DESIGN AND CHARACTERIZATION OF A NEW HDR BRACHYTHERAPY VALENCIA APPLICATOR FOR LARGER SKIN LESIONS

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Purpose:
The aims of this study were: (i) to design a new high-dose-rate (HDR) brachytherapy applicator for treating surface lesions with planning target volumes (PTV) larger than 3 cm in diameter and up to 5 cm size, using the microSelectron-HDR or Flexitron afterloader (Elekta Brachytherapy) with a 192Ir source; (ii) to calculate by means of the Monte Carlo (MC) method the dose distribution for the new applicator when it is placed against a water phantom; and (iii) to validate experimentally the dose distributions in water.

Materials and methods:
The Penelope2008 MC code was used to optimize dwell positions and dwell times. Next, the dose distribution in a water phantom and the leakage dose distribution around the applicator were calculated. Finally, MC data were validated experimentally for a 192Ir mHDR-v2 source by measuring: (i) dose distributions with radiochromic EBT3 films (ISP); (ii) percentage depth-dose (PDD) curve with the parallel-plate ionization chamber Advanced Markus (PTW); and (iii) absolute dose rate with EBT3 films and the PinPoint T31016 (PTW) ionization chamber.

Results:
The new applicator is made of tungsten alloy (Densimet), and consists of a set of interchangeable collimators. Three catheters are used to allocate the source at prefixed dwell positions with preset weights to produce a homogeneous dose distribution at the typical prescription depth of 3 mm in water. The same plan is used for all available collimators. The Penelope2008 MC code was used to optimize dwell positions and dwell times. Next, the dose distribution in a water phantom and the leakage dose distribution around the applicator were calculated. Finally, MC data were validated experimentally for a 192Ir mHDR-v2 source by measuring: (i) dose distributions with radiochromic EBT3 films (ISP); (ii) percentage depth-dose (PDD) curve with the parallel-plate ionization chamber Advanced Markus (PTW); and (iii) absolute dose rate with EBT3 films and the PinPoint T31016 (PTW) ionization chamber.

Conclusions:
The new applicator and the dosimetric data provided here will be a valuable tool in clinical practice, making treatment of large skin lesions simpler, faster and safer. Also the dose to surrounding healthy tissues is minimal.

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