DVH-Based Stereotactic Plan QA Using Dolphin Detector

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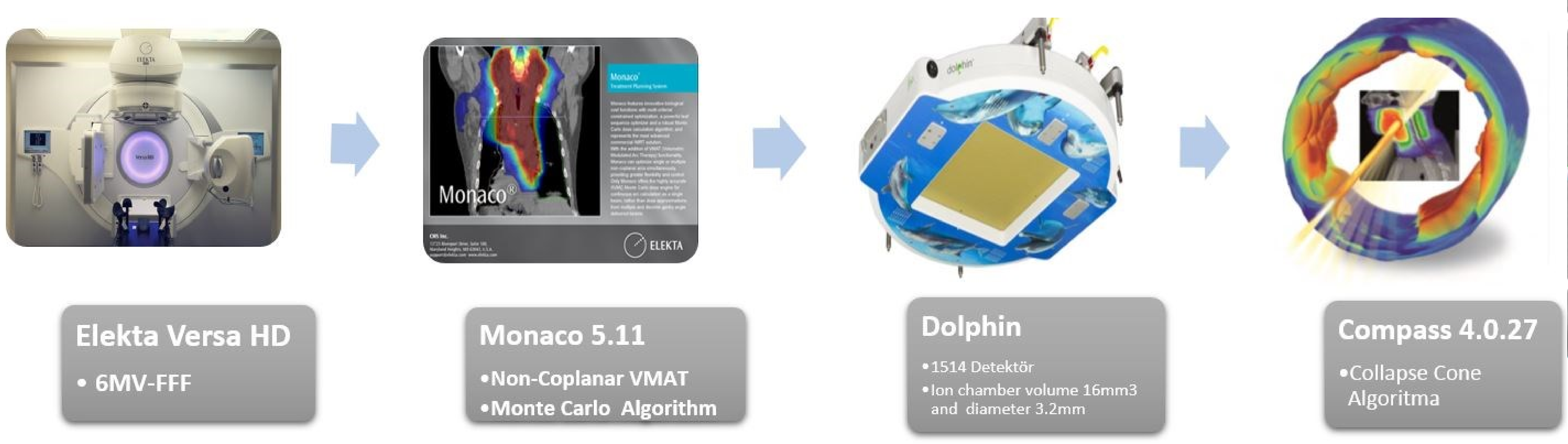
Purpose or Objective:

