Results: The DIR performs well visually and the sum of squares for the difference between the deformed CTs and the real CTs ranged between $4 \times 10^9$ and $5 \times 10^9$. For comparison, the difference between the deformed CTs and the real CTs ranged $16.5$mm(A-P) and $22.2$mm(S-I). SUVmax was on average $67.4$% higher in the gated acquisition (10 phases) compared to the non-gated case (range $13.1$%-22.8%). When comparing reconstructions in 4 and 10 phases, the average increase in SUVmax reduced to $13.3$% (range $2.3$%-31.2%). Corresponding figures for 6 to 10-phase comparison were $6.8$% and range $0.0$%-23.1%. In general, volumes estimated by the fixed-threshold method increased with increasing phase number, volumes obtained with the percentage method decreased and volumes obtained with the gradient-based method did not show a significant trend. On average, volumes calculated in the 10-phase ph(0) image by method a) were $8.9$% higher than volumes obtained by method b), while in the static acquisition (no gating) method a) gave volumes $20$% smaller than method b), on average.

Conclusions: 4D-PET-CT offers a clear advantage in 18F-FDG SUV estimation for tumors with respiration. The balance between acquisition/reconstruction time, signal-to-noise ratio and SUV estimation accuracy seems to be achievable splitting the respiratory cycle into 4 to 6 phases, depending on lesion location. The same observation holds for lesion volumes, however further research is needed to determine the optimal segmentation method. Gradient-based methods are less sensitive to the number of phases for volume estimation, however further study is necessary to fine-tune and validate their results.

PO-0864
Quantitative clinical image quality comparison of pelvic CBCT for two imaging systems
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Purpose/Objective: Quantitative objective analyses are widely used in radiology. These are relevant in oncology as well, since the use of pelvic CBCT for adaptive RT requires a certain level of image quality. The purpose of this study is to objectively evaluate the clinical image quality of two systems; a state-of-the-art CBCT system and a new CBCT system with improved reconstruction and hardware.

Materials and Methods: The patients included in this retrospective study had a planning CT and CBCT's from Clinac iX as well as Truebeam (Varian Medical Systems). Based on European Guidelines provided by CEC seven quality criteria in relation to the bladder on CBCT were defined along with an ordinal rating scale reflecting the fulfillment of a particular criterion. The corresponding author and a number of physicians rated in a randomized order the CT's and the pelvic CBCT's. The resulting data were evaluated by a statistical analysis called Visual Grading Characteristics (VGC) in the free software DBM MRMC 2.32 Build 3. The difference in image quality between the two modalities was evaluated by the area under the curve (AUC) and ANOVA. An AUC of 0.5 indicated equally image quality whereas higher values indicated superior image quality. If 0.5 was not included in the 95% confidence interval the difference in image quality of the systems was significant. A VGC curve comprising the total image quality criteria was found for each observer. Furthermore, the impact of the individual criteria was demonstrated by a VGC curve and the respective AUC. The Image Criteria Score (ICS) was calculated for the total and individual criteria and ideally ICS would equal 1.0. As a reference the VGC analysis of the CT was performed.

Results: An excerpt of the results of the corresponding author is included for five criteria (Figure 1). The VGC curves clearly illustrate better performance of Truebeam than Clinac iX for criterion I-IV, whereas the performance is more equivocal regarding criterion V. The AUC was 0.68 for the total quality criteria and the 95% confidence interval was [0.55, 0.80]. For criterion I the AUC was 0.72, criterion II yielded an AUC of 0.71, criterion III an AUC of 0.73, criterion IV an AUC of 0.70 and for criterion V AUC was 0.47. The total ICS for Truebeam and Clinac iX was 0.49 and 0.27, respectively. For the individual criteria the ICS was higher for Truebeam than Clinac iX. The percentage difference ranged between 11.1 and 33.2 percentage points.
Conclusions: The applicability of the VGC analysis on CBCT used for adaptive RT was investigated and found useful. Regarding the difference in image quality between the two systems Truebeam was found superior to Clinac iX. The VGC analysis might find its use for any two imaging systems in the clinic.

