DETERMINATION OF THE EFFECTIVE DOSE IN A RADIOTHERAPY BUNKER

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INTRODUCTION

The main uses of effective dose are the prospective dose assessment for the optimization of radiological protection and the demonstration of compliance with dose limits for regulatory purposes. In recent years, studies have focused on the evaluation of effective dose received by patients during their treatment, including exposure due to diagnostic and setup images before and during treatment respectively. To know the value of effective dose within a radiation therapy bunker can be important in the event of an accidental situation involving the permanence of a worker or the patient's companion, or the conscious loss of the personal dosimeter inside the bunker.

METHODS AND MATERIALS

This study measure effective doses in a radiotherapy bunker using a 6MV photon beam of an Oncor Impression Plus linear accelerator (Siemens Healthineers), 10x10cm^2 field, SSD=95cm, 200MU. Different groups of BeOSL dosimeters (OSL Control Chile) were irradiated. These were positioned on the treatment table at different distances from the isocenter (50, 100 and 150cm). A RW3 solid phantom centered on the beam axis was used as scatter material (Figure 1). The following dependencies were evaluated: gantry and couch angulation, beam energy (6 and 18 MV), monitor units (100 and 200MU), dosimeters orientation (front-back and front-lateral side), and attenuation effect by interposition between dosimeters. The measurements were repeated using Farmer ionization chamber (IC) (PTW Freiburg) located at the same distances from the isocenter and using buildup cap.

