Purpose/Objective: Concurrent chemoradiotherapy (CRT) is standard of care for patients with locally advanced head and neck squamous cell carcinoma (HNSCC). The current delineation and treatment planning approach uses a unique set of CT images. As a result, the volume change of the gross tumor volume (GTV) during RT is not considered. This could lead to changes in the initial dose distribution. Adaptive RT (ART) could counteract this problem. However, there is currently no way to identify suitable patients for ART. Diffusion weighted (DWI) MRI characterizes tissues based on the random displacement of water protons; quantified using the apparent diffusion coefficient (ADC). The aim of this study is to investigate if DWI is predictive for volumetric changes during RT and can help in the selection of patients suitable for ART.

Materials and Methods: 59 patients with HNSCC with an initial tumor volume above 15 cc were included. We have chosen this limitation because we believe that the volumetrical changes in tumors smaller than 15 cc would have no or very small repercussions on initial dose distribution. RT was delivered to a dose of 72 Gy (20 x 2 Gy daily, followed by 20 x 1, 6 Gy twice daily). Patients received an MRI (1.5 Tesla) before RT, 2 and 4 weeks after start of RT. ADC values were determined using six b-values 0, 50, 150, 500, 750 and 1000 s/mm². Volumes were determined on T1-weighted MRI at all time-points. Pretreatment ADC values were correlated with the volumetric change in the tumor at 2 and 4 weeks during RT in all 59 patients. In 20 of these patients ΔADC values at 2 weeks were correlated with the volumetric changes at 4 weeks. To determine the strength of the correlation a Pearson correlation coefficient was used. A p-value ≤0.05 was considered to be statistically significant.

Results: There was a significantly positive correlation between pretreatment ADC value and volumetric change at 2 weeks during RT (r=0.9; p=0.001). A positive correlation was also found with the volumetric changes at 4 weeks, however this failed to reach significance (r=0.4; p=0.08). No correlation was found between the ΔADC value at 2 weeks during RT and the volumetric changes at 4 weeks (r²=0.001; p=0.9).

Conclusions: The implementation of ART is limited due to its time consuming nature and the inability to select suitable patients. We investigated in 59 patients diagnosed with HNSCC (with a tumor volume above 15 cc) if DWI characteristics could help us in this regard. We saw a positive correlation between pretreatment ADC value and the anatomical changes of the tumor during RT. Patients with a lower pretreatment ADC value appear to have a greater volume decrease early during RT, which might be useful in the selection of patient who might benefit from ART. We will set up a study in the future to validate these results in a bigger patient group and to investigate the potential role of other functional imaging techniques such as dynamic contrast enhanced magnetic resonance imaging (DCE-MRI).