

Conclusion: In this study, the DLG determined using OCTAVIUS 4D system is in good agreement with ionization chamber and film measurement. OCTAVIUS 4D system may be an alternative of film dosimetry and provide an effective and efficient way to determine the MLC DLG value.

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Dose conformation evaluation of volumetric modulated arc therapy for cranial radiosurgery

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Purpose or Objective: To evaluate the quality and dose conformity of a volumetric modulated arc therapy (VMAT) cranial radiosurgery treatment plan using different parameters, as well as the accuracy of the dose calculation.

Material and Methods: Four patients were prescribed to 18Gy, planned with Elekta Monaco treatment planning system (v. 3.30.01), and optimized using biological and physical based cost functions for VMAT treatment on an Elekta Synergy linear accelerator equipped with a 160-leaf Agility MLC. 5 to 9 non coplanar arcs were used, for cranial lesions of different sizes (Target volume, 4 cc- 8 cc). Treatment isocenter was placed at the target volume center. The evaluation was performed using the RTOG Conformation Index (CI), the target coverage (TC), the Paddick's conformity index (Clp), the homogeneity index (HI), volume of healthy brain tissue receiving a dose of 10 Gy or more (V10), and the dose to organs at risk (OAR). The accuracy of the dose calculation was verified measuring the dose distribution with Gafchromic Film EBT3, inside the IBA Scanditronix I'mRT phantom, and read using FilmQA Pro software. Absolute dose measurements were made with a CC13 Scanditronix-Wellhofer ionization chamber located at the treatment isocenter. Also the 4D detector array ArcCHECK (Sun Nuclear Corporation) was used for 2 patients. Van Dyk's criterion, dose percentage difference and distance to agreement (DTA) 3%-3mm, was employed.

Results: Median CI, Clp and HI for all patients were 0.93, 0.82 and 1.16 respectively, with median TC of 88%. V10 was kept below 10cc for all cases. OARs were spared within tolerances. Conformity and received doses to OAR depend on the type and location of the target, and in one case all indices were significantly lower in order to comply with the V10 tolerance. Best results were obtained with 5 -6 non coplanar arcs arrangement. Dose distribution measured with Gafchromic Film EBT3 gave passing rates above 90% and absolute percent differences between measured and calculated dose with the ionization chamber were lower than 2% for all patients. ArcCHECK results showed a passing rate greater than 95% for the two patients.

Conclusion: With Monaco treatment planning system, in combination with a 160-leaf Agility MLC, it is possible to achieve highly conformal dose distributions for cranial radiosurgery VMAT plans, and target volumes larger than 4cc, with low doses to healthy tissue, even with highly irregular lesions. For the plan evaluation, the combination of TC with CI and Clp showed to be more helpful than the CI itself alone.

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Dosimetric impact of target separation in craniocaudal direction with TomoDirect Dynamic Jaw

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Purpose or Objective: TomoDirect is a non-rotational treatment option for Tomotherapy in which the treatment field is delivered at different discrete gantry angles with MLC modulation and couch translational movement. With the introduction of Dynamic Jaw Technique (Available for jaw

setting 5 cm and 2.5 cm) there is a potential improvement in the radiation dose fall-off at the cranio-caudal edges of a target, thus enhancing the effectiveness of dose reduction between the targets in the treatment with multiple metastases. In this study the effectiveness of dose reduction using Dynamic Jaw Technique was investigated for different target separations using different jaw settings, pitch factors and modulation factors.

Material and Methods: Two identical cylindrical targets of 6 cm length and 3 cm diameter aligning along superior-inferior (SI) direction with different separation ranging from 4.5 cm to 2 cm in 0.5 cm decrements were created on a water phantom image. TomoDirect planning was done on the planning CT images using Dynamic Jaw Technique with different jaw setting. Dose prescription was 2 Gy per fraction to 95% volume of both targets. Gantry angles 0°, 120° and 240° were used. Different plans were created with the modulation factor varying from 1.5 to 3 in 0.5 increments and the pitch factor ranging from 0.1 (default value) to 0.05 of the jaw width in 0.01 decrements. Same test plans were created using Fixed Jaw Technique for jaw width 5 cm, 2.5 cm and 1 cm for comparison. All plans were delivered and EDR2 film was used to measure the dose distribution on the coronal plane to verify the planning calculation.

Results: Measured dose distributions were in good agreement with the planning calculation for all plans as the gamma passing rate were higher than 90% with 2% in dose difference and 2 mm in DTA. The impact of reducing pitch value and increasing modulation factor were marginal on the dose fall-off between the targets for all plans. From figure 1, dose reduction effect between targets was greatly enhanced with different separations when Dynamic Jaw Technique was applied for jaw setting 5 cm and 2.5 cm. For target separation as small as 3 cm such dose reduction effect using 2.5 cm Dynamic Jaw Technique was comparable to 1 cm Fixed Jaw Technique.

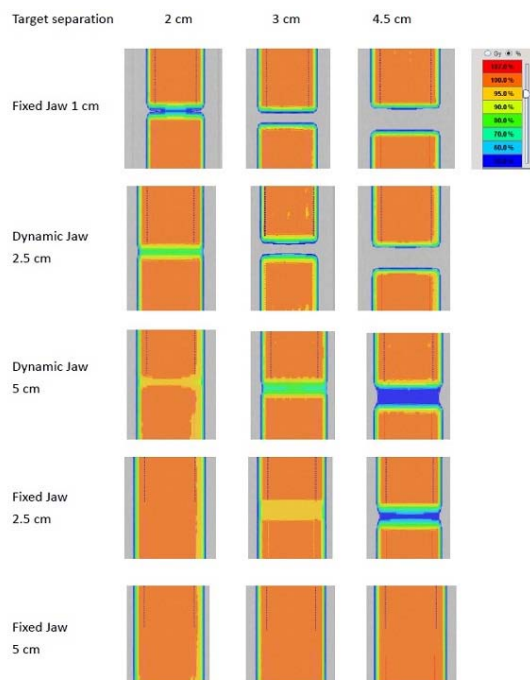


Figure 1. Isodose distribution on the region between targets with different separation using different technique in TomoDirect.

Conclusion: In Dynamic Jaw Technique, Jaw setting is the critical factor for dose reduction between the targets. For target separation not less than 3 cm Dynamic Jaw Technique with 2.5 cm should be used as the dose reduction effect is comparable with 1 cm Fixed Jaw Technique with shorter treatment time.