Real-Time In-Vivo Dose Tracking for Scalp Cutaneous Lymphoma Treated with Electron: First Time Application of e-PSD for Patient Dose Tracking

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INTRODUCTION

Studies on plastic scintillating detector (PSD) have demonstrated <1% agreement with the planned doses[1].

PSD has the advantages of small spatial resolution, water equivalence, and real-time dose tracking capability. There are studies on the clinical application of PSD in external beam radiation therapy (EBRT) and high-dose rate (HDR) brachytherapy for real-time patient dosimetry [2].

The OARtrack system (Angiodynamics, USA) allows real-time in-vivo dosimetry for patients receiving electron beam therapy.

AIM

This study is the first one that reported the clinical use of the PSD in electron beam radiotherapy for patient with cutaneous lymphoma..

METHOD

- Electron beams of 6MeV, 9MeV, 12MeV, 15MeV, and 18MeV, with 10x10 cm^2 field size and 100cm SSD, were used to deliver 200cGy at d_{max}. Calibrated parallel ion chamber was used for output verification in the phantom.
- Calibrations for e-PSDs and TLDs were performed in the same setup. e-PSD measurements were repeated three times for each energy.
- The patient was treated with 30Gy in 15 fractions using 9MeV electron beam and using 1 cm customized bolus.
- Two e-PSDs and two TLDs were placed under the bolus at the field center and on the field edge , respectively, during CT simulation (Fig. 1).
- e-PSDs were contoured in the planning CT (Fig. 2) and compared with the measurements. Two measurements (once every 5 fractions) were acquired throughout the treatment.

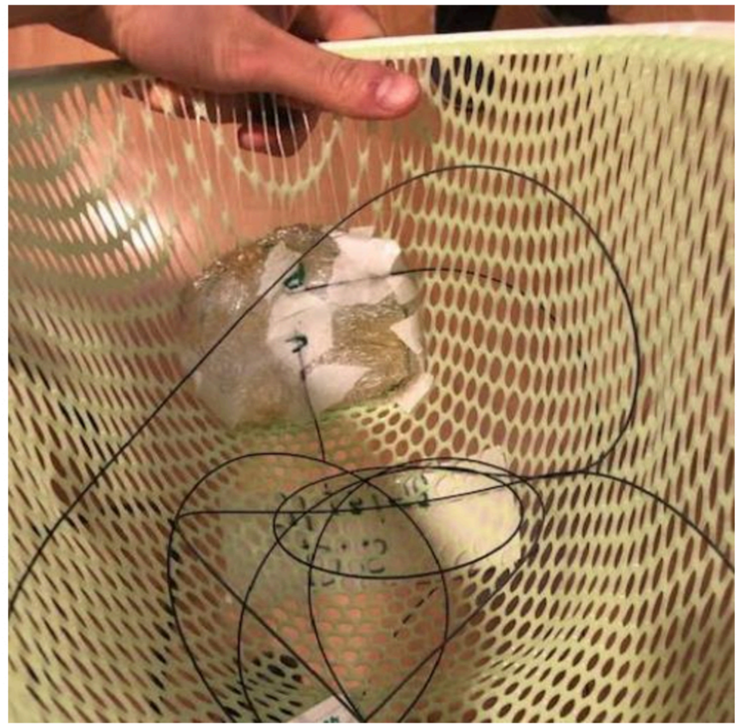

Figure 1. Two PSDs, one center detector and one peripheral detector (red arrows), were placed underneath the thermal plastic mask and custom bolus. TLDs (purple arrows) were placed next to the PSDs.

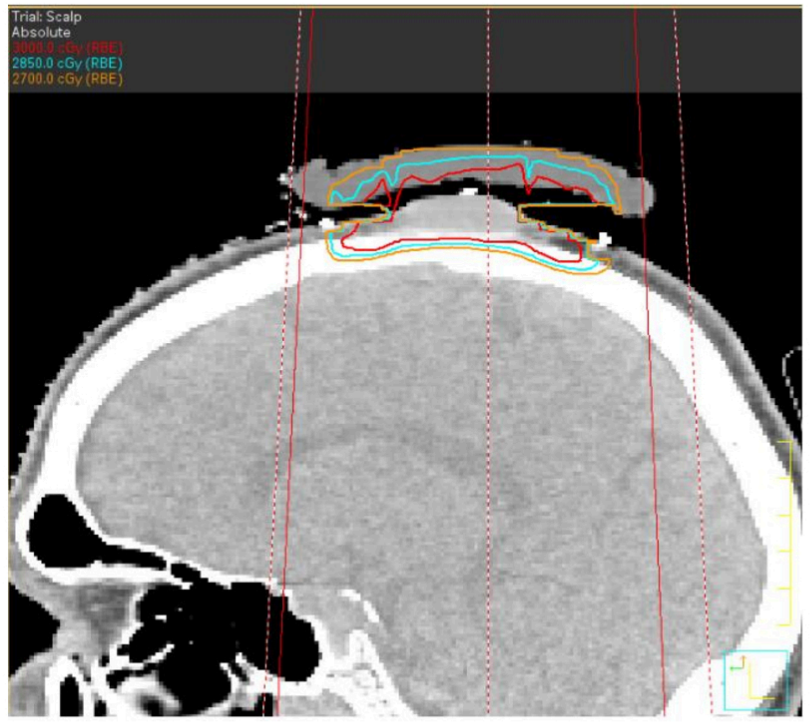

Figure 2. PSDs were imaged during CT simulation and contoured in the treatment plan (red arrow). Expected doses were achieved from the treatment plan.

