ABSTRACT SUBMISSION FORM

Please email to: info@mriinrt2018.com with 'abstract' as the subject

6th MR in RT Symposium 2018

Name (First, last)	Jarrad Begg
Mailing address (including province/state, country, postal/zip code)	Liverpool Cancer Therapy Centre, Locked Bag 7103, Liverpool BC, NSW, Australia, 1871
Institution/organization	Liverpool and Macarthur Cancer Therapy Centre and Ingham Institute for Applied medical Research
Position	Medical Physicist
Telephone (including country prefix)	+61 2 87389408
Email	Jarrad.begg@health.nsw.gov.au

The submission is to be considered in the following category	Trainee status
☒ Oral presentation preferred	☒ I am a trainee (student or postdoctoral fellow)
☐ Poster presentation only	☒ I wish to be a candidate for best student paper/poster

PRESENTATION TITLE

Experimentally derived ion chamber magnetic field correction factors using a variable field on an in-line MR-linac

AUTHOR(S)

Jarrad Begg[1,2,3] *, Urszula Jelen[1,2], Brendan Whelan[2,4], Bin Dong[1,2], Natalia Roberts[5], Gary Liney[1,2,3,5], Lois Holloway[1,2,3,4,5,6]

1. Department of Medical Physics, Liverpool and Macarthur Cancer Therapy Centre, Sydney, Australia
2. Ingham Institute for Applied Medical Research, Sydney, Australia
3. South Western Sydney Clinical School, School of Medicine, University of New South Wales, Sydney, Australia
4. Radiation Physics Lab, University of Sydney, Sydney, Australia
5. Centre for Medical Radiation Physics, University of Wollongong, Wollongong, Australia
6. Institute of Medical Physics, School of Physics, University of Sydney, Sydney, Australia

ABSTRACT

Purpose:
Reference dosimetry is a fundamental measurement for any clinical treatment machine. Ion chamber response has been shown to change in magnetic fields due electron pathlength changes through the chambers resulting in a change in dose measured[1]. The Australian MR-Linac utilises a unique rail system, allowing the movement of chambers into different magnetic field strengths whilst maintaining a constant source to chamber distance[2]. This work investigates the use of the sliding rail system to measure the magnetic field correction factor for chambers.

Materials & Methods:
The Australian MR-linac has the unique rail system allowing the linac to be slid from a relatively low to high magnetic field position. Output correction factors for chambers at different magnetic field strengths were determined by: 1) Measuring the magnetic field along the MR bore, and 2) Positioning a chamber at known magnetic field strengths and measuring the output whilst maintaining a constant source to chamber distance.

The magnetic field was measured using a HGM09s Guassmeter (MAGSYS, Germany, s/n: 011215007) over a distance of 1250 mm from the MR isocentre back toward the linac source along the vertical and horizontal axis of the bore.

A FC65-G farmer chamber (IBA dosimetry, Belgium, s/n:819) was placed in solid water, with 2.5 cm build-up to chamber central axis to eliminate electrons focused toward the central axis. The source to chamber centre was kept constant throughout the measurements at 2184±1 mm. A constant field size was used. The linac source to MR isocentre distance was varied between 3280-2480 mm during the measurements. The MR isocentre to ion chamber central axis distance was varied between 1100 to 300 mm. Linac output was corrected by a farmer

Name (First, last)	Jarrad Begg
Mailing address (including province/state, country, postal/zip code)	Liverpool Cancer Therapy Centre, Locked Bag 7103, Liverpool BC, NSW, Australia, 1871
Institution/organization	Liverpool and Macarthur Cancer Therapy Centre and Ingham Institute for Applied medical Research
Position	Medical Physicist

chamber (NE2571, s/n:2543) placed between the linac source and MLC in a 10 MV build-up cap. Repeat measurements at the furthest and closest position to the MR isocentre were performed using a diamond detector(PTW Frieburg TW60019, Germany, s/n: 122279) as the reference positioned 6 cm behind the central axis of the chamber. Previous monte carlo measurements have shown that inline magnetic field to have minimal impact on a diamond detector[3].

