

Fundamental study on responsiveness of gel dosimeters to carbon-ion beams and applicability of measurement of three-dimensional dose distribution/ゲル線量計の重粒子線に対する応答性と三次元線量分布測定への適用性に関する基礎的研究

In carbon-ion radiotherapy, the treatment plan is verified by comparing the planned dose and measured dose before treatment. The dose measurement is limited to a portion of the three-dimensional (3D) irradiation region of interest. Gel dosimeters can measure the 3D absorbed dose distribution using the reaction between radiation-sensitive dye and radicals generated by radiation exposure. However, gel dosimeters have the problem of low responsiveness in the position where the dose is localized, such as Bragg peak [1]. In order to solve the problem, this study was performed. Specifically, carbon-ion beams were irradiated onto micellar gel dosimeter and poly(vinyl alcohol) and iodide (PVA-I) gel dosimeter under various beam conditions, and then an optical absorbance and an optical density distribution was measured [2-3]. The results were compared with the absorbed dose distribution estimated by Particle and Heavy Ion Transport code System ("PHITS") [3]. The radical concentration distribution generated in the gel dosimeters was also estimated by liner energy transfer (LET) calculated using "PHITS". Based on these results, we considered the responsiveness of the gel dosimeters at Bragg peak and spread-out Bragg peak (SOBP). We will also introduce examples of the use of "PHITS" in a series of studies.

This collaborative study involved Yokohama National University, Toshiba Energy Systems and Solutions Corp. (Kawasaki, Japan), and Kanagawa Prefectural Hospital Organization. This study underwent an ethical review process and received approval from the Yokohama National University Institutional Review Board (YNU IRB 2020-7-9) on May 13, 2020, and from the Kanagawa Cancer Center (KCC IRB 2020-46), which is part of the Kanagawa Prefectural Hospital Organization, on June 29, 2020.

References

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Primary author: TOYOHARA/豊原, Masumitsu/尚実 (Toshiba Energy Systems & Solutions Corporation/東芝エネルギーシステムズ株式会社)

Co-authors: KUSANO/草野, Yosuke/陽介 (Kanagawa Cancer Center/神奈川県立がんセンター); YAMAMOTO/山本, Seiji/誠二 (Toshiba Energy Systems & Solutions Corporation/東芝エネルギーシステムズ株式会社); SHIMONO/下野, Yoshiaki/義章 (Toshiba Energy Systems & Solutions Corporation/東芝エネルギーシステムズ株式会社); GOTOH/五東, Hiroaki/弘昭 (Yokohama National University/横浜国立大学)

Presenter: TOYOHARA/豊原, Masumitsu/尚実 (Toshiba Energy Systems & Solutions Corporation/東芝エネルギーシステムズ株式会社)

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