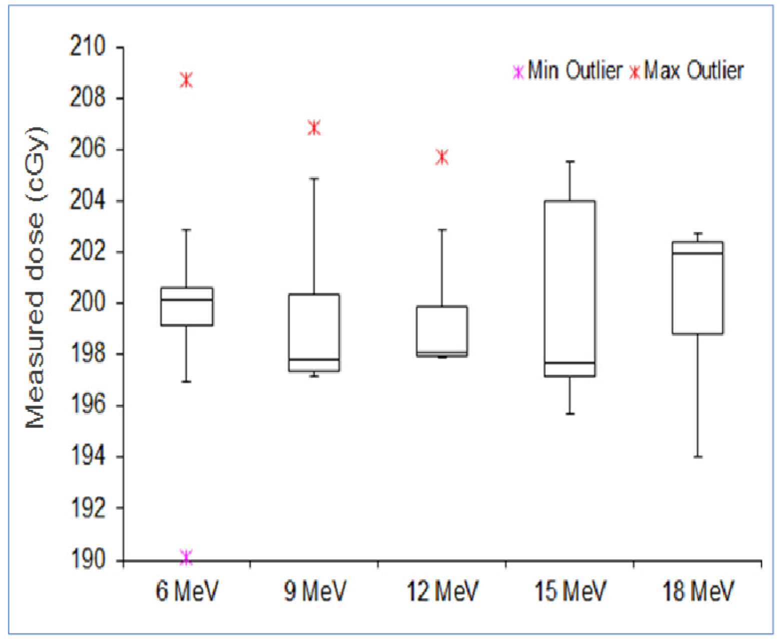

Figure 3. PSDs measurements for all electron energies

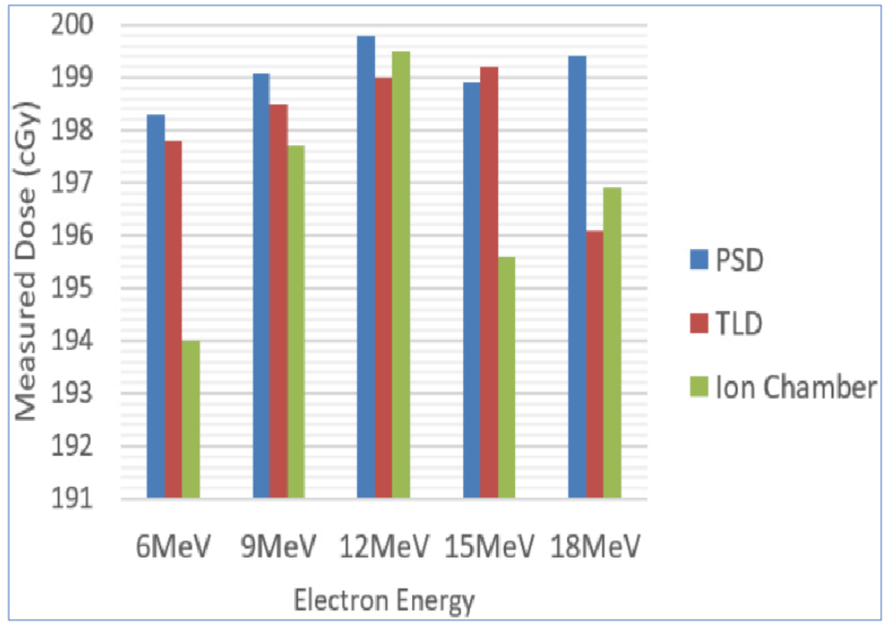

Figure 4. PSD, TLD, and ion chamber measurements in solid water phantom for all electron energies

RESULTS

- Figure 3. demonstrated the e-PSD measurements for 6MeV, 9MeV, 12MeV, 15MeV, and 18MeV.
- Figure 4 compared e-PSD measurements with those achieved from TLD and ion chamber. Ion chamber measurements were more affected by volume averaging effect.
- From the electron beam plan, the expected/calculated doses at the field center and periphery were 205.2cGy and 202.4cGy, respectively.
- Clinical measurements with PSDs at the center and edge were 211.6$\pm$1.5cGy and 208.3$\pm$1.1cGy, respectively while TLDs at the center and edge were 210.9$\pm$2.7cGy and 207.4$\pm$0.6cGy, respectively.
- The difference between expected and measured doses were all within 3%.

CONCLUSIONS

The e-PSD measurements agreed closely with TLD results in-vivo patient dosimetry and may be clinically used for dose tracking. However, a phantom based baseline measurement is highly recommended before clinical application.

REFERENCES

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