

Intensity modulation with photons for benign intracranial tumours. A planning comparison of volumetric single arc, helical arc and fixed gantry techniques.

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Introduction

Aim of the present study was to investigate the potential clinical role of a novel treatment technique, RapidArc (RA), expanding a series of investigations^{2,3} performed on small benign brain tumours.

Comparisons have been carried out against consolidated approaches as non coplanar fixed gantry intensity modulation on one side and, to represent rotational modulated delivery methods, Helical Tomotherapy approach.

Material and Methods

Plans for five acoustic neurinomas, five meningiomas and two pituitary adenomas were computed for an Helical Tomotherapy (HT) unit, for RapidArc delivery (RA) on a linac equipped with two types of MLC (RA_HD120 with the new High Definition MLC with 2.5 mm leaf width at isocentre and RA_M120 with the standard Millennium with 5 mm resolution) and for fixed beam IMRT with the High Definition MLC. Analysis was mostly performed on physical quantities derived from Dose Volume Histograms.

Results

Target coverage resulted basically equivalent among techniques. V95% (in %) was higher than 99% for all techniques, minimum significant dose (D99%) was 95.5±1.4 for IMRT, 96.2±1.4 and 97.0±1.2 for the RA_HD120 and RA_M120 approaches and 96.8±1.7 for HT, maximum significant dose (D1%, in %) was 102.2±0.8, 102.7±0.5, 102.4±0.5 and 103.0±1.1 respectively, standard deviation (in %) was 1.4±0.4, 1.3±0.3, 1.1±0.2 and 0.8±0.3 respectively. Conformity Index (CI95%) was 0.47±0.12, 0.46±0.12, 0.43±0.11 and 0.38±0.11 respectively. For organs at risk all techniques respected planning objectives. Concerning the healthy tissue: V10Gy (in %) was 9.4±5.5, 9.9±6.1, 9.2±6.1 and 12.1±8.8 respectively. Integral dose measured on the healthy tissue was: 7.5±3.3, 9.7±3.4, 8.7±3.4, 10.4±4.2 103Gy_{cm}³ respectively.

Discussion

For the class of tumours investigated in this report, HT and RA and IMRT showed similar degrees of target coverage and sparing of organs at risk. Concerning conformity and sparing of healthy brain tissue, some differences were found to be statistically significant.

This new study will allow also comparing to some extent, RA with the other techniques (from stereotactical convergent static beams to protons and to the progenitor of the new commercial VMAT solution of Elekta) from the companion publication.

References

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