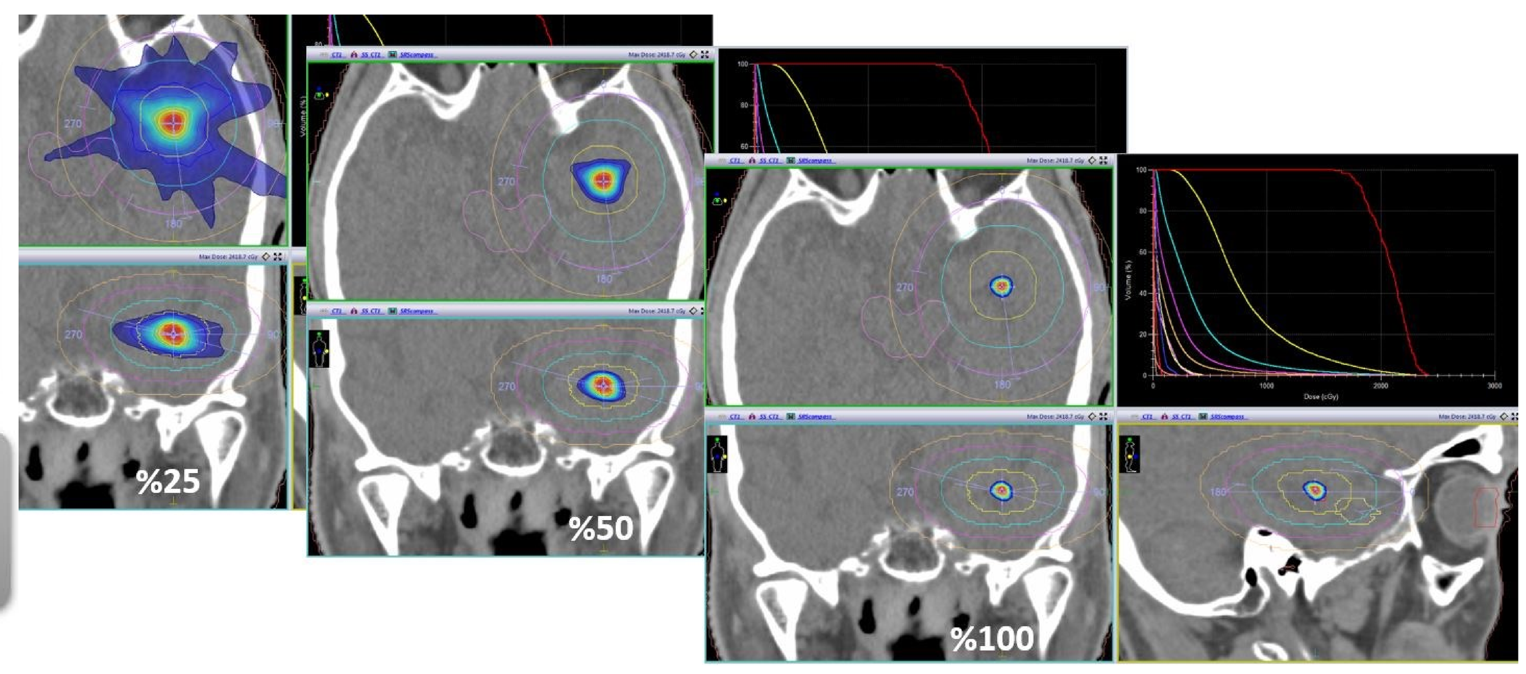
Dolphin's new transmision detector is used in the verification of plans by attaching it to the linac head. We can do DVH-based QA with Compass program. QA experience on stereotactic plans with Dolphin transmission detector and compass DVH analysis program.

Material and Methods:

12 spine SBRT, 20 lung SBRT and 25 SRS/SRT patients were prepared non-coplanar VMAT field plans in the Monaco 5.11 treatment planning system. Patient QA was measured with the Dolphin trasmission detector and evaluated by gamma index analysis in the DVH based Compass 4.0.27 program. In stereotactic plans, treatment is performed with a heterogeneous dose distribution in the target volume and plans with a high dose gradient outside the target. Gamma index values were calculated according to the criteria of 3%-3mm, 2%-2mm, 1%-1mm and 3%-1mm as dose difference and distance to agreement in QA of stereotactic plans. The gamma value of >90% of all points evaluated in two dimensions is not sufficient to detect plan accuracy in stereotactic treatments. For a more detailed analysis, average gamma index values were calculated, which was calculated by taking the numerical values of the gamma values at each evaluated point into account.

Stereotactic plans have a sharp dose fall off with a high dose gradient outside the target. For this reason, the target volumes were given 1cm, 2cm, 3cm and 4cm margins, and the regions to be analyzed in three dimensions were formed. The average gamma index values of these regions were calculated.





Results:

The plans were calculated by Monte Carlo dose calculation algorithm in Monaco planning system. Then the plans transferred to the compass system were recalculated with the Collapse Cone algorithm. Finally, the dose obtained with the Dolphin detector was transferred to the computed tomography images and computed with the collapse cone algorithm. Differences between TPS and Dolphin in SRS/SRT plans, PTV1; 5.1%, PTVaverage; 8.1% and PTV99; 9.2%. Differences between Compass and Dolphin in SRS/SRT plans, PTV1; 2.9%, PTVaverage; 4.8% and PTV99; 6.5%. Differences between TPS and Dolphin in lung SBRT plans, PTV1; 3.5%, PTVaverage; 2.2% and PTV99; 2.6%. Differences between Compass and Dolphin in Lung SBRT plans, PTV1; 2.7%, PTVaverage; 2% and PTV99; 2.6%. Differences between TPS and Dolphin in spine SBRT plans, PTV1; -1.9%, PTVaverage; -5.8% and PTV99; -6.8%. Differences between Compass and Dolphin in spine SBRT plans, PTV1; 3.3%, PTVaverage; -0.47% and PTV99; -1.1%.

