7/32.3 mL/100 mL\*min<sup>-1</sup>, 7.7/7.3/6.9/8.4 mL/100 mL, and 14.3/13.7/15.0/15.9 s. These differences were statistically not significant.

**Conclusion:** CTP might be able to discriminate between poorly differentiated LCC and other tumor types. CTP is not affected by tumor size or location as expressed by T stage.

PO43

**Comparison of CT dose and image quality with filtered back projection, iterative reconstruction and CT with a new detector with minimal electronic noise***A. Christe<sup>1</sup>, J. Heverhagen<sup>1</sup>, C. Ozdoba<sup>1</sup>, C. Weisstanner<sup>1</sup>, S. Ulzheimer<sup>2</sup>, L. Ebner<sup>1</sup>; <sup>1</sup>Bern, <sup>2</sup>Forchheim/DE*

**Purpose:** Compare the dependency of dose and image quality in the last three generations of CT scanners. What is the dose or image noise reduction of the new CT-scanners?

**Methods and Materials:** A lung phantom Chest Phantom N1 by Kyoto Kagaku was scanned with 3 different CT scanners: Somatom Sensation, Definition Flash and Edge (all by Siemens, Erlangen, Germany). The scan parameters were kept identical to the Siemens presetting for THORAX ROUTINE, scan length 35 cm, FOV 33 cm. Nine different exposure levels were examined (reference mAs/peak voltage): **100/120, 100/100, 100/80, 50/120, 50/100, 50/80, 25/120, 25/100 and 25 mAs/80 kVp**. Signal, contrast, noise and subjective image quality were recorded by two different radiologists with 10 and 3 years experience in chest CT radiology. Curves were fitted through graphic points of noise and dose-length-product. To determine the average dose reduction between two scanners the integral of the dose difference was calculated from the lowest to the highest noise level.

**Results:** Using iterative reconstruction (IR) instead of filtered back projection (FBP) the average dose reduction was 29.7%, 49.7% and 75.9% for imaging bone, soft tissue and air for the same image quality ( $p$ -value < 0.0001). The recently introduced Stellar detector lowered radiation dose additionally by 27.3%, 60.1% and 67.9% for bone, soft tissue and air, respectively ( $p$ -value < 0.0001). The benefit of dose reduction is much bigger on the low dose levels.

**Conclusion:** This study demonstrated a dose reduction between 30% and 75% applying the new Stellar detector, which equals the dose reduction using IR instead of FBP.

## PO44

**Value of morphological magnetic resonance imaging for lung nodule detection in high-risk populations:  
Comparison to low-dose computed tomography**

G. Sommer<sup>1</sup>, J. Tremper<sup>2</sup>, M. Koenigkam-Santos<sup>2</sup>, S. Delorme<sup>2</sup>, N. Becker<sup>2</sup>, J. Biederer<sup>2</sup>, H.-U. Kauczor<sup>2</sup>, C.-P. Heussel<sup>2</sup>, H.-P. Schlemmer<sup>2</sup>, M. Puderbach<sup>2</sup>; <sup>1</sup>Basel, <sup>2</sup>Heidelberg/DE

**Purpose:** CT screening for lung cancer is fraught with the risks of ionizing radiation and generates a considerable amount of false positive findings. This study investigates the potential of MRI for detection of lung nodules in a high-risk population in comparison to low-dose CT.

**Methods and Materials:** Forty-six participants of the German Lung Cancer Screening and Intervention Trial (LUSI) who showed a cancer-suspicious lung lesion in CT (diameter  $\geq 10$  mm or volume doubling time  $\leq 400$  d) were examined with non-contrast-enhanced breath-hold MRI of the lung at 1.5T including T2w ss-TSE, T1w 3D-GRE and bSSFP sequences. Gold standard was either histology or long-term follow-up. Data were mixed randomly with equally structured datasets from 30 healthy volunteers and read by two radiologists in a blinded fashion. Sensitivity and specificity for the presence of nodules were calculated. Contrast-to-Noise-Ratio (CNR) was measured for all MRI sequences and detected lesions.

Results:		Lesion present		
		Yes (CT positive)	No (CT neg. + volunteers)	Total
Lesion detected by MRI (Reader 1/Reader 2)	Yes	24/23	5/3	29/26
	No	25/26	28/30	53/56
	Total	49	33	82

Overall sensitivity and specificity were 48% and 88%. Sensitivities were equal for nodules larger or smaller than 1cm (49% vs. 46%). Sensitivity was higher for malignant nodules than for benign ones (75% vs. 35%). Malignant nodules were slightly larger than benign ones (mean diameter 18 mm vs. 14 mm). Inter observer agreement was 87% ( $\kappa=0.7$ ). Lesion-to-background CNR was highest for T2w ss-TSE ( $75 \pm 34$ ) followed by T1w 3D-GRE ( $50 \pm 41$ ) and bSSFP ( $34 \pm 20$ ).

**Conclusion:** MRI has lower overall sensitivity for pulmonary nodules than low-dose CT and thus is not a screening tool today. It appears, however, that benign nodules are less conspicuous in MRI than malignant ones.

## PO45

**The evolution of forensic radiology**

*T. D. Ruder<sup>1</sup>, M. Baglivo<sup>2</sup>, S. Winklhofer<sup>1</sup>, G. M. Hatch<sup>3</sup>, G. Ampanozi<sup>1</sup>, M. Thali<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>St. Gallen, <sup>3</sup>Albuquerque/US*

**Learning Objectives:** It was the aim of this poster to illustrate the evolution of published literature in the field of post-mortem and forensic radiology, determine what technology is most widely used, identify primary research topics and uncover areas where the evidence basis for post-mortem and forensic radiology is lacking.