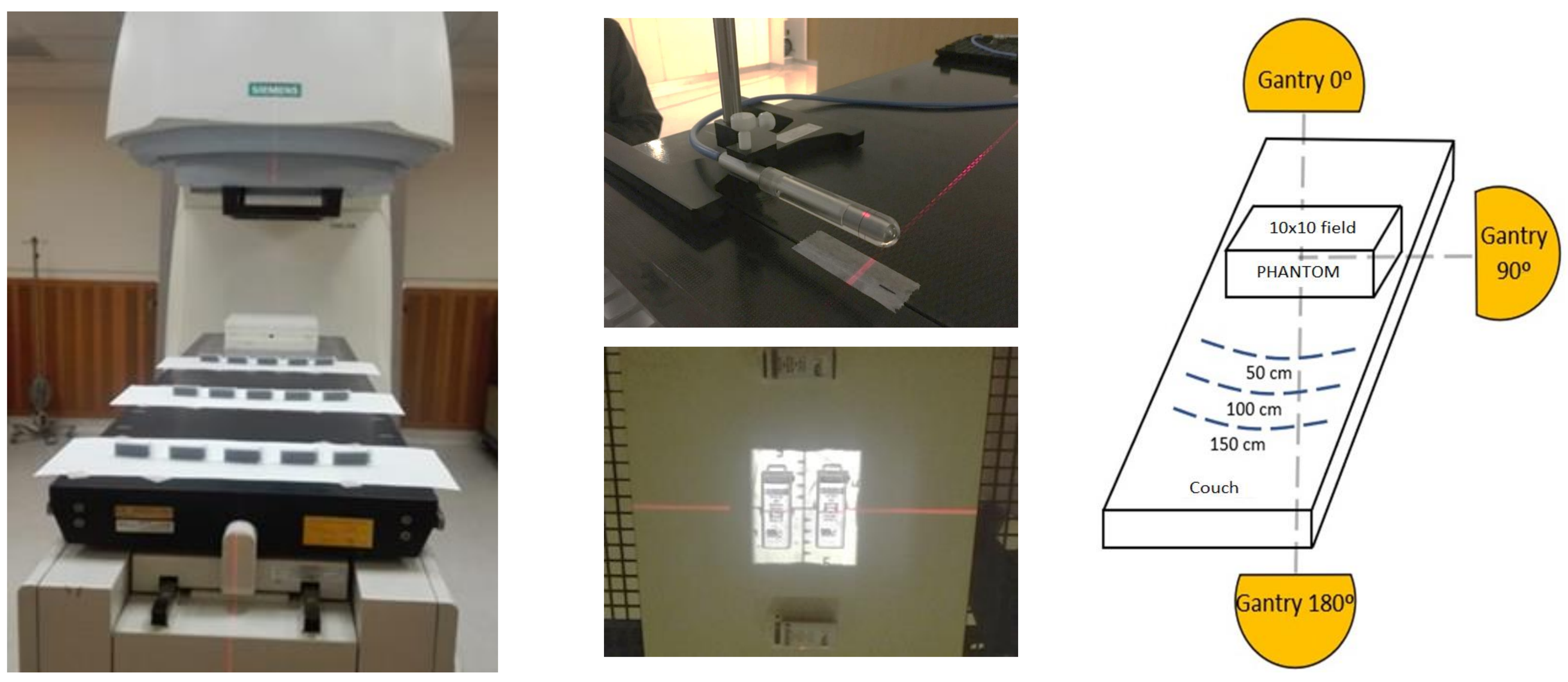

Figure 1. Left: linear accelerator with phantom and dosimeters located on the treatment couch, Up: measurement with ionization chamber (with build-up cap), Down: dosimeters within the 10x10 cm^2 field, Right: location diagram of the dosimeters.

RESULTS

For 0° and 180° gantry angles, the dosimeters within the 10x10 cm^2 field showed a difference of less than 3% between both. For MU dependence, the average deviation between the measurements obtained with the dosimeters and with the IC was below 1%. When comparing the percentage difference between the average values measured for dosimeters and the percentage difference between the average values measured for IC, a difference of less than 5% was obtained for 6MV and less than 7% for 18MV for all distances (Figure 2)

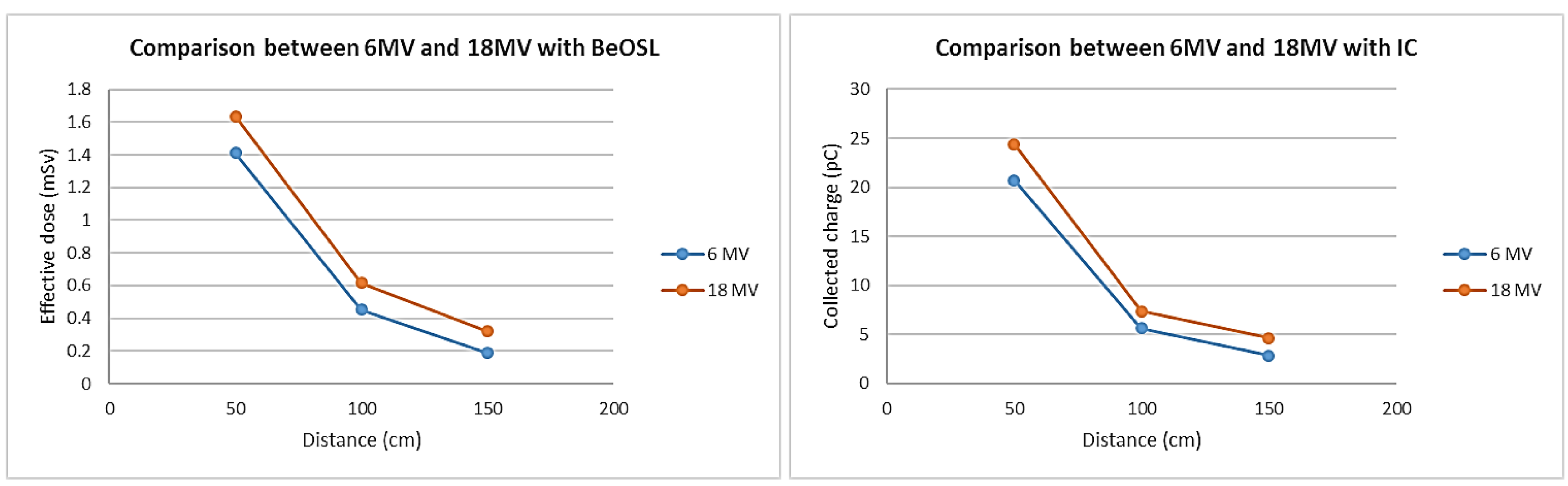

Figure 2. Left: energy dependence measured with BeOSL dosimeters, Right: energy dependence measured with ionization chamber.

The maximum differences obtained when comparing the front vs. lateral side and front vs. back side were 5% and 2% respectively, for all distances. In order to evaluate if the attenuation effect by interposition dosimeters disturbs the effective dose detection 15 dosimeters (5 in each distance) were irradiated, and after each set of 5 dosimeters was irradiated at each distance separately, showing differences less than 5%, being greater for the largest distance (Figure 3).

