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EASTERN TIME [GMT-4]

Implementation of New QA Method for Source Sector Movement Verification in Gamma Knife Radiosurgery

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INTRODUCTION

Gamma Knife (GK) is the gold standard for radiosurgery since 1960's. The structure of the GK unit has undergone several transformations all these years. The latest development in GK dose sculpting process is accomplished through sector design in collimator configuration. The sector movement is an analogy to MLC in linac based treatment. Routine QA checks are required to monitor the performance of sectors for radiation delivery.

AIM

A study to implement new source sector movement QA method in Gamma Knife Radiosurgery using film dosimetry.

METHOD

- For this study 50 shot irradiation plan simulating source sector movement (SSM) with varying x, y & z coordinate position was generated using three inbuilt collimators 4, 8 & 16mm in the control console of Gamma Knife Perfexion unit (GKPFX).
- The EBT3 films (Ashland ISP Advanced Materials, NJ) of size 3.5x3.5cm^2 were positioned in the spherical water phantom and mounted in the GKPFX couch at coordinate position x, y & z=100.
- The films were exposed to varying doses from 0 to 12Gy for calibration purpose.
- A film from the same batch of size 5x5cm^2 was placed inside same phantom for 50 shot irradiation with treatment time of 15 minutes.
- The same irradiation procedure was repeated on daily basis for three consecutive days on three separate films of same batch.
- The exposed films were scanned using high resolution Epson Expression10000XL scanner with image resolution of 720 dpi, saved in tiff format and were further analyzed using in-house developed MATLAB software codes.

RESULTS

The 50 shot plan irradiation displayed similar dose distribution pattern in each film exposed on three consecutive days. The film exposure comparison between first and third day showed close agreement of 91% and 98% pixel pass rate at 2%/2mm and 3%/3mm gamma pass criteria respectively (Figure 2a & 2b). The isodose overlay and line profile comparison of EBT3 films of first and third day exposure were in close agreement and showed less than 3% dose difference (Figure 3). The spatial dose distribution patterns generated by SSM with varying coordinate positions and collimator sizes are not verified as a periodic QA in GKPFX.

Figure 1: EBT3 film calibration for doses 0, 0.8, 1.6, 3.2, 6.4, 12.8 Gy respectively.

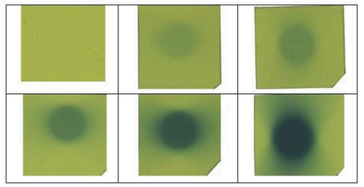
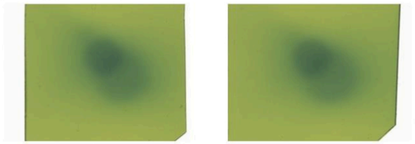


Figure 2: EBT3 film 50 shot irradiation of source sector movement verification (a) First Day and (b) Third Day.



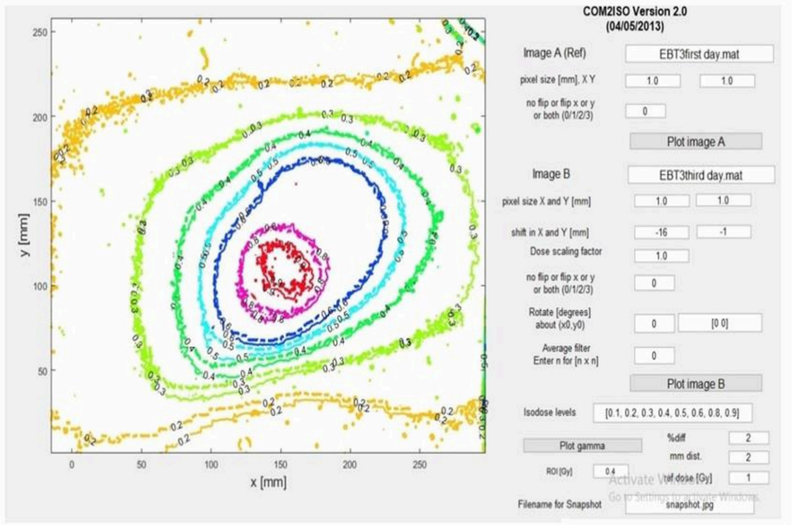


Figure 3: Isodose overlay comparison of EBT3 film irradiation performed on first day & third day using In-house Developed Matlab GUI for film dosimetry.

Figure 4: EBT3 film positioned in EPSON 10000XL scanner for scanning.

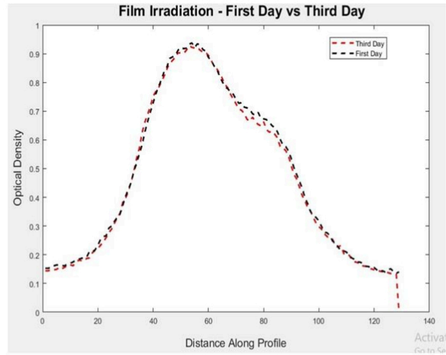


Figure 5: Line Profile comparison of EBT3 film irradiation performed on first day & third day using In-house Developed Matlab GUI for Film Dosimetry.

CONCLUSIONS

Verification of SSM is essential before treatment delivery in GKPFX as subtle variations in sector movement may have clinical significance. We propose this QA test to be done on daily or weekly basis for GKPFX.

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