ABSTRACT

Radiotherapy is one of the main methods in cancer treatment, heavily reliant on the accuracy and stability of radiation doses. The Linear Accelerator (LINAC) is a vital device in external beam radiation therapy, which must maintain its dose output within specific stability limits to ensure both treatment effectiveness and patient safety. This study aims to evaluate the daily output stability of 6 MV and 10 MV LINACs using statistical approaches, specifically linear trendline analysis and moving average. The data were collected retrospectively from daily measurements over a period of 8 months, comprising 150 data points for each energy level.

The results showed that daily output values for both 6 MV and 10 MV LINACs remained within the tolerance limits set by the AAPM TG-142 protocol, which is ±3% from the reference value. For the 6 MV LINAC, a slight downward trend was observed with a slope of -0.0025% per day and a coefficient of determination (R^2) of 0.0315. Conversely, the 10 MV LINAC exhibited a very slight upward trend with a slope of +0.00063% per day and an R^2 of 0.0021. The low R^2 values for both energies indicate that output variation is not significantly time-dependent, but rather influenced by daily random or environmental factors.

The 7-day moving average analysis supports the conclusion that the LINAC systems are operating in stable conditions, with minor fluctuations that quickly return to baseline values. Thus, although minor variations were detected, no long-term performance degradation was observed. This statistical approach has proven effective as a tool in Quality Assurance (QA) programs for early detection and preventive maintenance of LINAC systems. The study recommends integrating statistical methods into routine QA practices in radiotherapy facilities to improve accuracy, safety, and the overall quality of clinical services.

Keywords: LINAC, output stability, 6 MV, 10 MV, trendline, moving average, AAPM TG-142, radiotherapy QA