

Dynamic Conformal Arc versus Intensity Modulated Radiotherapy for Image Guided Stereotactic Radiotherapy of Cranial Lesion

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Abstract : Purpose: Dynamic conformal arc (DCA) and intensity modulated radiotherapy (IMRT) are two treatment techniques commonly used for stereotactic radiosurgery/radiotherapy of cranial lesions. IMRT plans usually give better dose conformity while DCA plans have better dose fall off. Rapid dose fall off is preferred for radiotherapy of cranial lesions, but dose conformity is also important. For certain lesions, DCA plans have good conformity, while for some lesions, the conformity is just unacceptable with DCA plans, and IMRT has to be used. The choice between the two may not be apparent until each plan is prepared and dose indices compared. We described a deviation index (DI) which is a measurement of the deviation of the target shape from a sphere, and test its functionality to choose between the two techniques. Method and Materials: From May 2015 to May 2017, our institute has performed stereotactic radiotherapy for 105 patients treating a total of 115 lesions (64 DCA plans and 51 IMRT plans). Patients were treated with the Varian Clinac iX with HDMLC. Brainlab Exactrac system was used for patient setup. Treatment planning was done with Brainlab iPlan RT Dose (Version 4.5.4). DCA plans were found to give better dose fall off in terms of R50% (R50% (DCA) = 4.75 Vs R50% (IMRT) = 5.242) while IMRT plans have better conformity in terms of treatment volume ratio (TVR) (TVR(DCA) = 1.273 Vs TVR(IMRT) = 1.222). Deviation Index (DI) is proposed to better facilitate the choice between the two techniques. DI is the ratio of the volume of a 1 mm shell of the PTV and the volume of a 1 mm shell of a sphere of identical volume. DI will be close to 1 for a near spherical PTV while a large DI will imply a more irregular PTV. To study the functionality of DI, 23 cases were chosen with PTV volume ranged from 1.149 cc to 29.83 cc, and DI ranged from 1.059 to 3.202. For each case, we did a nine field IMRT plan with one pass optimization and a five arc DCA plan. Then the TVR and R50% of each case were compared and correlated with the DI. Results: For the 23 cases, TVRs and R50% of the DCA and IMRT plans were examined. The conformity for IMRT plans are better than DCA plans, with majority of the TVR(DCA)/TVR(IMRT) ratios > 1, values ranging from 0.877 to 1.538. While the dose fall off is better for DCA plans, with majority of the R50%(DCA)/ R50%(IMRT) ratios < 1. Their correlations with DI were also studied. A strong positive correlation was found between the ratio of TVRs and DI (correlation coefficient = 0.839), while the correlation between the ratio of R50% and DI was insignificant (correlation coefficient = -0.190). Conclusion: The results suggest DI can be used as a guide for choosing the planning technique. For DI greater than a certain value, we can expect the conformity for DCA plans to become unacceptably great, and IMRT will be the technique of choice.

Keywords : cranial lesions, dynamic conformal arc, IMRT, image guided radiotherapy, stereotactic radiotherapy

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