Purpose:To quantify the secondary cancer risk (SCR) induced by daily-anatomical imaging during proton therapy.

Methods:First, we measured the characteristic radiation properties of a diagnostic imaging system used in proton therapy in our institute, digital imaging positioning system (DIPS, IBA, Belgium). Subsequently, we incorporated the measured beam data into a commercial radiation treatment planning system, Eclipse (Varian Medical System, USA) to efficiently calculate the distribution of dosage due to image-guided procedure. The secondary cancer risk additionally induced by the diagnostic-imaging radiation was estimated based on organ-equivalent dose concept. For the analysis, we select a 43-years-old female patient case, in which the patient underwent proton treatment at the treatment site of lumbar spine with prescribed dose of 4600 cGy and 23 fraction size.

Results:It was calculated that the diagnostic-imaging radiation for daily-patient imaging produced relatively small dose of ~4.7 cGy in average in the patient body, which corresponded about 0.1 % to the prescribed dose of 4600 cGy. However, this small dose substantially raise the radiation-induced SCR upto ~8 % in the ordinary patient treatment regimen and can further increase the SCR depending on irradiation conditions, particularly the imaging-field size with respect to targeted-tumor volume.

Conclusions: The present findings strongly suggest that not only the therapeutic radiation but also imaging radiation must be carefully managed in image-guided proton therapy.