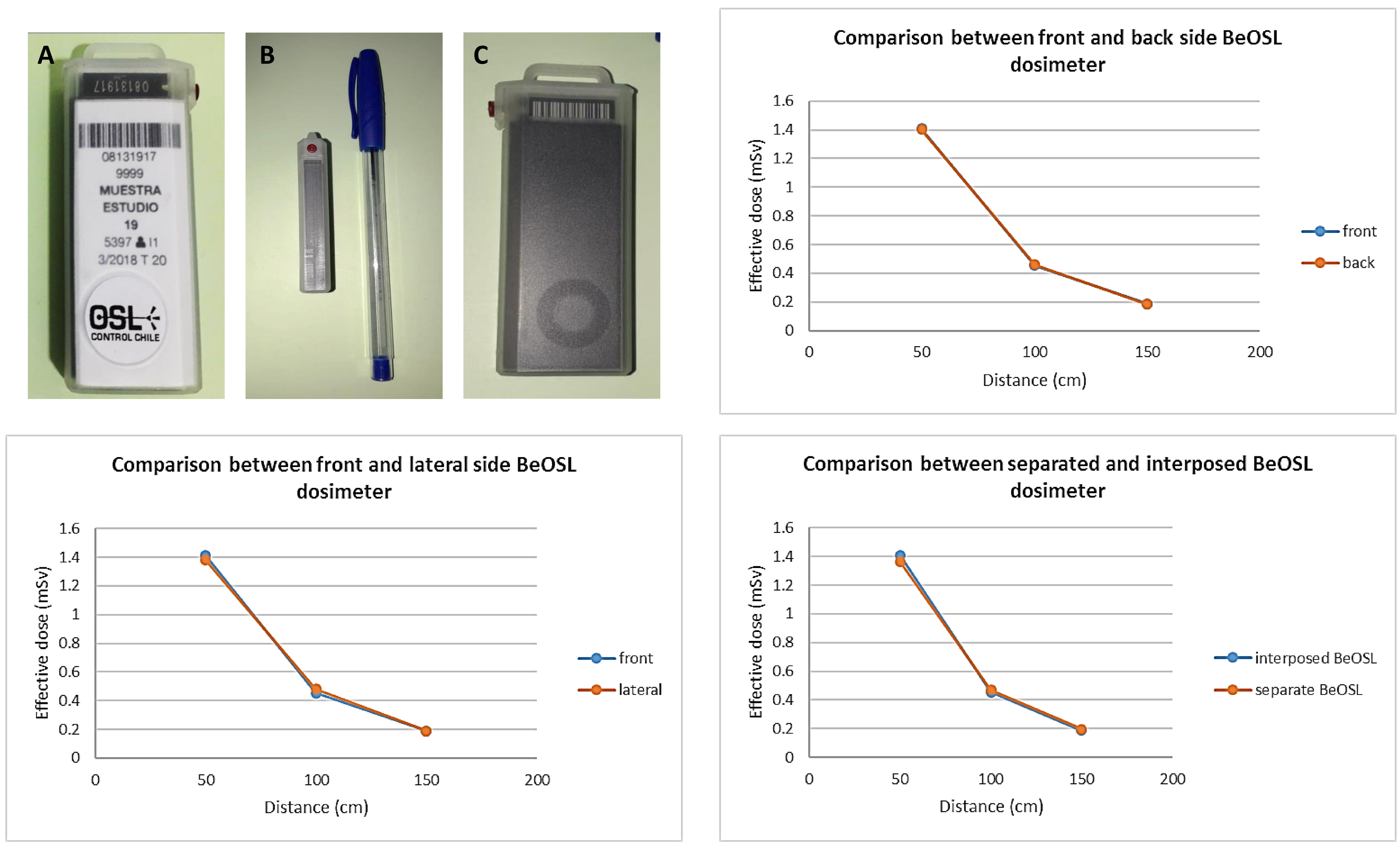

Figure 3. Comparison between different positions of the dosimeters. (6MV, Gantry 0°, SSD=95cm, 10x10 cm^2 field), a. front side, b. lateral side, c. back side

In the case of the gantry and couch angulation dependence, if normalize all curves to 50cm distance, the differences between dosimeters and IC are below 5% for all angles. For 180° gantry angle, the couch attenuation is responsible so that the measurements with dosimeters and IC are significantly much lower than those other gantry angle. Moreover, for couch angulation dependence, the differences between the dosimeters and IC for a same distance are greater than 10%, for all angles, this is due to the accessories holder configuration increase scattering for 90°couch angle (Figure 4).

