Clinical and Translational Radiation Oncology 33 (2022) 112–114

Contents lists available at ScienceDirect

Clinical and Translational Radiation Oncology

journal homepage: www.sciencedirect.com/journal/clinical-and-translational-radiation-oncology

Technical Note

Development of explanatory movies for the delineation of new organs at risk in neuro-oncology

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A R T I C L E I N F O

Keywords:
Atlas for neuro-oncology
Brain
Organs at risk
Film
Particle therapy
Radiotherapy

A B S T R A C T

Ten new organs at risk (OARs) were recently introduced in the updated European Particle Therapy Network neurological contouring atlas. Despite the use of the illustrated atlas and descriptive text, interindividual contouring variations may persist. To further facilitate the contouring of these OARs, educational films were developed and published on www.cancerdata.org.

Introduction

Accurate and uniform delineation of organs at risk (OARs) is essential to optimise the radiotherapy treatment plan, and thereby to minimise the risk of treatment toxicity. Moreover, it enables to accumulate large quantities of homogeneous toxicity data in the setting of multicentre clinical trials. These data can in turn allow for developing and refining normal tissue complication probability (NTCP) models. Several efforts have already been made in the field of neuro-oncology to uniformise OAR contouring. In particular, the European Particle Therapy Network (EPTN) presented in 2018 a consensus-based contouring atlas [1,2], as well as a summary of the radiation dose constraints for these structures [3]. Recently, an update of the EPTN atlas was published, including a series of ten new OARs (i.e. amygdala, caudate nucleus, corpus callosum, fornix, macula, optic tract, orbitofrontal cortex, periventricular space, pineal gland, and thalamus) [4,5], several of which are thought to be associated with cognitive toxicity [6–9].

Contouring of the ten newly introduced OARs was initiated in our radiation oncology department soon after the updated atlas became available. However, it was quickly apparent that despite the use of the textual description from the article and the illustrations from the atlas, an undesirable level of interindividual contouring variability was still present. The aim of this project was to reduce the inter- and intra-observer variability through the development of explanatory films for each of these new OARs.

Elaboration of the explanatory films

In order to facilitate the implementation of the contouring of the ten new OARs in routine clinical practice, weekly training session were initiated. Sessions were aimed at members of different disciplines involved in OAR contouring in the department (i.e. radiation oncologist

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https://doi.org/10.1016/j.ctro.2022.02.005
Received 11 February 2022; Accepted 11 February 2022
Available online 15 February 2022

