

Development of a “No Action Level (NAL)” protocol for physician time management during MRI guided online standard fractionation adaptive radiation therapy for head and neck cancer

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INTRODUCTION

MRI guided adaptive radiation therapy places enhanced expectations in terms of required daily physician presence at the console. Such expectations could present undue burdens on already limited physician availability for these procedures, especially in busy practices.

AIM

To develop a No Action Level (NAL) protocol to manage physician presence effectively during MRI guided online adaptive radiation therapy for head and neck cancer

METHOD

MRI guided online adaptive radiotherapy on the Elekta Unity platform presents two scenarios during clinical workflow that require physician verification/approval: Image Fusion between the reference (CT/MR) and the daily MR image and subsequent approval of adapted treatment plan.

We reviewed daily adaptation results from 9 head and neck cancer patient treatments, (total of 241 fractions) aspiring to establish an action level protocol to manage physician presence daily at the MR Linac effectively.

Typical treatment prescription for head and neck cancer patients included doses as high as 2.2 Gy per fraction up to a total of 33 fractions. Adaptation results included (a) daily patient shift information based on image fusion and (b) dosimetric criteria for adaptive plan generation.

MR GUIDED ADAPTIVE RADIATION TREATMENT WORKFLOW – MR LINAC (ELEKTA UNITY)

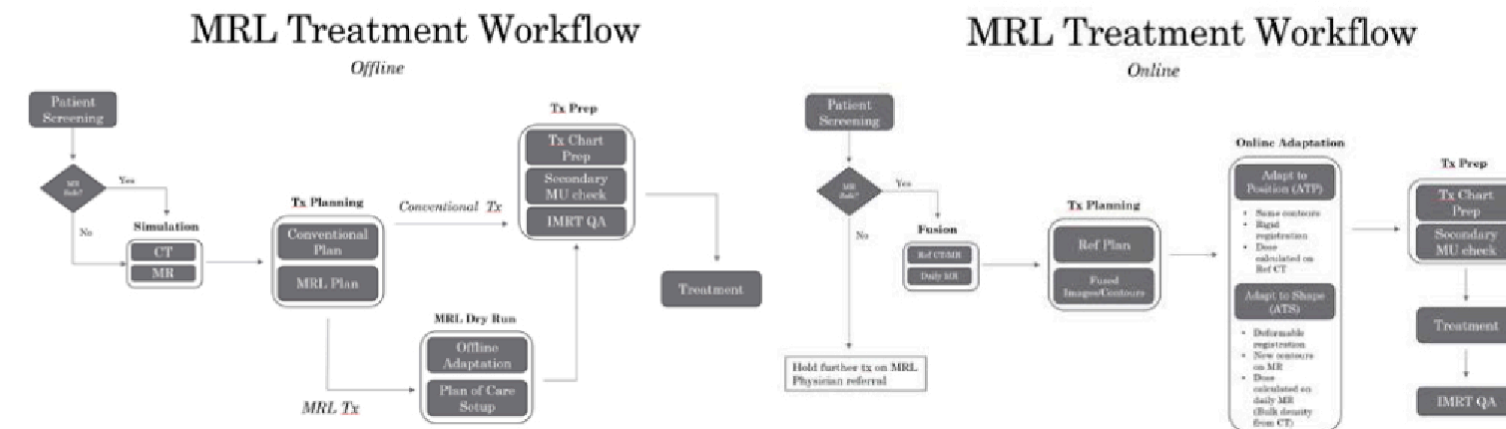


Figure 1 MR Linac Adaptive Treatment workflow (Left) Offline and (Right) Online. Active physician involvement in greater throughout the adaptive treatment process. Specifically, the reference MRL plan and conventional backup plan review during the offline portion and Image Fusion and Online Plan Adaptation sections during online portion of the treatment workflow.

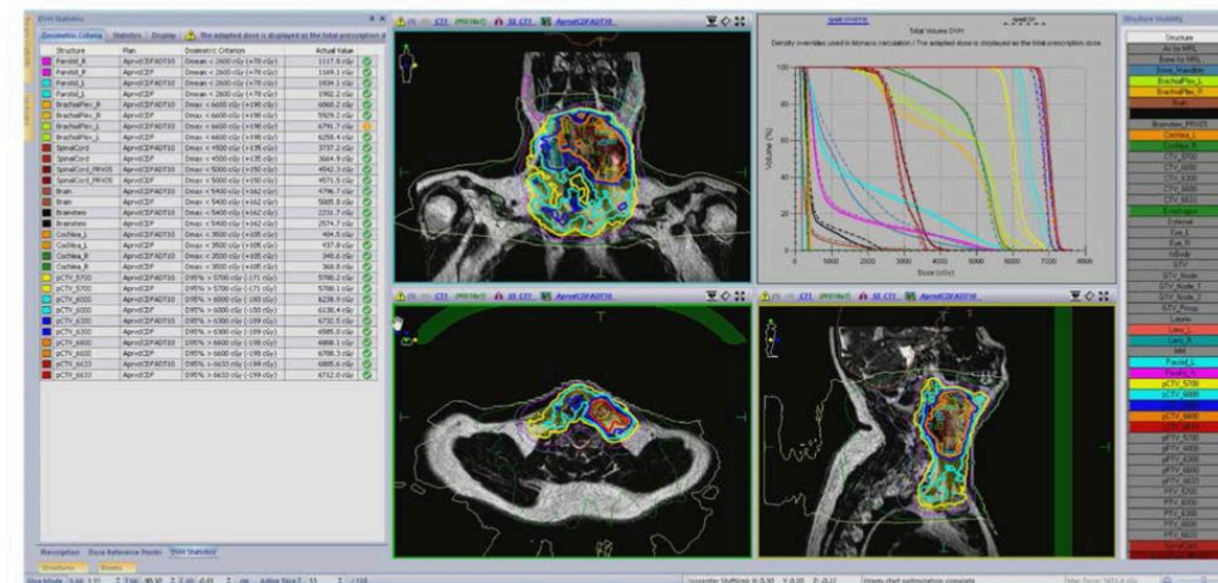


Figure 2 Screenshot of the adaptive image guided treatment planning interface showing the dose distribution, DVH and dosimetric report comparing dosimetric criteria between the initial reference and the adapted plan. As seen on the left, green checks indicate criteria that are met. Yellow exclamation marks indicate criteria that are within tolerances specified at the time of reference plan generation. Red crosses (not visible in this screenshot) indicate criteria that are not met post adaptation. Patient shifts are displayed towards the bottom on the right hand side of the screenshot. Treatment delivery will typically occur after physician review and approval of the image fusion and adapted plan. The goal of this study is to develop an effective way to manage physician presence at the MRL based on fractionation, adaptation criteria and other factors.

RESULTS

For the Adapt to Position (ATP) workflow: overall mean error in patient shift based on online image fusion was -0.03, 0.07 and 0.01 cm (RL, SI, AP). SD of systematic error was 0.33, 0.26 and 0.14 cm (RL, SI, AP). SD of random error was 0.17, 0.29 and 0.2 cm (RL, SI, AP).

All dosimetric criteria were usually always met (within the 2 % underdose or overdose levels for target and OARs respectively) during online plan adaptation for shifts in the ranges specified above.

CONCLUSION

An action level threshold of 0.5 cm patient shift (along any direction) was deemed to be acceptable as long as all dosimetric criteria were satisfied following plan adaptation.

Physician presence at the MR Linac was required if either shifts exceeded 0.5 cm or if any of the dosimetric criteria exceeded the 2% tolerance levels on more than three subsequent fractions.

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