Results:

The magnetic field with respect to distance from MR isocentre is shown in figure 1a. Also shown is the measurement points used for the magnetic field correct factor. Figure 1b shows the calculated correction factors at different magnetic field strengths. The error bars represent the reproducibility as determined by repeat measurements at the maximum and minimum source to isocentre distance. Measurements using the diamond detector as a reference showed a correction of 0.992±0.001 at 1 T.

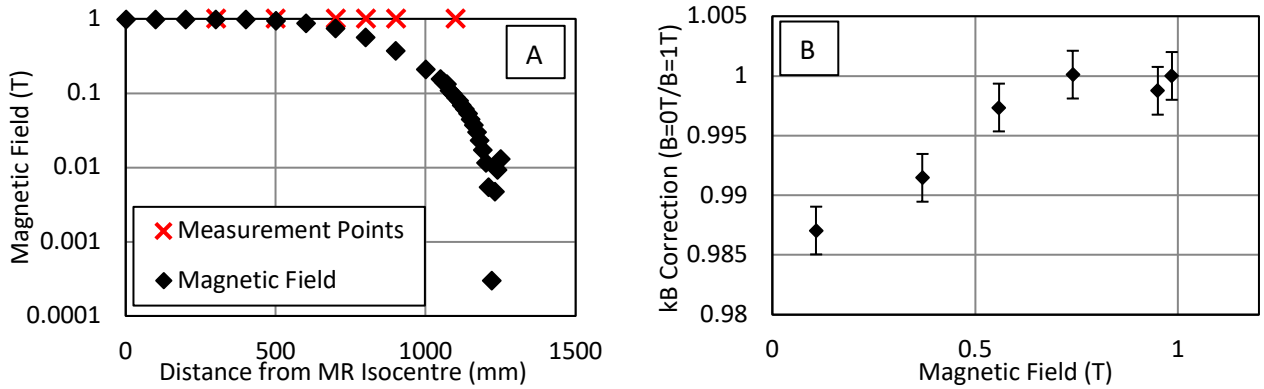

Figure 1: A) Measured magnetic field on the Australian MR-linac and measurement points used for ion chamber measurements, B) Correction factors derived from measurements in different magnetic field strengths.

Alanine dosimetry was previously used to measure a correction factor of 0.990±0.012 at 1 T for the FC65-G farmer chamber used in this work[4]. A monte carlo response of ~0.99 was simulated for similar Farmer chambers (NE2571 and PRO6C) for in-line orientated MR-linacs at 1 T[5].

Conclusions:

The presented measurements were able to determine a magnetic field correction factor for a farmer ion chamber similar to previously measured and simulated results. The methodology used can be used to measure correction factors for other dosimeters.

References:

1. Meijsing, I., et al., *Dosimetry for the MRI accelerator: the impact of a magnetic field on the response of a Farmer NE2571 ionization chamber.* Physics in medicine and biology, 2009. **54**(10): p. 2993.
2. Liney, G.P., et al., *Experimental results from a prototype high-field inline MRI-linac.* Medical Physics, 2016. **43**(9): p. 5188-5194.
3. Reynolds, M., B. Fallone, and S. Rathee, *Dose response of selected solid state detectors in applied homogeneous transverse and longitudinal magnetic fields.* Medical Physics, 2014. **41**(9).
4. Billas, I., et al. *Reference dosimetry measurements in the Australian MRI-linac.* in *World Congress on Medical Physics and Biomedical Engineering*. 2018. Prague, Czech Republic.
5. Reynolds, M., B.G. Fallone, and S. Rathee, *Dose response of selected ion chambers in applied homogeneous transverse and longitudinal magnetic fields.* Medical Physics, 2013. **40**(4):