Feasibility of Personalized 3D Bolus for H&N Cancer: Applied to Oral Cavity and Supraclavicular Area

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Purpose: The IMRT makes it easier to shape the dose distribution, but side effects such as dry mouth, a sore and inflamed throat, and skin change remain in especially the oral cavity or head and neck cases. In this study, in order to alleviate this, a patient-specific 3d bolus is designed and manufactured, applied to patients, and the dose distribution is evaluated.

Materials and Methods: During CT simulation of an oral cavity patient, a balloon was put in the mouth and air was injected in order to immobilize the tongue as far as possible from the tumor located in the hard palate. The balloon in the oral cavity was made as a 3d bolus structure. In addition, the partial 3d bolus structure was created by extending the gross tumor volume (GTV) to that needs a build-up bolus because it is close to the skin for patients treated with supraclavicular area. The 3d boluses were manufactured using PLA material with 3d printer (3DWOX, Sindoh) and their density were overridden during planning. The manufactured 3d bolus was applied during treatment of each patient, and the in-vivo dosimetry was performed using EBT3 film to evaluate dose of the tumor and surrounding normal tissue.

Results: In the case of an oral cavity patient, a dose of 93.8% compared to the prescribed dose was measured at the tumor location, and it was realized that the tumor was effectively built-up. In addition, a dose of 8% compared to the prescribed dose was measured at the position of the tongue closest to the tumor at a straight distance, indicating that the 3d bolus effectively fixes the tongue so that it is located away from the tumor. In addition, in the case of supraclavicular patient, the area to which 3d bolus was applied showed doses of 91.9~113.5% of the prescribed dose, indicating that an appropriate build-up was achieved for tumor. In other areas, the doses were 68.5~86.1% compared to the prescribed dose, and skin sparing could be observed in the area where the GTV did not contact the skin.

Conclusion: In this study, the dosimetric effects of the patient-specific 3d boluses were verified for head and neck patients that are difficult to apply commercial bolus products.

Keyword: 3d bolus, H&N cancer, dosimetric effect, immobilization effect