**Background:** The field of forensic radiology has undergone rapid expansion in the last decade and some practitioners suggest it is and should become a distinct sub-specialty of radiology and forensic medicine

**Imaging Findings or Procedure Details:** Publications related to post-mortem and forensic radiology experienced a tenfold increase over the last 10 years. The majority of all publications focused on the documentation of injury or disease and identification of human remains. Computed tomography (CT) is chiefly used to investigate traumatic injury, magnetic resonance (MR) to assess cardio-vascular and cerebral disease, and radiographs to identify human remains. Other techniques are only rarely used. Over 40 countries worldwide contributed to the field during the study period.

**Conclusion:** The number of scientific publications on forensic and post-mortem radiology grew significantly between the year 2000 and 2011. During this decade, forensic and post-mortem radiology rose from an obscure topic to a relevant field in the forensic sciences.

## PO46

**Image quality comparison between standard and low dose protocol for head CT**

*S. V. Kashikar, A. K. A. Bari, A. A. Sachan; Wardha/IN*

**Purpose:** The increasing use of ionizing radiation poses considerable hazards for patients being evaluated for neurological disease. Our objective was to compare the image quality of head CT scans using low mAs with that of conventional scans.

**Methods and Materials:** Standard protocol non-enhanced head CT scans were obtained in 50 patients (all >65 years with history of headache) by using a multidetector technique: 170 mA and 1-second scanning time (ie, 170 mAs), 140 kVp, table speed of 7.5 mm per rotation, pitch of 0.75, section thickness of 5 mm, and field of view of 25 mm. Another limited volume helical data acquisition covering four 5-mm-thick images was obtained by using 90 mAs (the other parameters remaining constant). The resulting images were visually rated for quality in a blinded comparison. Conspicuity and the contrast-to-noise ratio were analyzed in 1- to 4-mm<sup>2</sup> regions of interest in gray matter and white matter locations. Statistical comparisons were done by using the Student t test.

**Results:** There was no significant difference in mean gray matter conspicuity between the 170- and 90-mAs groups. Mean gray matter contrast-to-noise ratio was approximately 19% higher with 170 mAs than with 90 mAs. Slightly greater image noise was seen in all 90-mAs images than the 170-mAs scans but with sufficient perceived resolution.

**Conclusion:** With moderate increase in noise in 90-mAs head CT scanning, radiologists found them to have acceptable diagnostic quality.

## PO47

**Emergency usage in multiple injured patients: Changing the role of imaging**

*R. E. Bolt<sup>1</sup>, J. Hohmann<sup>1</sup>, S. Shamdasani<sup>1</sup>, M. Jakob<sup>1</sup>, A. L. Jacob<sup>1</sup>, G. Bongartz<sup>1</sup>, T. Gross<sup>2</sup>, D. Bilecen<sup>3</sup>, R. Hügli<sup>3</sup>, W. Ummerhofer<sup>1</sup>; <sup>1</sup>Basel, <sup>2</sup>Aarau, <sup>3</sup>Bruderholz*

**Purpose:** The aim of this study was to establish the amount of time gained in the process of diagnosing or excluding serious injuries with the use of a CT scanner located in the emergency room as compared to the traditional work up of a multiple injured patient with a CT scanner in a separate location.

**Methods and Materials:** All patients included into this study received whole body CT scans. We compared two groups of patients: one group was diagnosed in the multifunctional image guided therapy suite (MIGTS) with an integrated multi slice spiral CT (MSCT), the other group was first diagnosed in the designated trauma room for severely injured patients in the emergency ward and transported to a MSCT in the radiology department. The patients were randomized into one of these groups before starting the diagnostic procedure.

**Results:** The imaging of all areas is significantly faster in the MIGTS. There were a significant shorter times for both the diagnosis and the exclusion of injuries especially for the neurocranium. The exclusion of an injury of the pelvis seems easier than the correct diagnosis of an injury. The evaluation of the spine is the most time consuming part.

**Conclusion:** In conclusion this study suggests that the integration of a CT into the emergency room significantly shortens the time for diagnoses in multiple injured patients. In addition Ad-hoc treatments with minimal invasive interventional procedures are also possible.

## PO49

**Quality improvement model in radiology: Private experience**

*T. Laswad, D. Fournier, J. Moreau; Sion*

**Purpose:** (a) set up a quality control model with key performance indicators (KPIs) (b) to analyze the patients flow chain in our radiology clinic to detect bottle necks (c) Monitor the productivity, professional outcome and customers satisfaction; (d) set up a principle of quality assurance and future continuous quality improvement.

**Methods and Materials:** Methods: 1. Lean method, 2. Six sigma principle, 3. Quality assurance (QA), 4. Continuous quality improvement (CQI); **Data collection:** 1. Patients Flow Chain "Main Stream Mapping", 2. Productivity Analysis, 3. Customer Satisfaction, 4. Professional Outcome Analysis

**Results:** 1. Patients Flow Chain Mapping showed big variation in CT, MRI and ultrasound examination time. The main route cause is absence of standard protocols. 2. There is an inefficiency in the finalization of the radiologic reports. Only 57% of cases are finalized within 24 hours. 3. Professional outcome analysis showed a nice success rate of shoulder injections (77%) and spinal injections (66%). 4. Customers satisfaction analysis showed decline in satisfaction about waiting time for CT and MRI exams.

**The following corrective actions have been undertaken:** 1. Engagement of all staff members, 2. Minimize variation by standardizing work, 3. Eliminate waste, 4. Keep lean and swiftly work flow, 5. Anticipation, 6. Future trends, innovation, 7. Customers perspective.

