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Clinical implementation of machine learning autoplanning for breast treatments: the CHUV recipe

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Purpose: To report a general framework for the clinical implementation of a machine learning (ML) autoplanning model in RayStation (RS) TPS.
Methods: ML autoplanning was developed for left-sided breast patients under deep-inspiration breath-hold treated with a double-arc VMAT technique. Different ML models (M) were built for two SIB prescriptions, 60/50Gy (M1) and 48/42.4Gy (M2), respectively. There were 4 sequential phases for each model: preparatory, learning, tuning, and commissioning. The preparatory phase aimed to improve the existing dose distributions used as model input for learning while providing a revised list of clinical goals for PTVs and OARs. Model learning was executed by RS. Model tuning was carried out on 5 patients previously treated to improve the automated dose distribution with respect to the clinical one. Commissioning was finally performed on 15 patients comparing automated vs clinical delivered plans.
Results: In the preparatory phase, 87% of plans were redesigned due to missing dose objectives or structures in the existing plan. This lead to improve clinical goals for all OARs ($p<0.05$ for right lung and heart maximum dose) while keeping the same level of target coverage and homogeneity. Model learning required 80 plans for both M1 and M2. M1 was developed first. Tuning for M1 required 4 models by RS before commissioning, while for M2 the second model was directly considered acceptable for commissioning. From the commissioning, autoplans resulted in general better or at least equivalent to clinical plans for both models. Differences statistically significant were observed for target coverage, left lung mean dose and right breast maximum dose for M1 and left lung for M2. The whole process took 6 and 4 months for M1 and M2, respectively.
Conclusion: Clinical implementation of left breast autoplanning in RS was effective. Revision of input data used for model learning and ML model improvement in the tuning phase have to be carried out carefully to avoid suboptimal model outputs.

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