Purpose: The CyberKnife uses an online prediction model to track moving targets. The system works well if patients can breathe regularly. However, some patients cannot maintain a regular breathing pattern, which means a larger PTV margin is necessary for these patients to ensure sufficient CTV dose coverage. However, it is very difficult to predict a patient's breathing pattern in advance. The purpose of this study is to investigate a quick and easy way to adapt the treatment plan if extra margins are needed.

Methods: Multiple algorithms have been developed to calculate the adjustment. Generally, if a larger target region requires coverage by the prescription dose, the size of the beams will be larger and they should move in a peripheral direction for a certain distance to avoid hot spots. Dose is recalculated and renormalized consistently after the adjustment. If the dose distribution of the new plan covers the new PTV with acceptable conformality and coverage, the plan will be used for treatment. Otherwise, more iterations of the adjustment are performed. Dose calculations are limited to a small region surrounding the target to reduce calculation time.

Results: 5 clinical cases (3 lungs, 1 liver and 1 adrenal) have been tested in this study. The dose margin can be extended up to 10 mm without changing dose distributions around the target region dramatically. The average PTV coverage is 98.7% compared to 99.1% in the original plans and the average CI is 1.22, which is slightly less than the 1.24 in the original plans.

Conclusions: Treatment margins can be sufficiently expanded resulting in satisfactory plan quality for patients with breathing irregularities.