**Results of execution:**

CT	Before	After	%
Time	38.09	28.75	-24.5%
SD	20.37	11.48	-34.7%

MRI	Before	After	%
Time	27.99	22.44	-19.8%
SD	17.15	13.94	-18.5%

**Conclusion:** This project has allowed us to: 1. Become familiar with the principles of quality and quality improvement methodologies. 2. To better understand our internal processes. 3. Identify bottle necks. 4. Smooth work flow. 5. Improve performance

## PO50

**Clinical CT imaging: Patient exposure can be reduced through the adoption of advanced data acquisition and processing**

*M. Kinzel<sup>1</sup>, T. Betschart<sup>1</sup>, T. Schenkel<sup>1</sup>, M. Hentschel<sup>2</sup>, T. Beyer<sup>1</sup>, T. Jung<sup>1</sup>;  
<sup>1</sup>Zürich, <sup>2</sup>Bern*

**Purpose:** CT imaging contributes to ~10% of patient examinations involving ionizing radiation while accounting for ~60% of the effective dose per capita. We retrospectively compare average patient exposure from CT before and after adopting CT technology updates.

**Methods and Materials:** We analyzed 100 consecutive CT (Siemens Somatom Definition AS128) data sets each for scans (01/2009–11/2012) of the head, thorax and abdomen (BAG-categories 1+2, 8+9+10 and 13). Analysis was performed for 3 patient groups:

(G1) – initial scan protocols,

(G2) – as (G1) with Care-kV option, and

(G3) – as (G2) with iterative image reconstruction.

Care-kV automatically adapts X-ray tube voltages to each patient for dose optimization. The image reconstruction used in (G3) is a sinogram-affirmed iterative algorithm (SAFIRE) rather than standard filtered back-projection. We report the mean ( $\pm$ SD) of the DLP and CTDIvol for each anatomic region and patient group using DICOM-documented CT dose levels.

**Results:** Mean DLP [mGy\*cm] for the head, thorax and abdomen in (G1) was (1009 $\pm$ 85), (285 $\pm$ 149) and (443 $\pm$ 162), respectively. Mean DLP in (G2) was reduced by 4%, –20% and 16%, respectively. Mean DLP in (G3) was reduced by 14%, 31% and 38%, respectively compared to (G1). A similar trend was observed for CTDIvol. The observed initial increase in patient exposure in (G2, thorax), in particular, indicates the need to carefully adjust and choose acquisition parameters.

**Conclusion:** We demonstrate a clinical potential for generally reduced patient exposure through the adaptation of tube voltage and iterative image reconstruction, in addition to basic radiation safety measures, such as tube current modulation.

PO51

**Reading tea leaves with MR**

*T. D. Ruder<sup>1</sup>, H. J. A. Crooijmans<sup>2</sup>, D. Gascho<sup>1</sup>, N. Schwendener<sup>3</sup>, G. M. Hatch<sup>4</sup>, M. Thali<sup>1</sup>, E. Hefti<sup>3</sup>, W. Schweitzer<sup>1</sup>; <sup>1</sup>Zürich, <sup>2</sup>Basel, <sup>3</sup>Bern, <sup>4</sup>Albuquerque/US*

**Learning Objectives:** The objective of this presentation is to illustrate how radiologists can benefit from drinking weak black tea in order to relax from work related stress.

**Background:** The daily workload of radiologists is constantly increasing and the job is becoming more and more stressful. It is therefore vital that radiologists are able to relax during their time off work. To have a cup of tea is thought to be relaxing. However, the relaxation provided by tea and the influence of tea strength on relaxation time has to this date not been determined scientifically.

**Imaging Findings or Procedure Details:** Several cups of black tea at concentrations of 1.5 Tea, 3.0 Tea, and 7.0 Tea were scanned on a 3.0T MR Unit using T1- and T2-weighted sequences. To stir the tea prior to imaging we acquired a STIR (Short Tau Inversion Recovery) sequence. On T2-weighted images, the MR signal of tea was highest at 1.5 Tea and lowest at 7.0 Tea. The inverse was observed on T1-weighted images. Weak tea has longer relaxation times than strong tea. T-test revealed that the differences between the signal intensities at 1.5 Tea, 3.0 Tea and 7.0 Tea were statistically significant.

**Conclusion:** MR is able to read tea leaves and provides a suitable technique to differentiate weak tea from strong tea. Tea strength does have a significant influence on the relaxation times of tea. Our findings suggest that radiologists should drink weak tea to reduce stress and maximize their feeling of relaxation during work breaks.

PO52

**Potential of optimization of CR- and DR- units**

*S. Scheidegger<sup>1</sup>, K. Haller<sup>2</sup>, B. Markert<sup>2</sup>, H. Güdel<sup>3</sup>, L. D. A. Vieira<sup>2</sup>, G. Lutters<sup>2</sup>; <sup>1</sup>Winterthur, <sup>2</sup>Aarau, <sup>3</sup>Villigen*

**Purpose:** Regarding the development of new X-ray sensor technology in the last two decades, the potential for optimization of CR- and DR-units should be explored. In contrast to conventional film-screen systems, digital detectors deliver electronic images which can be modified by using image filters or processed to reach an optimal representation of grey scales.

**Methods and Materials:** To investigate the potential for optimization, an Alderson phantom (pelvis region) was used to determine image quality (qualitative judging, MTF, SNR, CNR). The determination of the image quality parameters was done with MatLab and ImageJ. The entrance dose was measured with an iba RQA-detector.

**Results:** For the tested CR- and DR-systems and image of pelvis, the entrance dose can be reduced significantly (2.02 mGy down to 0.75 mGy for CR-System and 1 mGy to 0.25 mGy for DR-System) by using a tube voltage of 90 kV instead of 73 kV (CR) and 81 kV (DR). Increasing tube voltages below 100 kV allows maintaining image quality at reduced entrance dose.

**Conclusion:** The results clearly show a potential for optimizing image quality and radiation exposure by increasing tube voltages. Since units of different manufacturers show different behavior regarding dose response and image quality, an adapted optimization process relying sensor technology, image processing and anatomical region should be established for digital X-ray units in clinical use.

