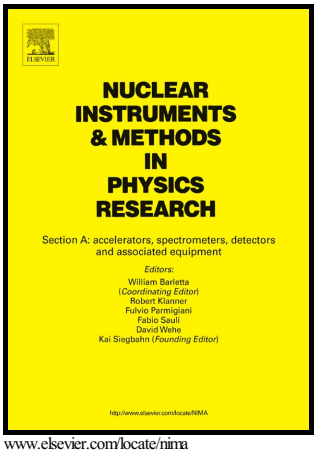
Design, construction and performance evaluation of the target tissue thickness measurement system in intraoperative radiotherapy for breast cancer

Mohammad Reza Yazdani, Saeed Setayeshi, Hossein Arabalibeik, Mohammad Esmaeil Akbari



www.elsevier.com/locate/nima

PII: S0168-9002(16)31333-X
DOI: http://dx.doi.org/10.1016/j.nima.2016.12.065
Reference: NIMA59555

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date: 17 May 2016
Revised date: 31 December 2016
Accepted date: 31 December 2016

Cite this article as: Mohammad Reza Yazdani, Saeed Setayeshi, Hosseir Arabalibeik and Mohammad Esmaeil Akbari, Design, construction an performance evaluation of the target tissue thickness measurement system i intraoperative radiotherapy for breast cancer, *Nuclear Inst. and Methods i Physics Research, A,* http://dx.doi.org/10.1016/j.nima.2016.12.065

Design, construction and performance evaluation of the target tissue thickness measurement system in intraoperative radiotherapy for breast cancer

Mohammad Reza Yazdani

Faculty of Energy Engineering and Physics, Amirkabir University of Technology, Tehran, Iran.

Email: myazdani@aut.ac.ir

Saeed Setayeshi

Faculty of Energy Engineering and Physics, Amirkabir University of Technology, Tehran, Iran.

Tel: +982164545252

Email: setayesh@aut.ac.ir

Hossein Arabalibeik *(corresponding author)*

Research Center for Biomedical Technology and Robotics (RCBTR), Tehran University of Medical Sciences, Tehran, Iran.

Tel: +989122466620

Email: arabalibeik@tums.ac.ir

Mohammad Esmaeil Akbari

Cancer Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Abstract

Intraoperative electron radiation therapy (IOERT), which uses electron beams for irradiating the target directly during the surgery, has the advantage of delivering a homogeneous dose to a controlled layer of tissue. Since the dose falls off quickly below the target thickness, the underlying normal tissues are spared. In selecting the appropriate electron energy, the accuracy of the target tissue thickness measurement is critical. In contrast to other procedures applied in IOERT, the routine measurement method is considered to be completely traditional and approximate. In this work, a novel mechanism is proposed for measuring the target tissue thickness with an acceptable level of accuracy. An electronic system has been designed and manufactured with the capability of measuring the tissue thickness based on the recorded electron density under the target. The results indicated the possibility of thickness measurement with a maximum error of 2 mm for 91.35 percent of data. Aside from system limitation in estimating the thickness of 5 mm phantom, for 88.94 percent of data, maximum error is 1 mm.

Keywords: Breast cancer; Intraoperative electron radiotherapy; Target tissue thickness; Measurement system.