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Comparison Between Hyperarc and Conventional VMAT for Single and Multiple Brain Tumors Treated by Stereotactic Radiosurgery

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Purpose/Objective(s): The aim of this work is to evaluate the planning parameters obtain by the HyperArc (HA) planning in comparison with obtained with VMAT planning for stereotactic radiosurgery treatment.

Materials/Methods: VMAT and HA planning were performed for 20 patients, that presented between 1 to 6 brain tumors. The dosimetric parameters for PTV (homogeneity index, HI; homogeneity index ICRU83, HI ICRU83; conformity index, CI; conformity index Paddick, CI Paddick; gradient index, GI; gradient Measure, GM) and brain tissue (V10Gy) were calculated for both planning systems. These parameters were compared besides the physical characteristics (Monitor unit, MU) of both treatments in order to evaluate the difference between both methods.

Results: The results of GM obtained with VMAT (0.49 ± 0.09) and HA (0.46 ± 0.11) planning systems, did not present significant difference ($p = 0.05$), and the same behavior was observed for the values GI for HA (3.53 ± 0.81) and VMAT (3.96 ± 1.45). Although the difference was not significant it was observed that the dose fall-off with HA is higher than VMAT, indicated that normal Brain tissue more preserved. The following parameters, obtained respectively with VMAT and HA, also don't present significant differences ($p = 0.05$) as shown by the results: CI (1.10 ± 0.12 vs. 1.08 ± 0.06), CI Paddick (0.90 ± 0.07 vs. 0.88 ± 0.05). The ICRU 83 parameter obtained with VMAT was 0.36 ± 0.10 and for HA was 0.27 ± 0.06. The t-student test showed significant difference between them with 95% confidentiality. This difference can be explained because in HA planning the maximum dose was not fixed and in this case the algorithm in general try to adjust the same homogeneity index. The VMAT planning the definition of homogeneity index is depending of the person that is planning the treatment. No significant differences in the volume of healthy brain (V10Gy) and Monitor Unit MU were observed. It's important to emphasis that the time spend to planning SRS VMAT was around four times that necessary to obtain the same planning with HA system.

Conclusion: It is possible to conclude that the planning quality with VMAT and HA are similar, but the time for optimization of the procedure with HA is faster than with VMAT, resulting in better resulting in faster patient treatment.

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Improving Radiotherapy Workflow Through Implementation of Delineation Guidelines & AI-Based Annotation

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Purpose/Objective(s): Incidence of breast cancer is increasing as the number of radiotherapy treatments. Delineation of target volumes and organs at risk (OARs) is time-consuming and suffers from heterogeneity. New guidelines have emerged, towards standardizing the process and improving treatment outcomes. The objective of this effort is twofold: assess the benefit of these guidelines and the added value of AI-driven delineation methods in terms of quality and resources gain.

Materials/Methods: A CE-marked solution for automatic delineation of 80+ organs at risk harnessing a unique combination of anatomically preserving and deep learning delineation concept was developed. Using transfer learning the models were re-trained according to the latest ESTRO guidelines, through the integration of 256 cases randomly selected from HYPOG-01 trial. One hundred unseen cases were selected for evaluation: half were delineated based on the ESTRO guidelines (C1) and 50 cases were delineated before guidelines implementation (C2). For each case, automatic delineations (AD) were generated and blended with the ones corresponding to the experts for qualitative and independent evaluation. Overall, 33% of AD structures, 33% manual structures from C1 and 33% manual structures from C2 were scored by 4 radiation oncologist breast experts as A for "No correction required", B for "Minor correction required" and C for "Major corrections required". Correction effort towards moving AD to clinically-acceptable target volumes and OARs (heart, lungs, spinal cord, esophagus and thyroid) were measured in C2 by one expert.

Results: Assessing benefit of guidelines, significant gain was observed on expert delineations between C1 & C2. Some OARs were not delineated before guidelines implementation such as thyroid in 95% of C2 cases. The delineations of experts were assessed clinically acceptable (A+B) for 93% of C1 cases, while the percentage ramped down to 75% in C2. In terms of expert versus AI, 93% of the automated delineations in C1 & C2 were considered as clinically acceptable (A: 49%; B: 44%), reaching human expertise. All target volumes were better scored with AD (92% and 94% of A+B for breast and nodes for AD vs. 86% and 87% respectively for manual delineations). Spinal cord and lungs were better scored using AD (94% and 96% respectively of A) than manual delineation (76% and 91%). On the contrary, 35% of the AD brachial plexus required major corrections (13% for the manual ones). The mean time to correct an AD case was 2.6 ± 1.9 min (4.3 ± 1.6 min for cases with nodal treatment; 1.8 ± 1.0 min without).

Conclusion: This systematic, blinded, random evaluation suggests that using AD in breast cancer has high potential for delineation guidelines propagation, homogenization of practices and time saving. Only minor corrections were required, showing the clinical relevance of the developed software. Evaluation of dosimetric impact of AD is on-going on C2 cohort to validate its major interest in clinical practice.

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Post-Operative Radiotherapy With Intensity Modulated Proton Therapy for Thoracic Malignancies

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Purpose/Objective(s): Post-operative radiotherapy (PORT) in thoracic malignancies has been linked with acute and long-term toxicities with possible detrimental survival impact in localized non-small cell lung cancer (NSCLC) and thymic tumors. Modern radiotherapy (RT) techniques have the potential to improve outcomes by limiting toxicity. Given that the mediastinum and hilum are less subject to breathing related motion, this is an optimal setting in which to use intensity modulated proton therapy