PO53

**CTDI measurements for clinical protocols and comparison to CTDI indications of CTs**

*L. D. A. Vieira<sup>1</sup>, B. Markert<sup>1</sup>, S. Scheidegger<sup>2</sup>; <sup>1</sup>Aarau, <sup>2</sup>Winterthur*

**Purpose:** Recent development of CT technologies leads to several constraints for CTDI-measurements for clinical protocols (helical mode, overranging and overbeaming). Standard method for access CTDI from protocols cannot be applied properly. Besides this problem, measuring Dose Length Product (DLP) in clinical mode can be used to evaluate protocols. An important question is referring the comparability of indicated CTDI (CT unit readout; CTDI<sub>ind</sub>) to dose values evaluated from DLP measurements under clinical conditions.

**Methods and Materials:** To perform the DLP measurements, a standard phantom (32 / 16cm) and an ionization chamber (DCT-10) connected to a dosimeter Dosimax plus A HV from IBADosimetry was used. DLP was read for four clinical protocols (Thorax, Abdomen, Pelvis and Head) at different positions. The automatic exposure was turned on. Gafchromic film (XR-CT2, ISP) were used to access the axial dose profile including overranging in helical mode.

**Results:** Comparing measured dose values (CTDI<sub>meas</sub>) and CTDI<sub>DRL</sub>, 10% (thorax), 20% (abdomen), 30% (pelvis) and 80% (head) exceed 75-percentil and 50%, 10%, 40% and 0% are below 25-percentil of Dose Reference Levels (BAG). Regarding the difference between maximal and minimal normalized deviations between CTDI<sub>ind</sub> and CTDI<sub>meas</sub>, we have 79%, 91%, 65% and 156%. Up to 40% of the cases, deviation is outside 30% (allowed range for DLP-calibration).

**Conclusion:** A significant number of institutions has a high CTDI deviation. Head protocols are the most dramatic cases. DLP in combination with axial dose profile seems to be the choice to solve the standard CTDI phantom problem. Much more effort is needed to access patient exposure.

PO54

**Material differentiation in forensic radiology with single-source dual-energy computed tomography**

*T. D. Ruder<sup>1</sup>, Y. Thali<sup>2</sup>, S. Bolliger<sup>3</sup>, S. Mathier<sup>2</sup>, M. Thali<sup>1</sup>, G. M. Hatch<sup>4</sup>, S. Schindera<sup>5</sup>; <sup>1</sup>Zürich, <sup>2</sup>Bern, <sup>3</sup>Aarau, <sup>4</sup>Albuquerque/US, <sup>5</sup>Basel*

**Purpose:** The goal of this study was to investigate the value of dual-energy computed tomography (CT) to differentiate frequently encountered foreign materials on CT images using a standard single-source CT scanner.

**Methods and Materials:** We scanned 20 different, forensically relevant materials at two X-ray energy levels (80 kVp and 130 kVp) on CT. CT values were measured in each object at both energy levels. Analysis of variance (ANOVA) was performed to assess significance levels between X-ray attenuation at 80 kVp and 130 kVp. T-test was used to investigate significance levels between mean HU values of individual object pairings at single energy levels of 80 kVp and 130 kVp respectively.

**Results:** ANOVA revealed that the difference in attenuation between beam energies of 80 kVp compared to 130 kVp was statistically significant ( $p < 0.005$ ) for all materials except brass and lead. T-test showed that using single energy levels of 80 kVp and 130 kVp respectively 181/190 objects pairs could be differentiated from one another based on HU measurements. Using the combined information from both energy levels, 189/190 object pairs could be differentiated.

**Conclusion:** Scanning with different energy levels is a simple way to apply dual-energy technique on a regular single-energy CT and improves the ability to differentiate foreign bodies with CT, based on their attenuation values.



PO55

### MR imaging on a clinical 3T system of ex-vivo mouse joints with SPION uptake in an arthritis model using 3D difference ultrashort echo time images

L. A. Crowe<sup>1</sup>, M. Koenders<sup>2</sup>, E. Vermeij<sup>2</sup>, F. A. van de Loo<sup>2</sup>, A. Gramoun<sup>1</sup>, A. Petri-Fink<sup>3</sup>, H. Hofmann<sup>3</sup>, W. B. van Den Berg<sup>2</sup>, J.-P. Vallee<sup>1</sup>; <sup>1</sup>Genève, <sup>2</sup>Nijmegen/NL, <sup>3</sup>Lausanne

**Purpose:** Superparamagnetic iron oxide nanoparticles (SPION) accumulate in macrophages in the synovium of arthritic knees. We developed a 3D dUTE MRI protocol for multiple mice knee specimens on a clinical 3T for SPION detection in an antigen-induced-arthritis model.

**Methods and Materials:** Arthritis was induced in mice knees using a standard mBSA/CFA/inactivated Bordetella pertussis protocol. Knees were dissected at time points to day 7 after intra-articular (ia) or intravascular (iv, 1mg) amino-PVA-SPION injection (n=138, 3–6 per group). Arthritic and control samples were arranged in a wrist coil of a Siemens 3T clinical scanner, and imaged using 3D dUTE and T1-GRE sequences. SPION presence and quantitative scoring was assessed by blinded reading with ANOVA to compare groups.

**Results:** Accumulation of SPION in the synovium of arthritic knees was visible on both the T1-GRE and dUTE, the latter more efficient for quantification. In scoring T1-GRE, SPION is clearly seen in addition to “false positives” (vessels etc.) from other hypo intense signals making scores less consistent. These artifacts are suppressed by dUTE positive contrast with the subtraction. For dUTE, but not T1-GRE, the SPION uptake in the arthritic knee showed a difference between iv, contralateral, ia and no SPION ( $p < 0.05$ , Bonferroni ANOVA). Only after iv (not ia) was there a decrease in SPION between days 1 and 7.

**Conclusion:** dUTE was most efficient in quantifying small variations in SPION accumulation. We demonstrate a robust, easily implementable protocol for a clinical MR system for fast assessment of SPION uptake and macrophage activity in arthritic mouse knee specimens with potential for future studies.