PO-0867
A novel method for converting pixel values to Hounsfield units for cone beam CT images
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Purpose/Objective: The purpose of this study is to develop a method for converting pixel values in CBCT images to Hounsfield units (HUs) using the histograms of pixel values for the cone beam computed tomography (CBCT) to calculate the dose distributions on the CBCT images.

Materials and Methods: The simulation computed tomography (sim-CT) and CBCT images of an electron density phantom and 5 prostate cancer patients were acquired. The histograms of pixel values for each slice of the sim-CT and CBCT images of the electron density phantom and of the prostatic cancer patients were obtained with an in-house program. To perform correction of the pixel values for each slice of the CBCT images, the shapes of the histograms for each slice of the CBCT images were closed to the shapes of the histograms of the sim-CT images using linear scaling method with a minimum sum of squared differences for the regions of soft tissue and bone. Such CBCT images with converted pixel values were defined as the modified CBCT (mCBCT) images. The pixel values of the mCBCT images were compared with those of the sim-CT images, and the differences were evaluated. To evaluate clinical significance, the dose distribution on the mCBCT images was compared with the original plan on the sim-CT images by using gamma analysis with a 3% / 2 mm criterion. In addition, the calculated MUs were compared with the original plan.

Results: The linear scaling of pixel values in the CBCT images was successfully applied to the histograms. After the linear scaling, the histograms of mCBCT resembled the histograms of sim-CT. Thus, it is possible to judge pixel values for CBCT images in HUs. However, because the artifacts peculiar to CBCT remained, differences between both HUs were observed (-3.7 ± 33.3 HU for subcutaneous fat, -14.9 ± 24.8 HU for prostate, 11.5 ± 30.8 HU for muscle, 11.7 ± 35.9 HU for bone). The pass rate of gamma analysis (3% / 2 mm) were more than 95%, and the differences in calculated dose using the mCBCT images were less than approximately 1 MU for the monitor unit.

Conclusions: The proposed novel method using histograms is a feasible method for converting pixel values in CBCT images to HUs; this may facilitate calculation of accurate doses using CBCT images.

PO-0867
Novel evaluation method of non-rigid image registration algorithms for image-guided adapted radiation therapy
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Purpose/Objective: Non-rigid image registration (NIR) is an essential image processing tool for image-guided adapted radiation therapy. The current radiotherapy process requires three-dimensional (3D) quantification of the registration error, which is not accurately achieved by existing evaluation methods. The objective of this study is to develop a method for 3D evaluation of NIR algorithms.

Materials and Methods: Cone-beam (reference) and planning (moving) CT scan images of fifteen prostate cancer patients were scanned using the VelocityAI (Velocity Medical Solutions) platform, which employs B-spline-based NIR algorithms. The NIR algorithms were evaluated by measuring the distance between two factors: (1) the outlines (reference contours) of the bladder, the dorsal right and left seminal vesicles (SV), the proximal SV, the prostate, and the rectum in the reference images; and (2) other outlines (deformed contours) in the deformed images of the same CT slice. This distance is the difference between two points that indicate the point of intersection of the reference and the deformed contours that cross a straight line every 10° from the center of gravity of the reference contour. However, the difference in direction was determined as being 'negative' if it was inside the reference contours for the deformed contours, and 'positive' if it was outside the reference contours for the deformed contours. The measurement values were displayed on a two-dimension (2D) difference map.

Results: The 2D difference map of the bladder indicated a large error of +3 to +8 mm in the upper region. The dorsal right and left SVs showed an overall error of -3 to +3 mm, while the error pertaining to the proximal SV was -4 to -1 mm around the prostate interface. The error pertaining to the prostate ranged from -2 to +1 mm in the