Abstract

This study conducted an in-depth evaluation of the stability of Hounsfield Unit (HU) values in three variants of plasticine bolus material, pure silicone rubber (SR), and 6% silicone rubber-tungsten composite (SR-W) during a cycle of 25 fractions of 6 MV photon radiotherapy. Using a Canon Aquilio CT simulator, HU values were monitored periodically every 5 fractions to compare their radiological performance against baseline values. Mechanical testing based on the ASTM D412 standard confirmed SR-W as the material with optimum elasticity, recording the highest tensile strength of 1.17 MPa with an elongation capacity of 210%. In comparison, pure SR showed a figure of 0.8 MPa with an elongation of 185%, while plasticine had significant mechanical limitations with an elongation of only 10-11%, making it more susceptible to permanent deformation. From a radiological perspective, SR-W showed the most superior CT-Number stability with a deviation of only ±0.7% during the fractionation period. Pure SR followed with a fluctuation of 1,96%, while plasticine experienced the most noticeable shift of +8.3% (from 120 HU to 130 HU). Analysis of the impact on the Treatment Planning System (TPS) revealed that although all three materials remained within the clinical tolerance threshold (±20 HU), SR and SR-W provided very high consistency in dose distribution with minimal variability (< 0.1%). Conversely, plastisin showed a downward trend in average dose of 0.23%, which could potentially accumulate in long-term therapy protocols. Overall, the SR-W composite is the most ideal clinical bolus candidate because it integrates highly stable radiological stability, robust mechanical resistance, and excellent flexibility against repeated radiation exposure.

Keywords: *Bolus, Hounsfield Unit, radiotherapy, CT-number stability, tungsten, silicone rubber, plastisin, TPS dose distribution.*