Purpose:

Quality assurance (QA) is essential in safe and accurate delivery of radiation therapy. However, QA in proton therapy is challenging due to complicated and often facility-specific beam delivery systems and limited beam time for QA. The purpose of this study is to develop an efficient and comprehensive QA procedure for a multi-room proton therapy center using uniform scanning beams.

Methods:

Our proton therapy center is comprised of a 230 MeV cyclotron, one fixed beam room, two inclined beam rooms, and one gantry room. Uniform scanning is employed exclusively in all treatment rooms. A rfDaily QA3 (Sun Nuclear Inc., Melbourne, Florida) together with home-made devices is used for daily QA. Parallel plane chambers, a multi-layer ionization chamber array (Zebra, IBA dosimetry, Schwarzenbruck, German), and an IC profiler (Sun Nuclear Inc., Melbourne, Florida) are used to QA the characteristics of the uniform scanning beams, including output, range, modulation width, flatness, symmetry, and penumbra, for both monthly and annual QA. QA procedures and acceptance criteria were developed, taking into account the likelihood and potential risk of failure, as well as the available equipment, personnel and other resources.

Results:

QA procedures and tolerances were developed for daily, monthly and annual QA at our proton therapy center. Daily QA is performed by radiation therapists, and can be completed within 30 minutes for all rooms. Monthly QA and annual QA are performed by physicists, taking about 4 hours and a weekend respectively. Trend analysis was performed for various machine characteristics, such as machine output, range, flatness, and symmetry.

Conclusion:

QA standards are desired in Radiation Oncology, but not many standards are developed and available for proton therapy. In the mean time, facility-specific QA procedures should be developed based on the equipment failure modes and available resources.