PO56

### Custom stereoscopic lenticular printing of volumetric imaging

J. Spaltenstein, Genève

**Learning Objectives:** Volume rendering is increasingly used to visualize medical data. While shading and perspective can be used to bring forth much of the three dimensional nature of an object being visualized, some depth information remains harder to perceive. For example, in CT angiography of the brain, the full network of arterial vasculature remains difficult to fully appreciate from a static volume rendering. Stereoscopic lenticular printing overcomes this limitation and allows the full depth of images to become immediately clear to the observer. This inexpensive technology allows for much better communication of anatomical structures in contexts where digital media is cumbersome and printed media more desirable.

**Background:** Stereoscopic lenticular printing, a relatively old technology, requires quality 3D digital models, extremely high precision printing, and carefully extruded lenticular lenses. The availability of the Open Source OsiriX DICOM workstation, modern consumer grade inkjet printers with astonishing resolution, and new plastic extrusion techniques have all come together to allow for a revival of this proven technology.

**Imaging Findings or Procedure Details:** Volumetric images are visualized in OsiriX using the volume rendering component. A bundle of images with appropriate parallax is then exported using a custom OsiriX plugin. The images in the resulting bundle can then be interlaced with custom software, and printed on high quality photo-paper using a consumer grade inkjet printer. A lenticular lens with an adhesive backing is then applied to the printed image.

**Conclusion:** Stereoscopic lenticular images provide a good medium to communicate intricate 3D structures in informal learning contexts such as poster presentations, small group classes, and patient consults.

## PO57

**The limping child-ages 0 to 5 years: Differential diagnosis and systematic imaging approach***G. Schweigmann, C. Kellenberger; Zürich*

**Learning Objectives:** To become familiar with the differential diagnosis of limping in the pediatric age group from 0 to 5 years. To define the role of current imaging modalities in diagnosing a child with a limp. To describe how to expand MRI Protocol in children with non-localized pain.

**Background:** Investigation of small children (ages 0–5 years) with a limp is a challenge. Examination starts with clinical evaluation focusing on presence of pain, history of trauma and signs of infection. Often localization of the pain is not possible. Choice of imaging modality and order of investigations vary according to the likely differential diagnosis.

**Imaging Findings or Procedure Details:** The imaging appearances of common causes of limping in children are presented and according to this the systematic imaging approach is shown. In a posttraumatic patient localized radiography is most appropriate. In a patient with no traumatic history and no suspicion for infection hip ultrasound is the initial study of choice. If ultrasound findings are negative radiography will be the next. If signs of infection are present MRI should be performed. In cases with undetermined location MRI can be used as a screening tool, performing a coronal STIR from lower thoracic spine to toe.

**Conclusion:** Differential diagnosis of the limping child is wide. Imaging approach depends on clinical data. In cases of undetermined location of origin MRI can serve as screening tool.

## PO58

**MRI in hip dysplasia: What are the pediatric orthopedic surgeon needs and how MRI influences his decision-making***E. Stranzinger, T. Dobrocky, A. Schankath, K. Ziebarth, A. Joeris, R. Wolf; Bern*

**Purpose:** To optimize and shorten the MR study to the needs of the pediatric orthopedic surgeons and to compare the decision-making based on MR-images and conventional radiographs.

**Methods and Materials:** 14 consecutive MR studies of the hips of 13 patients were included in the study (1–5 months of age). Two pediatric orthopedic surgeons evaluated all MR sequences for image quality, type of hip dysplasia and had to determine the management of the patient based on the MR images. Quality assessment based on a 1–5 point scale (1=not helpful, 2=insufficient, 3=neutral, 4=good, 5=excellent). For the type of hip dysplasia the Tönnis criteria were used (1–4). Conventional radiographs (n=11) were evaluated for the type of dysplasia and compared with MRI and management of the patient.

**Results:** Valuable sequences were: coronal planes: TIRM (4.6), T2 TSE (4.1). In axial planes: PD axial (4.75), DESS reformats (4.5). All sagittal sequences and most T1w images were not helpful for the orthopedic surgeons. Decision-making after conventional radiographs (n=11) was: surgical management in 5/11, conservative management in 6/11. The change of management occurred in 7/11 patients.

**Conclusion:** MRI was superior to conventional radiographs to confirm the position of the femoral head in the acetabulum. MRI changed in the majority of exams the type of management compared to conventional radiographs. MRI studies may be shortened to two sequences to image the dysplastic hip after treatment in a cast reliably. This may reduce the need of general anesthesia or sedation.

## PO59

**Comparative studies of dose in the practice of pediatric examinations requiring the fluoroscopy***F. Guignard, C. Elandoy, R. Meuli, F. Gudinchet; Lausanne*

**Purpose:** At first, the purpose of this study is to verify the impact of the technological evolution (change of installation) on the dose delivered during examinations requiring of the fluoroscopy. Secondly, it is necessary to compare the practices of two different sites equipped with the same installation.

**Methods and Materials:** The dose reports of 60 urinary cystography and 60 oesogastroduodenal transit are collected for two categories of children; one on from 0 to 1 years and the other one from 1 to 6 years. The time of scopie and the dose deposited on surface are retained as the parameters of comparison. The data are transferred in the form of graphs allowing a better overview.

**Results:** Graphs concerning the change of installation demonstrate a decrease at the level of time of scopie and the dose. Those concerning the practice do not demonstrate significant differences between sites. However, it appears some differences in the results obtained for the examinations of the first category.

**Conclusion:** The technological evolution at the level of the installations allows a clear improvement as for the delivered dose. As far as it is advisedly used. This study highlights hypotheses of elements explaining the variabilities, for example the excessive use of the grid in the small irradiated volumes.

## PO60

**Role and feasibility of magnetic resonance cholangiopancreatography in pediatric biliary and pancreatic pathologies***S. Toso, A. Kanavaki, E. Maturana, B. Wildhaber, M. Anooshravani-Dumont; Genève*

**Purpose:** To study feasibility and contribution of magnetic resonance cholangio-pancreatography (MRCP) in the work-up and management of congenital and acquired biliary as well as pancreatic pathologies in children.

