Intensity modulated radiation therapy can be achieved by driving the leaves of a multileaf collimator (MLC) across an x-ray therapy beam. Algorithms to generate the required leaf trajectories assume that the leaf positions are exactly known to the MLC controller. In practice, leaf positions are subject to change over time, even within tolerances. The purpose of this study was to determine the effects of leaf position inaccuracies on intensity modulated beams.

Dynamic leaf trajectories for flat fields using varying leaf velocities were generated using in-house software. Inaccuracies in leaf position were simulated by adding or subtracting constant offsets to all the leaves in a single bank or by multiplying leaf positions by the worst gain error feasible within current tolerances. Prescriptions incorporating these modifications were delivered using an Elekta MLC. The resulting doses were measured using ionisation chamber and compared to the dose from an unmodified field.

Leaf offsets give a constant error over a flat field, proportional to 1 / leaf velocity. Opposing gain variations on opposite leaf banks lead to a gradient over a flat field. This error gradient is also proportional to 1 / leaf velocity. Absolute errors (in monitor units) are independent of absolute monitor units delivered to a point. The quantification of the effects of MLC leaf position inaccuracy allows assessment of the tolerances which should be accepted in the quality control of MLC jaw and leaf positions for specific types of beam modulation.

This work was supported by Elekta Oncology Systems Ltd.