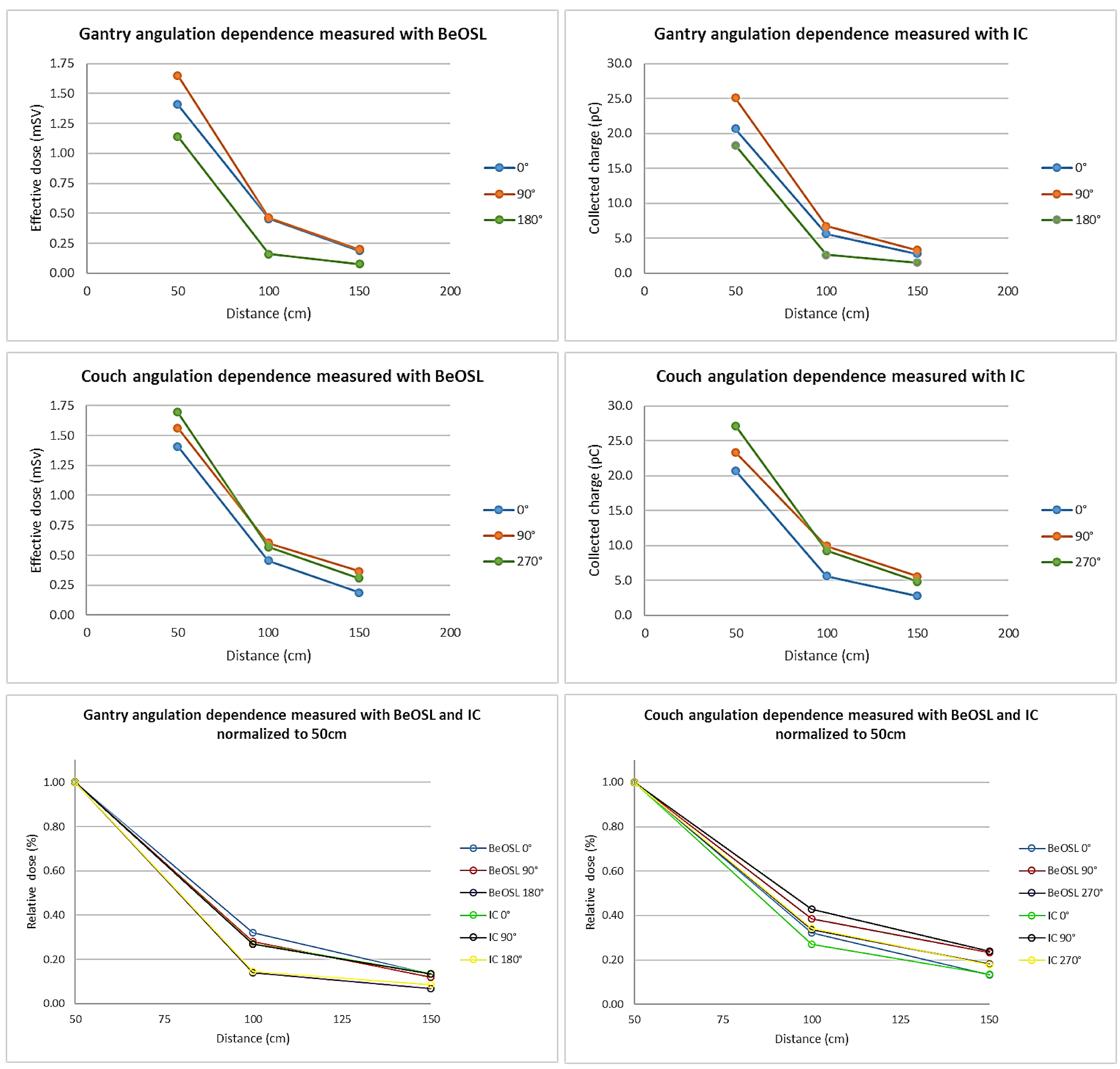

Figure 4. Up: gantry angulation dependence measured with BeOSL dosimeter and IC, middle: couch angulation dependence measured with BeOSL dosimeter and IC, down: gantry and couch angulation dependence normalized to 50cm (6MV, Gantry 0°, SSD=95cm, 10x10 cm^2 field).

CONCLUSIONS

This study establishes the parameters to be taken into account in order to use the BeOSL dosimeters in the determination of effective dose in a radiotherapy bunker and its comparison with ionization chamber. Percentage differences of the measurement dependences are within 5%, except for the 180° gantry angle, and within 15% for couch angulation dependence evaluated. The response of both detectors was similar, which highlights the reliability of the results provided by the OSL dosimeters, since the accuracy and stability of the ionization chamber is known.

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