Purpose: To infer the energy spectrum of X-rays from a linear accelerator (Linac) for medical use by use of photon-counting technique. Almost all of the radiation therapy treatment planning system uses the values of energy spectrum of X-rays from a Linac based on Monte Carlo simulations for dose calculation. While energy spectrum of X-rays from a Linac is usually "validated" via percentage depth dose in water, here, we propose a direct method to infer the energy spectrum of X-rays from a Linac.

Methods: An NaI scintillation detector was used to measure the energy spectrum of X-rays (4 MV) from a Linac (Varian Clinac 21-EX). To reduce the rate of photons from Linac, attenuation plate, which is made of lead with 15cm depth, was located in front of the scintillation detector. Scintillation detector was shielded by lead cave to reduce the background photons. Scintillation signal was read by photomultiplier and amplified by read-out electronics and counted by multi channel analyzer. To unfold the measured spectrum, we modeled the relationship between measured spectrum and source spectrum as a linear model. Detector response was calculated by Monte Carlo simulation toolkit EGS5. As an unfolding algorithm, we adopt an iteration algorithm, which was not sensitive with noise and make possible robust calculation for continuous spectrum.

Results: Measured energy spectrum by a scintillation detector was successfully unfolded by use of an iteration algorithm. Resultant unfolded spectrum was consistent with the energy spectrum by Monte-Carlo simulations reported by other authors.

Conclusions: A direct inference of energy spectrum of X-rays from a Linac was proposed and validated.

This technique has a potential to improve the accuracy of energy spectrum which is a base of dose calculation by a modern therapy planning system.