**Methods and Materials:** We reviewed MRCP images of 37 patients aged between 29 days and 16 yrs. (21 boys and 16 girls) addressed for various clinical presentations such as cholestasis, trauma, tumor, clinical pancreatitis and hepatic transplantation. All patients had an initial ultrasound, followed by MRCP (Avento Siemens 1.5T). Some patients also had an abdominal CT and a few underwent percutaneous cholangiography or ERCP. MR sequences consisted of: T2 axial and coronal slices HASTE (3–5 mm), 2D HASTE (20–40 mm, breath-hold when possible), 3D FSE (1,2 mm free breathing and respiratory gating) with MIP reconstructions.

**Results:** MRCP was useful in the diagnosis of the following pathologies: liver transplants with biliary stenosis (10), choledocal cysts (10, three of which also had choledocolithiasis), sclerosing cholangitis (5), traumatic pancreatic or biliary lesions (2), abdominal neoplasms with biliary tract involvement (2), cystic fibrosis (1), pancreatitis (2), venous cavernomas with subsequent biliary compression (2), no anomalies (2), no contribution (1).

**Conclusion:** In children, biliary and pancreatic lesions are frequently diagnosed with advanced US techniques. Further investigation by MRCP, a non-invasive and non-irradiating tool with fast sequences, often with no contrast injection, presents a clear advantage in a more precise visualization of the entire biliary and pancreatic tract, hence allowing better management of their abnormalities and complications.

## PO61

**Ultrasound of the axillary arch muscle in children**

*P. Steiger, O. Bucher, E. Stranzinger; Bern*

**Purpose:** Unilateral or bilateral axillary masses in children are often of clinical concern for malignancies. Our review illustrates a normal variant of the axilla mimicking clinically an axillary mass.

**Methods and Materials:** Systematic review of our PACS and RIS with the keyword "axilla" and the modality "ultrasound" in children under 16 years of age from 1.12.2009 until 30.11.2012. 19 axillary ultrasound examinations in 16 patients (7m/9f, age 3 months to 15 years) were included. One patient was examined 2 and one patient 3 times. In 6 patients a prominent muscle was noted overlying the humeral head in an abducted position. The muscle diameter was measured in cm and compared with the contralateral side. In one patient photographs of the axilla were available.

**Results:** In 16 examinations a lymphadenopathy (n=5), abscess formation (n=5), seroma or hematoma (n=1) or lymphangioma (n=1) and no diagnosis (n=1) was found. In 4 patients (25%) a unilateral muscle variant and in 2 patients a bilateral muscle variant (axillary arch muscle) was noted. In one patient a duplication of the muscle was found. In 4 patients the muscle was larger than the contralateral side.

**Conclusion:** An axillary mass in children without other clinical complaints may be related to a normal variant, the axillary arch muscle. Ultrasound is the first modality of choice if imaging is required. Radiologists should be aware of this normal variant since no other workup is necessary in asymptomatic children.

PO71

### Cost-effectiveness of F-18-FDG PET and PET/CT in tumors other than lung cancer: A systematic review

G. Treglia<sup>1</sup>, S. Annunziata<sup>2</sup>, L. Ceriani<sup>1</sup>, L. Giovannella<sup>1</sup>; <sup>1</sup>Bellinzona, <sup>2</sup>Rome/IT

**Purpose:** Evidence-based data about the cost-effectiveness of F-18-FDG PET and PET/CT in lung cancer already exist. The aim of our study is to systematically review published data about the cost-effectiveness of F-18-FDG PET and PET/CT in tumors other than lung cancer.

**Methods and Materials:** A comprehensive literature search of studies published in PubMed/MEDLINE, Scopus and Embase databases through September 2012 was carried out. A search algorithm based on a combination of these terms was used: a) "PET" or "PET/CT" or "positron emission tomography" and b) "cost-effectiveness" or "cost-utility" or "cost-efficacy" or "technology assessment" or "HTA". Only cost-effectiveness or cost-utility analyses in English language were included. Exclusion criteria were: (a) articles not within the field of interest of this review; (b) review articles, editorials or letters, conference proceedings and (c) outcome evaluation studies, cost studies or health technology assessment reports. For each included study, information was collected concerning basic study, type of tumors evaluated, perspective/type of study, results, unit and comparison alternatives.

**Results:** Eighteen studies were included. Head and neck tumors were evaluated in 4 articles, lymphoma in 4, colorectal tumors in 3 and breast tumors in 2. Only one article was retrieved for melanoma, esophagus and ovary tumors. Cost-effectiveness results of F-18-FDG PET or PET/CT ranged from dominated to dominant.

**Conclusion:** Evidence-based data about the cost-effectiveness of F-18-FDG PET or PET/CT in tumors other than lung cancer are still limited. Nevertheless, F-18-FDG PET or PET/CT seems to be cost-effective in selective indications in oncology.

PO72

### Prevalence and malignancy risk of focal areas of incidental F-18-FDG uptake in the thyroid: A meta-analysis

G. Treglia<sup>1</sup>, M. Salvatori<sup>2</sup>, L. Ceriani<sup>1</sup>, L. Giovannella<sup>1</sup>; <sup>1</sup>Bellinzona, <sup>2</sup>Rome/IT

**Purpose:** To meta-analyze published data about the prevalence and malignancy risk of focal areas of incidental F-18-FDG uptake detected by PET or PET/CT in the thyroid (focal thyroid incidentalomas [FTIs]).

**Methods and Materials:** A comprehensive literature search of studies regarding FTIs detected by F-18-FDG PET or PET/CT was performed. Pooled prevalence of patients with FTIs and malignancy risk of FTIs after histopathology verification were calculated. Furthermore, separate calculations for geographic areas were performed. Finally, average standardized uptake values (SUV) in benign and malignant FTIs were reported and compared.

