Conclusion: The extraction of iodine concentration maps from injected DECT scan was achieved to evaluate the differential function of lungs and kidneys. Therefore, our DECT analysis tool provides functional information in addition to the high resolution DECT images. Further improvement in the analysis tool will include advanced algorithms to perform segmentation and 3D model to address functionality according to specific sections of an organ. Further work will also incorporate the functional information to radiation oncology treatment planning decisions to eventually spare further functional tissue and reduce the toxicity.

OC-0418
Cluster analysis of DCE MRI reveals tumor subregions related to relapse of cervical cancers
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Purpose or Objective: Solid tumors are known to be heterogeneous, often consisting of regions with different treatment response. Early detection of treatment resistant regions can improve patient prognosis, by enabling implementation of adaptive treatment strategies. In this study, K-means clustering was used to group voxels in dynamic contrast enhanced (DCE) MR images of cervical cancer tumors. The aims were to explore the intratumor heterogeneity in the MRI parameters and investigate whether any of the clusters reflected treatment resistant regions.

Material and Methods: Eighty-one patients with locally advanced cervical cancer treated with chemoradiotherapy underwent pre-treatment DCE MRI. The resulting image time series were fitted to two pharmacokinetic models, the Tofts model (K\textsubscript{trans} and ve) and the Brix model (ABrix, kep and kef). K-means clustering was used to cluster similar voxels based on the pharmacokinetic parameter maps or the relative signal increase (RSI) time series. The association between clusters and treatment outcome (progression-free survival, locoregional control or metastasis-free survival), was evaluated using the volume fraction of each cluster or the spatial distribution of the cluster.

Results: We identified three voxel clusters based on the Tofts parameters, all significantly related treatment outcome. One voxel cluster based on the Brix model was significantly linked to progression-free survival and metastatic relapse. Two RSI based cluster were significantly related to all types of treatment outcome.

Conclusion: Based on either pharmacokinetic parameter maps or relative signal increase time series, we were able to group the voxels into cluster that were associated with treatment outcome. With the exception of one cluster, the spatial distribution rather than the volume fraction of each cluster was significant.

OC-0419
Association between pathology and texture features of multi parametric MRI of the prostate
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Purpose or Objective: The aim of this study was to find a correlation between multiparametric (mp) MRI derived quantitative imaging parameters (textual features) and pathological verified tumor occurrence. Textual feature analysis (TFA) as a method for quantifying the spatial distribution of intensities in images has already shown promising results in the field of diagnostic oncology and also as biomarker for treatment response.

Material and Methods: 25 prostate cancer patients which underwent prostatectomy were investigated in this study. Multiparametric MRI were collected prior to the surgical procedure. Along with T2 weighted images, dynamic-contrast-enhanced (DCE-MRI) (K\textsubscript{trans}, AUC) and diffusion-weighted MRI (DW-MRI) with its estimated apparent diffusion coefficient (ADC) were recorded. The resected prostate was axial cut in slices of 3-4 mm thickness and the tumor was tagged by a pathologist. On the T2 images delineation of the central gland (CG) and the peripheral zone (PZ) was performed by two physicians. Additional, the prostate was divided into 22 geometrical substructures following the PI-RADS classification. Hence, the tagged tumor area on the pathological slices could be assigned to the respective substructure on the MRI where it was scored into distinct levels according to the volume covered by malignant tissue. For each geometrical substructure texture analysis was performed using gray level co-occurrence matrix (GLCM). Additional to the textual parameters also histogram based information (gray value) was investigated. The large amount of information created by the TFA was analyzed with principal component analysis (PCA). For each image modality, the 23 textural parameters were compressed into two principal components, which explained most of the variation found in the data. Prior to analysis, each variable was mean centered and also scaled to unit variance.

Results: The TFA showed a significant difference between substructures in the CG and PZ. A correlation was found between the pathological findings and the texture of the ADC map as shown in fig 1a, where the larger dots represent substructures with confirmed tumor occurrence. For the other investigated modalities the correlation was weaker or absent. Based on the score plot (fig 1a) ROC curves were calculated (fig1b) resulting in an AUC of 0.789 for ADC considering the highest tumor scores only.
Conclusion: The current study indicates that ADC mapping is the most promising MRI technique to predict the tumor location in the prostate based on TFA and therefore is absolute prerequisite for dose painting approaches in advanced adaptive radiotherapy (ART).

OC-0420
Radiomics in OPSCC: a novel quantitative imaging biomarker for HPV status?

