Study of Parameters Affects the Dosimetry System

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Abstract

Purpose: This paper evaluates the mechanical parameters for three dimensions PTW automatic water phantom system (MP3-S) and its computer controlled measuring system (ME-PHYSTO software version 7.3).

Material and Methods: This study compares the scanning overall speed using the PTW water phantom and PTW ME-PHYSTO software at different levels of overall speed 5, 10, 15, 20, 30, 40, and 50 mm/sec. These measurements are done for depth dose curve, beam profile and diagonal profile using different step intervals and different spatial resolutions (low, medium, and high).

Results: The scanning overall speed for depth dose measurements using PTW water phantom is about 19% to 86% less than the scanning overall speed of MEPHYSTO software at different overall speed levels 5 to 50 mm/sec at 1 mm step size. There is no difference in scanning overall speed between beam profile and depth dose measurements using PTW water phantom, while the scanning overall speed at diagonal profile is about 21% to 55% less than PDD.

Conclusion: This study compared between scanning overall speed using the PTW automated water phantom and PTW MEPHYSTO software. It showed that the scanning overall speed using the PTW water phantom is affected by changing the spatial resolution (low, medium and high) and by changing the scanning type (depth dose and diagonal profile). The facilities in the PTW MEPHYSTO software for increasing the scanning overall speed and saving the measurements time have not achieved its aim. Our recommendations first of all is to add a time factor beside the distance present in hand control of PTW water phantom to enable the user to know the true scanning overall speed, and second is doing quality assurance between the software and mechanical water phantom during the system calibration regularly. On the other hand to move from measurement to others using big step size the system is achieve it's aimed.

Key Words: MEPHYSTO — Depth dose — Diagonal profile — Water phantom.

Introduction

ONCE a new facility in radiotherapy technology has been developed, it is typically implemented first in centers that have a strong physics research team. As the technology matures and becomes accepted among the radiation oncology community, it begins to make its way into the hospitals and freestanding facilities. Accurate data acquisition by any Automatic Water Phantom System requires test prior to use [1-5]. The PTW Automatic Water Phantom System (MP3-S) has new facilities for increasing the scanning overall speed and saving the measurements time. It can measure of pulsed photon and electron radiation from all types of accelerators and continuous radiation from Co-60 and Cs-137 teletherapy units easy and accurate. The user is provided with the greatest latitude in beam data acquisition. The dual channel TANDEM electrometer performs integrated dose measurements easily and reliable in 10 ms. Measuring probes can be positioned to 0.1 mm accuracy at overall speeds of 50 mm/s with PTW MEPHYSTO software version 7.3.

Material and Methods

The PTW water phantom System is used for relative and absolute dosimetry [2] according to different protocols [3]. It is a computer controlled using PTW MEPHYSTO software. This study compares the scanning overall speed using the PTW water phantom and the scanning overall speed using PTW MEPHYSTO software version 7.3 for depth dose curve, beam profile and diagonal profile at different levels of overall speed 5, 10, 15, 20, 30, 40, and 50 mm/sec. This study also illustrates the relationship between the water phantom scanning overall speed and step intervals at different levels of MEPHYSTO scanning overall speed step. The different spatial resolution (low, medium, and high) is considered. With the spatial resolutions you choose whether the step intervals that you have just specified are to be observed (medium) or whether twice the number of steps (low) or only half the number (high).
Results and Discussion

The overall scanning overall speed for depth dose measurements using PTW water phantom and MEPHYSTO software at different interval of step sizes 1, 2, 4, 8, 16 and 20mm with fixed time of measurements as 0.2 second is shown in Fig. (1). The scanning overall speed for depth dose measurements using PTW water phantom and small step size 1mm is about 19%, 40%, 58%, 66%, 77%, 83 and 86% less than the scanning overall speed of MEPHYSTO software at different overall speed levels 5, 10, 15, 20, 30, 40 and 50mm/sec respectively. On the other hand the differences using 20mm step size are 4%, and 47 % less than the scanning overall speed from MEPHYSTO software at different overall speed levels 5, 10, 15, 20, 30, 40 and 50mm/sec respectively. As the step size increase the overall speed differences between mechanical and MEPHYSTO software is decreased.

