Characterization of the non-dedicated scanning proton beamline for ocular treatment and clinical workflow at CNAO

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CNAO is a synchrotron-based facility equipped with fixed beamlines, treating patients since 2011 with proton and carbon ions (pencil beam scanning modality). More recently, a general-purpose proton horizontal beamline was adapted to treat also ocular diseases [1]. Monte Carlo simulations and experimental dosimetry were performed to optimize the nondedicated eyeline, showing that maximizing the air gap between range shifter (28 mm thick) and pt-specific collimator reduced the lateral dose penumbra of the collimated scanning beam (1.4-1.7 mm). 31 discrete energies (63-90 MeV) were commissioned (32 mm max range). Distal dose fall-off ranged between 1.0 and 1.5 mm. Beam delivery time, for 60 Gy(RBE) in 4 fractions, was around 2-3 minutes per session. Clinical workflow included the main following procedures [2]: straight-ahead reference simulation in supine position based on CT scan and dedicated evetracker; clip-based target location (with fundus image registration) and plan calculation using Eclipse TPS (EOPP); verification CT scan for the planned gaze direction; SOBP calculation using Matlab-based tool and brass collimator production; pre-treatment dosimetric plan verification; in-room treatment set-up verification (stereoscopic x-ray imaging and real-time gaze direction monitoring by the evetracker) and dose delivery, in sitting position. In conclusions, our adapted proton beamline satisfied the requirements for safe and proper treatment of intraocular tumors. Since 2016, 300 patients have been treated so far (75 pts in 2021, 15% of the total).

- 1. Ciocca M et al. Design and commissioning of the non-dedicated scanning proton beamline for ocular treatment at the synchrotron-based CNAO facility. Med Phys. 2019;46(4):1852-1862.
- 2. Via R et al. A platform for patient positioning and motion monitoring in ocular proton therapy with a non-dedicated beamline. Phys Med. 2019;59:55-63.