Purpose: To evaluate treatment plan quality of IMRT and VMAT plans for high energy photon beams delivered with (FF) and without (FFF) flattening filter.

Methods: 9-field IMRT and 360° single arc VMAT plans, based on 10 MV beams with and without flattening filter, were created using Monaco (Elekta/CMS, v.2.04, USA) for three different patients (prescribed PTV dose 78 Gy). This treatment planning systems was commissioned for FF and FFF beams provided by an Elekta linac. The Pareto optimal fronts were created by calculating different treatment plans with varying rectum constraints and evaluating the PTV volume receiving less than 95% of the prescribed dose ($V_{<95\%}$) and the volume of the rectum receiving 70Gy or more ($V_{\geq 70Gy}$). Treatment plan efficiency was evaluated by recording number of monitor units (MUs) and by measuring the delivery time (T) using an Elekta Precise linear accelerator in FF and FFF mode.

Results: The POFs of the rectum for both IMRT and VMAT in FFF mode were similar or even superior to the FF-modalities. For two of the three patients the POFs of IMRT and VMAT revealed a systematic difference of about 2% in target coverage. The POFs of the remaining patient showed virtually no difference for all four modalities. The delivery time of IMRT FFF decreased by about 23% compared to IMRT FF. In contrast to the IMRT techniques, delivery time increased by 20% when using VMAT FFF compared to VMAT FF.

Conclusions: The evaluation of the POFs confirms that a flattening filter is not necessary for static and rotational IMRT treatments. Similar studies are needed for other IMRT indications, like head-and-neck cancer, to draw final conclusions. Sequencing algorithms for FFF-beams need to be optimized and further improvement of the mechanical MLC properties are desirable for VMAT in FFF mode.

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