Fig. (1): The scanning overall speed for depth dose measurements using PTW water phantom and MEPHYSTO software at different step sizes 1, 2, 4, 8, 16 and 20mm.

Fig. (2) illustrates that the difference between the scanning overall speed at diagonal profile and PDD at the same distance with step interval 2mm. The overall speed using diagonal profile scanning for PTW water phantom is about 21%, 29, 31, 39, 52 and 55% less than the PDD for the same water phantom at different overall speed levels 5, 10, 15 and 20mm/sec respectively. While water phantom scanning overall speed is fixed, 12 5mm/sec, at MEPHYSTO scanning overall speed ranged 30 to 50mm/sec. So water phantom scanning overall speed is nearly independent using step intervals, 1mm spatial resolution or less. At step interval 20mm scanning resolution the water phantom scanning overall speed is ranged from 4.8, 9.3, 14.7, 20.8, 26.3, 26.3 and 26.3mm/sec for the scanning overall speed of MEPHYSTO software at different overall speed levels 5, 10, 15, 20, 30, 40 and 50mm/sec respectively. As step intervals increases the water phantom scanning overall speed increases.

Fig. (2): The difference between the scanning overall speed at diagonal profile and PDD at the same distance with step interval 2mm.

At step interval 1mm the water phantom scanning overall speed ranged from 4, 6.6, 8.3 and 10 for the scanning overall speed of MEPHYSTO software at different overall speed levels 5, 10, 15 and 20mm/sec respectively. While water phantom scanning overall speed is fixed, 12 5mm/sec, at MEPHYSTO scanning overall speed ranged 30 to 50mm/sec. So water phantom scanning overall speed is nearly independent using step intervals, 1mm spatial resolution or less. At step interval 20mm spatial resolution the water phantom scanning overall speed is ranged from 4.8, 9.3, 14.7, 20.8, 26.3, 26.3 and 26.3mm/sec for the scanning overall speed of MEPHYSTO software at different overall speed levels 5, 10, 15, 20, 30, 40 and 50mm/sec respectively. As step intervals increases the water phantom scanning overall speed increases.

Fig. (3): The difference between the water phantom scanning overall speed at different spatial resolution with step interval 2mm for medium and its low and high spatial resolution.

Fig. (3) shows the difference between the water phantom scanning overall speed at different spatial resolution with step interval 2mm for medium and its low and high spatial resolution.
olution you choose whether the step intervals that you have just specified are to be observed medium at 2mm step or whether twice the number of steps (low 4mm step) or only half the number (high 1mm step) are to be carried out. As the step intervals decreases the spatial resolution increases, so the spatial resolution means change in step intervals.

Table (1) illustrates the effect of MEPHYSTO scanning overall speed (5, 10, 15, 20, 30, 40 and 50mm/sec) and step intervals at 2, 4, 8 and 20mm on the water phantom scanning distance for depth dose and profile measurements. By evaluate the effect of MEPHYSTO scanning overall speed and step intervals on the scanning distance we found there is no any effect on the water phantom scanning distance.

Table (1): The effect of MEPHYSTO scanning overall speed on the water phantom scanning distance at different step intervals 2, 4, 8 and 20mm for depth dose and profile measurements.

<table>
<thead>
<tr>
<th>MEPHYSTO scanning overall speed (mm/sec)</th>
<th>Step intervals (mm)</th>
<th>Depth dose scanning distance (cm)</th>
<th>Profile scanning distance (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2 4 8 20</td>
<td>30</td>
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<td>10</td>
<td>2 4 8 20</td>
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</table>

Conclusion:

This study compared between scanning overall speed using the PTW water phantom and PTW MEPHYSTO software. It showed that the scanning overall speed using the PTW water phantom is affected by changing the step intervals, as step intervals increases water phantom scanning overall speed increases. The PTW water phantom scanning overall speed is affected by the scanning type (depth dose and diagonal profile). The facilities in the PTW MEPHYSTO software for increasing the scanning overall speed and saving the measurements time have not achieved completely its aim. On the other hand to move from measurement to others using big step size the system is achieve it’s aimed. Our recommendations are, first of all is to add a time factor beside the distance present in hand control of PTW water phantom to enable the user to know the true scanning overall speed, and the second is doing quality assurance between the software and mechanical water phantom during the system calibration regularly.

References