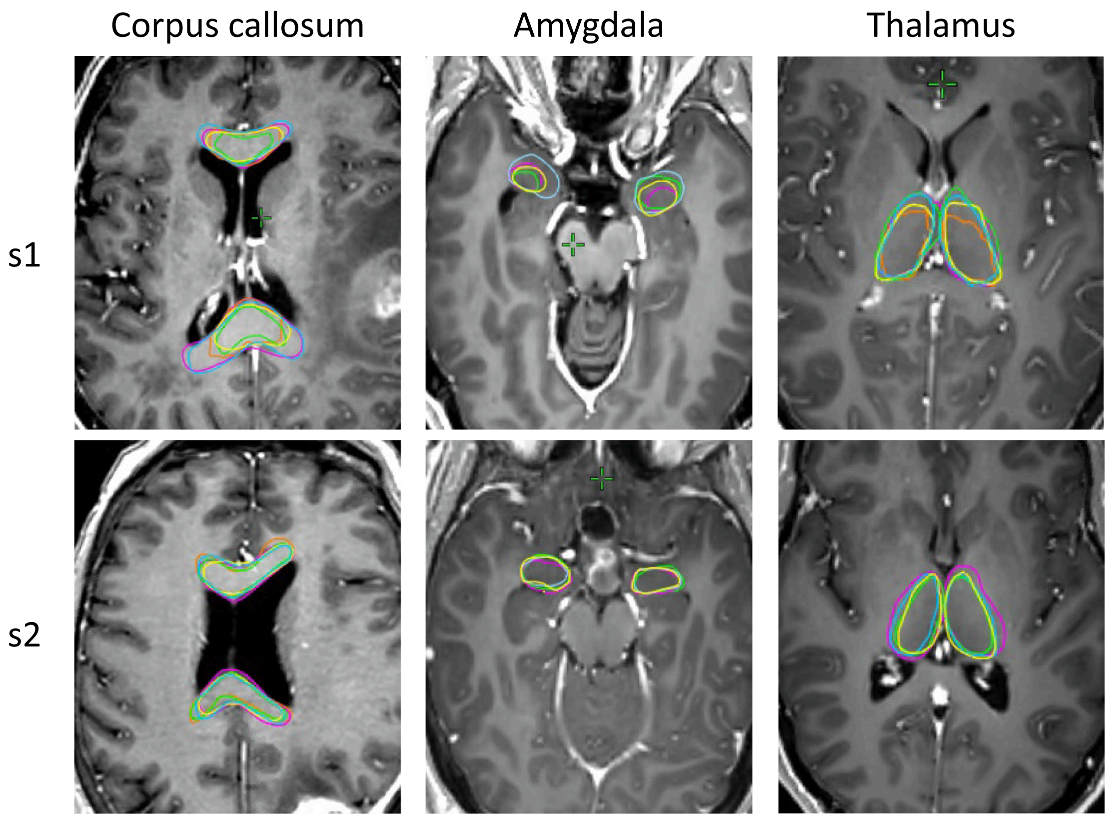

Fig. 1. Inter-individual contouring variability was reduced when comparing the delineations of the participants during the first training session (s1) and the second one (s2), as shown for the corpus callosum, amygdala, and thalamus.

(RTO), radiation technologist (RTT), clinical scientist, and medical student). At each of the sessions, a new OAR was introduced. Before the session, participants were asked to perform the contouring on a patient image set (CT/MR scans), based on the article [4] and the online atlas [5]. During each session, interindividual delineation differences were inspected and discussed with an experienced neuroradiologist (AP). Anatomical boundaries were recalled, most common difficulties were noted, and advice was provided. This OAR was then delineated again during the next weekly sessions on new patient study sets, until visual contouring agreement was reached. At that moment, the OAR was removed from the program of the training sessions. These sessions lead to a quick reduction in interindividual contouring variability (Fig. 1).

In recent times, digital learning has been playing an increasingly important role, which has been even more accelerated by the COVID-19 pandemic [10]. Based on this, educational movies describing the ten new OARs were produced. These movies were designed to be used by the different professionals involved in contouring (e.g. RTO or RTT), with the aim of accelerating the contouring learning curve. The films describe the anatomical boundaries of the OARs and provide tips and tricks to help with the most common difficulties and errors encountered during contouring, with images of different patients. The movies were reviewed and adjusted accordingly by an experienced neuroradiologist (AP), two radiation technologists (LV and HB), two radiation oncologist of our department who did not participate to the meetings (LiV, FH), as well as by an external radiation oncologist expert in neuro-oncology (ET), before being shared online on www.cancerdata.org [11].

Discussion

Delineation atlases are being increasingly used in the field of radiation oncology, both for target volume contouring (e.g. for breast [12], prostate [13], or head and neck (H&N) cancer [14]) and for OARs (e.g. in the H&N region [15]). Such atlases were shown to effectively decrease interindividual contouring variability [16–19].

In the recent update of the EPTN neurological contouring atlas [4,5], ten new OARs were introduced with the aim of further improving the knowledge of radiation-related toxicity in neuro-oncological patients (e.g. cognitive decline). Despite the availability of a written description of the OARs and of the illustrated atlas, interindividual contouring variations can persist, which is highly undesirable. Delineation accuracy and uniformity are essential to the development of new NTCP models or to the refinement of existing ones, with the aim of better predicting treatment toxicity and minimising it on a per-patient basis.

In this context, the use of educational movies could help improving OAR delineation. To our knowledge there is no previous publication on the use of explanatory films in this specific application. Nevertheless, this strategy has long been used in surgical education and was shown to be particularly effective [20].

In the future, automatic contouring is expected to make the task faster and more reproducible [21], thereby reducing its dependency on human time-investment. Nevertheless, uniform manual contouring will still be required, on the one hand, to delineate the scans that are used to train the automatic contouring algorithms and, on the other hand, to critically evaluate the results of automated delineation.

The educational movies are freely available on www.cancerdata.org [11]. These are meant to be used in combination with the 2021 update of the EPTN neurological contouring atlas [4,5]. As this atlas is expected to evolve based on advances in knowledge of radiotherapy toxicity, the videos will be updated when indicated in the future.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

Dario Di Perri is supported by a grant from Fondation Saint-Luc, Belgium.

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