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Purpose or Objective: Oropharyngeal squamous cell carcinoma (OPSCC) is one of the fastest growing head and neck cancers, for which human papillomavirus (HPV) status has been described as a strongly prognostic factor. Overall, prognosis is favorable for HPV positive (HPV+) patients, which makes this an interesting subgroup for de-escalation protocols. An established, non-invasive, imaging biomarker of HPV status currently does not exist. Radiomics-the high-throughput extraction of large amounts of quantitative features from medical images has already been shown to be of prognostic value for head and neck cancer. In this study we evaluate the use of a Radiomic approach to distinguish between HPV+ and HPV negative (HPV-) OPSCC patients.

Material and Methods: A total of 542 patients with OPSCC, treated with curative intent between 2005 and 2010 were collected for this study. HPV status was determined by p16 immunohistochemistry (IHC) and found positive in 134 (25%) patients. The analyzed data set included clinical, pathological, and treatment related outcomes on a total of 542 patients. MRI and CT image interpretation was performed by radiologists in the OPSCC clinic at our institution. In a first step, the radiomic feature space was populated with features extracted from medical images using MATLAB. These features were the result of applying a multiresolution texture analysis approach. A total of 542 patients with OPSCC, treated with curative intent between 2005 and 2010 were collected for this study. HPV status was determined by p16 IHC and found positive in 134 (25%) patients. The analyzed data set included clinical, pathological, and treatment related outcomes. In a first step, the radiomic feature space was populated with features extracted from medical images using MATLAB. These features were the result of applying a multiresolution texture analysis approach. 211 (49%) patients without visible CT artifacts, of whom 134 were HPV positive. The modeling process resulted in an eleven-feature multivariable prediction model. The overall receiver operator curve is shown in Figure 1. The bootstrapped AUC was on average 0.77 (95% CI: 0.73-0.80).

Results: Out of the patients with known HPV scoring, we identified 211 (49%) patients without visible CT artifacts, of which 134 were HPV positive. The modeling process resulted in an eleven-feature multivariable prediction model. The overall receiver operator curve is shown in Figure 1. The bootstrapped AUC was on average 0.77 (95% CI: 0.73-0.80).

Conclusion: Using a Radiomic approach, we were able to distinguish between HPV+ and HPV- OPSCC patients, using standard pre-treatment CT imaging. These results require further validation, but suggest the potential for a novel quantitative Radiomic biomarker of HPV status, facilitating personalized treatment selection.

Symposium: Adaptive treatments in the pelvic region

SP-0421
Brachytherapy pelvic and MRI-Linac combination

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MRI guidance for the radiation treatment of patients with cancer in the pelvic region has globally increased during the last two decades. MRI is used for staging, treatment planning, monitoring of treatment response and for disease observation during follow up. Consistent and repetitive use of MRI has provided insight into tumour and surrounding organ anatomy as well as their movements and deformations. In cervical cancer treatment, MRI guidance for brachytherapy treatment planning and dose delivery allowed better tailoring of the dose to the target, with higher tumour doses while sparing the organs at risk (OARs). However, the aimed dose for target and OARs may differ from the actually delivered dose due to movements and deformations of the OARs during HDR or PDR treatments. Several single institution reports describe that dose uncertainties caused by displacement and deformations of OARs are on average small, however individual outliers occur. Especially for the rectum higher delivered doses have been found in individual patients. In case of HDR brachytherapy, re-imaging prior to dose delivery can help to detect unfavourable anatomical changes, allowing for interventions that might help to stabilize dosimetry and prevent morbidity. The availability of MR imaging within the brachytherapy suite is an upcoming innovation that supports these types of adaptive brachytherapy approaches. The aim of the international ‘EMBRACE’ study (www.embracestudy.dk) was to introduce MRI based brachytherapy in a multicentre setting within a prospective observational setting and to correlate DVH parameters with outcome. Preliminary results from EMBRACE, from the retrospective ‘Retro-EMBRACE’ study (www.retroembrace.com) and from several single institution reports, revealed an increase in local control due to the use of MRI guidance. Brachytherapy treatment allows delivery of sterilizing doses to the primary cervical tumour, however, lymph node disease is getting the dose delivered by external beam radiotherapy treatment (EBRT). The upcoming prospective multicentre ‘EMBRACE II study’ will focus on advanced Image Guided and Adaptive EBRT (iGART) combined with MRI guided intracavitary/interstitial brachytherapy with