Purpose:
With increasing availability of MR simulators and their ability to provide better soft tissue contrast, we propose a semi-automatic multi-modality segmentation method to improve medical experts' productivity and consistency in delineating normal radiation-dose-limiting tissues in head-and-neck cases with co-registered CT and MR.

Methods:
Based on our previous graph based semi-automatic segmentation method for single modality, we minimize a global energy function defined by local probabilistic regional and boundary terms: p(yi | xi) and p(yi, yj | xi not equal to xj),where yi is the image feature (intensity) at voxel i, xi is the classification (target organ or background) and voxels i and j are neighbors. To accommodate information from multiple image modalities, e.g. CT and MR, we use a multi-value vector for image feature, by defining yi = (yi_CT , yi_MR). CT and MR are registered using rigid mutual information registration to obtain image features from both modalities. Probabilities are estimated from samples collected locally from experts' input by using an intuitive paint brush tool to roughly specify the voxels inside and outside the target organ. Side-by-side manual segmentation on the registered CT and MR is used as ground truth for comparison.

Results:
A preliminary study of brainstem segmentation in 4 patient cases, the dice similarity coefficient is 89.8±0.8% and the surface distance to the ground truth is 0.7±1.5mm.

Conclusions:
The novelty of our approach is the use of a multi-value feature vector to exploit image formation from multiple modalities and use these features in a statistical energy minimization scheme for segmentation without removing expert oversight. Our initial results are encouraging and the semi-automatic method has the potential to reduce user fatigue and improve productivity in treatment planning.