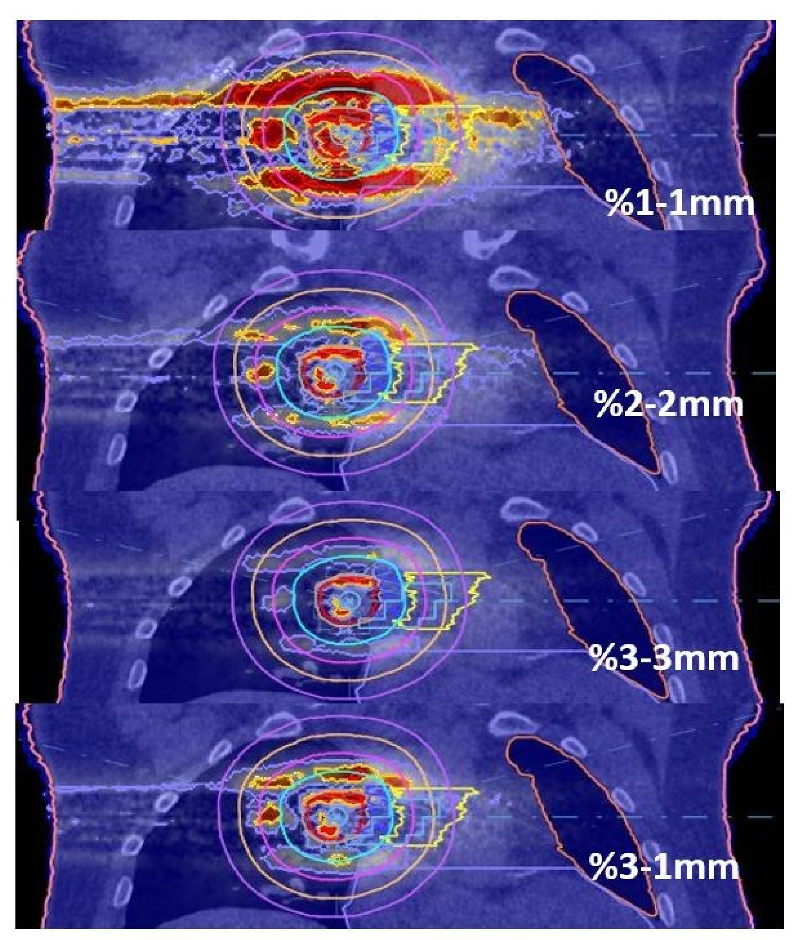
When average gamma values are examined in the regions formed with 1,2,3,4 cm margins in SRS/SRT/SBRT plans; 3%-3mm 0.34-0.6, 2%-2mm 0.51-0.83, 1%-1mm 0.92-1.15, 3%-1mm 0.36-0.86. The most accurate criteria for SRS/SRT/SBRT is 2%-2mm and 3%-1mm. In 2D gamma analysis, SRS/SRT was 96%, lung SBRT was 88% and spine SBRT was 84.1% according to the criteria of %2-2mm. SRS/SRT was 93%, lung SBRT was 83% and spine SBRT was 72.4% according to the criteria of %3-1mm.

Conclusion:

DVH-based analysis has a crucial role in validating stereotactic plans. Evaluating QA from differences in the doses of PTV and OAR is the best way to assess the accuracy of the plan. it is more accurate to analyze according to the criteria of 3-1mm and 2-2mm because it has high heterogenity and gradient index in stereotactic plans. We do a more comprehensive analysis with average gamma.

In high density targets such as spine SBRT, the difference between the monte carlo and collapse cone algorithms increases because the difference between dose to water and dose to medium calculation increases.

The main reason for differences between Monaco and Compass with dolphin measurement is that the plans have high dose gradients and high dose heterogeneity. Especially in small volume PTVs these differences are increasing.



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