**Results:** Thirty-two studies comprising 3327 patients with FTIs detected by F-18-FDG PET or PET/CT were included. The pooled prevalence of FTIs was 2.1% (95% confidence interval [95%CI]: 1.8–2.5%). Overall, 1295 FTIs detected by F-18-FDG-PET or PET/CT underwent histopathology evaluation by fine needle aspiration or surgery. Pooled risk of malignancy was 38% (95%CI: 33.7–42.4%), without significant differences among various geographic areas. A significant difference in average SUV between benign and malignant FTIs was described in some articles; nevertheless, a significant overlap about SUV between these two groups was found.

**Conclusion:** FTIs are observed in about 2% of F-18-FDG PET or PET/CT studies and carry a high risk of malignancy. It is difficult to differentiate benign from malignant FTIs by SUV alone in any individual case and a F-18-FDG PET report should suggest further investigation when FTIs are described.

PO73

### A one-step method to quantify tumor background activity in PET using histogram analysis

I. Burger<sup>1</sup>, H. A. Vargas<sup>2</sup>, B. J. Beattie<sup>2</sup>, D. Goldman<sup>2</sup>, J. L. Humm<sup>3</sup>, S. M. Larson<sup>2</sup>, R. C. Schmidtlein<sup>2</sup>; <sup>1</sup>Zürich, <sup>2</sup>New York/US

**Purpose:** Many common PET segmentation methods for malignant lesions use surrounding background activity, commonly measured by drawing a second volume of interest (VOI) in nearby, non-diseased tissue. The aim of our study was to analyze if the background can be determined accurately within the tumor VOI with simple histogram analyses.

**Methods and Materials:** Ten consecutive patients with biopsy-proven tumors who underwent FDG-PET in January 2012 were retrospectively selected, for each the following tumor types: head and neck cancer (neck), lung cancer (lung), hepatic metastasis (liver), melanoma (skin), and cervical cancer (pelvis). One lesion per patient was selected and a cubical VOI (VOITumor) was drawn around the lesion and a fixed-size cubical VOI over background (VOIBG). The mean value of VOIBG was compared with the mode of the histogram of VOITumor, using equivalence testing with a margin of  $\pm 0.5$  SUV. Inter-reader agreement was analyzed for mean background, and the mode of the VOITumor histogram using the concordance correlation coefficient (CCC).

**Results:** For both readers, the mode of VOITumor was equivalent to the mean in VOIBG ( $p < 0.0001$  for R1 and R2). The inter-reader agreement was very high with a CCC of  $> 0.92$  for both the mode of VOITumor and the mean of VOIBG.

**Conclusion:** The average background activity determined by the mode of the histogram is accurate and equivalent to separately measured mean background values.

PO74

### Comparison of contrast-enhanced PET/CT and PET/MRI with only T2-weighted images in patients with head and neck cancer: How much MR information is needed in PET/MRI?

F. Kuhn, M. Hüllner, S. Kollias, G. K. von Schulthess, P. Veit-Haibach; Zürich

**Purpose:** Generally, in MRI contrast media is given for lesion detection and characterization. In multi-modality imaging, the information about malignancy may derive from the PET-component. We evaluated if a single T2 weighted (T2w) MR pulse sequence in PET/MRI might be equivalent to contrast-enhanced (ce) PET/CT for lesion characterization in patients with head and neck cancer.

**Methods and Materials:** Eighty consecutive patients referred for primary staging or re-staging of head and neck cancer underwent sequential whole-body 18F-FDG PET with CT-based attenuation correction, ceCT and 2-point Dixon based T2w axial MRI (IDEAL pulse sequence, GE Healthcare) of the head and neck in a tri-modality PET/CT-MR system. PET-positive lesions were assessed by CT and MRI for their anatomical localization, conspicuity and additional information for characterization.

**Results:** In 38 patients with at least one PET-positive lesion, 60 lesions were evaluated. No significant difference was found between T2w and CT regarding lesion localization and size. Furthermore no significant difference was found between T2w and CT regarding conspicuity of tumors (Wilcoxon signed rank test,  $p=0.16$ ) and PET-positive lymph nodes ( $p=0.16$ ). In CT fewer artifacts (7%) reduced the diagnostic confidence compared to T2w (23.2%). Overall lesion characterization with T2w was considered superior to CT in 32% of lesions, equal to CT in 56% and inferior to CT in 12%.

**Conclusion:** PET/MRI with only axial T2w images and without the application of contrast media has the potential to replace cePET/CT as the primary diagnostic imaging tool for the evaluation of head and neck cancers.

PO75

### Compensatory hyperfunctioning lingual muscles after hemi-glossectomy: A potential cause of false positive PET interpretation in oral cancer patients

*V. Soubeyran, K. Sandu, P. Brachet, S. Monteiro, J. Feilchenfeldt, E. Kamel; Sion*

**Purpose:** To describe the typical pattern of contralateral compensatory FDG accumulation within lingual muscles in patients underwent partial- or hemi-glossectomy for oral cancer.

**Methods and Materials:** Ten patients with tongue cancer (n=7) and mouth floor cancer infiltrating the tongue (n=3) were studied. Surgical intervention of those patients consisted of hemi-glossectomy (n=7) and partial-glossectomy (n=3). Follow-up FDG PET/CT without I.V contrast media was requested for all patients and the images were analyzed for any potential local disease recurrence. Abnormal FDG accumulation was defined as that exceeded normal background activity with or without correlative nodular pattern on the native CT.

**Results:** Abnormal contralateral FDG accumulation was observed in 8 (80%) out of 10 patients ( $SUV_{max}$   $8.11 \pm 5.2$ ). Correlative CT referred these metabolically active areas to the extrinsic muscles of the tongue (hyoglossus, n=8, genioglossus, n=1, and both muscles, n=1) that appeared homogenous without suspicious nodular pattern on CT. Clinical and radiological follow-up (mean  $8 \pm 3.5$  month) did not reveal local disease recurrence in any patient and hence the benign entity of these muscular FDG accumulations was confirmed. Interestingly, these findings were observed in 7/7 (100%) patients with hemi-glossectomy, and 1/3 (33%) patient with partial-glossectomy suggesting a probable relation between the resected tongue bulk and the aforementioned compensatory phenomena.

