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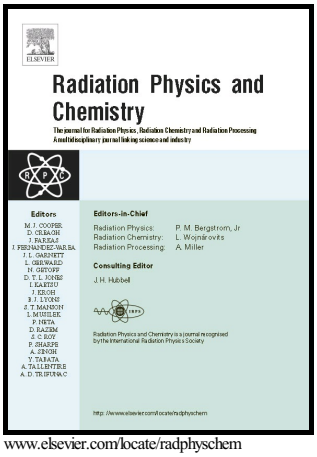

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N. Ade, F.C.P. du Plessis

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Electron beam dose perturbations caused by diode detectors used for in vivo dosimetry: Gafchromic film dose measurements in a realistic pelvic prosthesis phantom

N. Ade and F.C.P. du Plessis*

Medical Physics Department, University of the Free State, PO Box 339, Bloemfontein 9300, South Africa

*Corresponding author: Tel. +27 (0)51 405 2698; E-mail address: DuPlessisFCP@ufs.ac.za

ABSTRACT

Background and purpose:

Diode detectors used for in vivo dosimetry could influence patient dose due to their shadow effect in radiation fields. This study measures the impact of in vivo diodes on therapeutic electron beam dose distributions in a realistic pelvic prosthesis phantom.

Materials and methods:

Two commercially available electron in vivo diodes (the IBA Dosimetry EDP-5^{3G} and Sun Nuclear QED 1112000) were studied. Depth dose measurements for 8 × 8, 10 × 10 and 11 × 11 cm^2 15 MeV electron fields for open beams and with the diodes placed on the central axis (CAX) of the beam were acquired using Gafchromic EBT3 films in a realistic pelvic phantom that contains Ti hip prosthesis and bony structures. Deviations between dose data obtained with and without the diodes in the electron fields were used to evaluate the impact of the diodes on the electron dose inside the phantom.

Results:

CAX depth dose distributions measured using Gafchromic EBT3 film with the diodes in the electron fields on the prosthesis and non-prosthesis sides of the phantom showed dose reductions in the shadow of the diodes compared to dose data acquired in open fields. The average dose reductions recorded along the CAX at depths <= 4.0 cm ranged from 6–8% and 10–13% for the QED and EDP diodes, respectively. In the treatment of epithelial skin cancer or scleredema of Buschke using 10 irradiation fractions, the diodes would reduce the electron dose by approximately 1% if only single IVD measurements are performed. For treatment regimes using 3–5 fractions a dose reduction ≥ 2% would be attained.

Conclusion:

Electron in vivo diodes can induce strong perturbations on patient dose that could influence clinical outcome especially for single-fraction electron treatment of $CD30^+$ lymphoproliferative disorders and accelerated partial breast irradiation delivered by intraoperative radiotherapy using a single dose after lumpectomy or a treatment regime using 3–5 fractions.