A typical CyberKnife treatment plan contains 80~150 beams with multiple collimator sizes. There are two collimation systems available, the fixed cone collimator and the Iris collimator. Since its first introduction 5 years ago, the Iris collimator has gained popularity and become the most frequently used system for CyberKnife treatments. However, due to Iris mechanical failures, treatments sometimes have to be cancelled or postponed. The purpose of this study is to investigate the feasibility of switching a plan from one collimation system to another without replanning.

We first performed Monte Carlo dose calculations on 10 clinical cases using both the Iris collimator and the fixed cone collimator. An in-house developed Monte Carlo code was used for this study. We compared the conformity index (CI), the target coverage and the maximum, minimum and mean doses to the critical structures to determine the reproducibility of the two plan types. We then compared the beam profiles and output factors from the Iris and the fixed cone collimator plans. A series of scaling factors were introduced to adjust the Iris collimators’ opening size, to match the profiles from the Iris collimator with the profiles from the fixed cone collimator. The doses for the 10 cases were then recalculated using the adjusted Iris collimator sizes.

For the CyberKnife system, the definitions for the cone sizes are slightly different between the Iris collimator and the fixed cone collimator. The Iris collimator was designed to make the beam profile FHWM match the nominal cone size, while the fixed cone collimator was designed to make the physical size projected at 80 cm SAD match the nominal cone size. So for the same nominal cone size, the beam profiles generated by the fixed cone collimator are slightly wider than those generated from the Iris collimator. This difference becomes more apparent for larger cone sizes. For example, for the 5 mm collimator, the difference between the beam profiles is small, while for the 60 mm collimator the difference is large.

Our results show that the two collimators deliver similar dose distributions. The average target doses from the fixed cone plan are 1% to 6% higher than the Iris plan. The average CI for the fixed cone plan was 1.36 compare to 1.28 for the Iris plan. To reduce this difference, a scale factor of 1.024 was applied to the Iris collimator. Figure 1 shows the beam profiles of the 5mm, 30mm and 60mm cones, before and after the scale factor was applied. We recalculated the doses for each of the 10 plans using the corrected Iris collimator sizes. After this correction, the differences between the target doses from the two collimator plans was reduced to less than 2%, while the CIs become almost identical.

In general, small target dose differences were found between the plans using the two different collimation systems, which may be compensated for by adjusting the iris collimator sizes using a correction factor of 1.024. Dose differences to the critical structures was not significant. After adjusting the Iris collimator size by using this correction factor and re-commissioning, patients can be safely switched from an Iris collimator plan to a fixed cone collimator plan without replanning.