**Conclusion:** After incomplete tongue resection, compensatory contralateral extrinsic lingual muscles FDG accumulation is a frequent finding occurred in 100% of patients with hemi-glossectomy and 33% of patients with partial-glossectomy. This abnormal FDG uptake should not be mistaken for local disease recurrence on PET interpretation.

PO76

### FDG-PET $SUV_{max}$ values do not correlate with EGFR mutation status in adenocarcinoma of the lung

*J. Müller, M. Früh, M. P. Putora; St. Gallen*

**Purpose:** Previous reports have hypothesized correlation between FDG-PET  $SUV_{max}$  values in lung adenocarcinomas and EGFR mutation status (1). With the hypothesis that lower  $SUV_{max}$  correlate with a positive EGFR-Status, so that costly EGFR-Testing might be spared in high  $SUV_{max}$  values.

**Methods and Materials:** To proof this concept we reviewed PET-CTs from 2007 to 2012 performed in patients with adenocarcinomas of the lung.  $SUV_{max}$  values of adenocarcinomas with positive EGFR mutations were compared with  $SUV_{max}$  values of EGFR wild-type. To rule out influence of scanner specific changes in  $SUV_{max}$  a third group of equal size with FDG-PET scans for lung cancer at approximately the same time, same age and same Uptake-Time was defined.

**Results:** 14 patients had positive EGFR mutations, 14 patients had EGFR wild type and 14 patients were selected as control. The average  $SUV_{max}$  values for EGFR mutated adenocarcinomas was 10.03, wild-type 9.86 and the control group 11.14. We could not confirm any significant difference in SUV values for EGFR mutated and wild-type adenocarcinomas in our cohort.

**Conclusion:** Conclusions: Omitting EGFR testing in lung cancers based on low  $SUV_{max}$  is not feasible.

1) Förster GJ, Misch D, Kollmeier J, Köcer T, Griff S, Kaiser D, Bauer TT. «Der SUV im FDG-PET als prädiktiver Wert einer EGFR-Mutation beim nicht-kleinzelligen Lungenkarzinom.» Pneumologie 2012; 66 – P201.

PO77

### Uptake of $^{111}\text{In}$ -pentetreotide in the caecum: A normal variant

*I. C. Mainta, V. Garibotto, L. Allainmat, F. Buchegger, O. Ratib, C. Tabouret-Viaud; Genève*

**Purpose:** To evaluate the normal uptake of  $^{111}\text{In}$ -pentetreotide in the caecum.

**Methods and Materials:** We performed a retrospective review of 41 subjects without evidence of neuroendocrine tumor localized to caecum, who underwent a three-day protocol of octreoscan in our institution. The images were evaluated independently and the uptake was rated visually in the caecum (0=uptake equal to background activity, 1=uptake slightly superior to background and 2= uptake clearly superior to background). A semi-quantitative analysis on planar imaging (ratio of the activity in the caecum and descending colon to background activity on the right thigh) was conducted. We applied a paired t-test to compare the uptake in the investigated areas at the three time points.

**Results:** Caecal uptake visually scored as 2 represented 32.5% of cases at 4–6h p.i., 67.5% at 24h and 63.1% at 48h p.i. In these cases, the ratios of the average counts/background activity at 6h, 24h and 48h p.i. were 2.0/ 5.9/ 4.1 in the caecum, comparing to 1.4/ 3/ 2.5 in the descending colon. The ratios were significantly different ( $p < 0.05$ ) in the two regions.

**Conclusion:** Physiological uptake of  $^{111}\text{In}$ -pentetreotide in the caecum is often non-negligible even 6h p.i., and significantly higher than the activity observed in the colon. Therefore, intense uptake in the caecum should be carefully taken into consideration in the diagnosis and the follow up of neuroendocrine tumors.

PO78

### SPECT-CT assessment of pseudarthrosis after spinal fusion: Characteristic findings

*G. Amzalag, O. Ratib, O. Rager; Genève*

**Learning Objectives:** Characteristic findings of pseudarthrosis and differential diagnosis after spinal fusion procedure.

**Background:** Spinal fusion is a frequent treatment for the vertebrae's segmental instability. It can be associated with several complications including pseudarthrosis. Some recent studies have shown that new hybrid imaging using SPECT-CT ( $Tc-99m$  HDP) or PET-CT ( $F-18$  NaF) improves diagnostic accuracy. SPECT-CT information can be useful to surgeons in order to carefully select patients who might benefit from re-operation, and to plan surgical procedures accordingly.

**Imaging Findings or Procedure Details:** Assessment of the posterior segment of the spine including screws and rods is necessary to identify pathological structures, as well as the anterior segment with bone graft tissue often associated with an interbody device. Persistence of focal uptake in these sites is a characteristic of pseudarthrosis. A pitfall finding is when a screw is broken outside the bone, thus no uptake is observed around the screw as the instability is focused on the interbody area.

**Conclusion:** Understanding of the different surgical procedures and techniques of arthrodesis is key to interpret spine imaging. The analysis of SPECT-CT findings requires knowledge of these characteristics, while concurrently considering the diagnostic pitfalls.



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# Montreux 2014

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Montreux Music & Convention Centre (2m2c)  
12.–14. Juni 2014



101. Jahreskongress SGR-SSR  
101<sup>ème</sup> Congrès annuel SGR-SSR



14. Jahreskongress SGNM  
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68. Jahreskongress SVMTRA  
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37. Jahreskongress SGPR  
37<sup>ème</sup> Congrès annuel SSRP



16. Generalversammlung SGRRC  
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13. Jahresversammlung SSCVIR  
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