IMRT Dose Verification using One Scan Radiochromic Film Dosimetry

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EBT3+FilmQAPro™ Professional Users Meeting
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Acknowledgements

Advanced Materials Group, Ashland Inc.
1361 Alps Road, Wayne. NJ 07470

Providing the EBT3 and FilmQAPro 3.0
Equipment and Tools

- Varian Trilogy Linac
- Memorial Sloan-Kettering IMRT/VMAT TPS
- EBT3 films (lots # A101711, A012412)
- FilmQAPro 3.0
- Epson 10000XL flatbed scanner
- Four 5-cm thickness polystyrene phantoms
Energy Dependence of the New EBT3 Film’s Dose-response Curve

Chiu-Tsao ST, Massillon-JL G, Domingo-Muñoz I, Chan MF.
SU-E-T-96, 54th annual meeting of AAPM, Charlotte, NC, July 28-August 2, 2012
Benefits and Limitations of EBT2/EBT3 Film Dosimetry

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<th>Time</th>
<th>Spatial Resolution</th>
<th>Dynamic Range</th>
<th>Energy Independence</th>
<th>Tissue Equivalence</th>
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M.F. Chan, EBT3+Film QA<sup>TM</sup> Professional Users Meeting, 53<sup>rd</sup> annual meeting of AAPM, Vancouver, Canada, July 30-August 4, 2011
Linearization of Dose Response Curve of the Radiochromic Film Dosimetry System

What is “One Scan” Radiochromtic Film Dosimetry?
One Scan Protocol

- Simplifying calibration
  - Simple rational function fitting
  - Less number of points required
  - Master calibration curve per film lot

- Combining calibration and measurement in a single scan
  - One known dose and one background to rebuild the master calibration curve
One Scan Film Dosimetry Method

**Step 1 Master Curve** ➔ **Step 2 One-Scan Digitization** ➔ **Step 3 Overlay & Analysis**

- **Lot-dependent**
- **(4t, Cal. dose=80-100%*D_m)**
- **(DD, DTA, Gamma)**
EBT3 film with triple-channel dosimetry
Lesions: 195% (63Gy)  
WB: 100% (32.25Gy)  
Hippocampi: 18% (< 6Gy)

**Whole Brain 32.25 Gy/2.15 Gy daily**  
**Concurrent boost to lesions 63 Gy/4.2 Gy daily**
Radiochromic Film Dosimetry Procedure

Import Plan via DICOM

Export via R&V System

Flatbed Scanner

Plan vs. Measurement

Expose Phantom
Validation of One Scan Protocol (1)

IMRT: 30 min vs. 72 hr Post-exposure  VMAT: Portrait vs. Landscape Orientations
Validation of One Scan Protocol (2)

4-point calibration: 98.0% (2%/2mm)  
7-point calibration: 98.1% (2%/2mm)
Validation of One Scan Protocol (3)

MapCHECK2: 99% (2%/2mm)  EBT3 Film: 98% (2%/2mm)  EPI Dose: 97% (2%/2mm)

VMAT: EBT3 Film (97%:2%/2mm)  VMAT: AC-3DVH (99%:2%/2mm)
Benefits of One Scan Protocol

- Fitting function matched to behavior of the film
- Fewer exposures and less film required
- One scan to eliminate scan-to-scan variability
- Ability to obtain accurate results in minutes

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Conclusions

One Scan Radiochromic Film Dosimetry provides a practical solution for routine IMRT/VMAT QA without sacrificing spatial resolution for convenience.