Use of EPIDs for Routine Linac QA

E. Van Uytven, J. Beck, T. Van Beek, P. McCowan, B. McCurdy
Division of Medical Physics
CancerCare Manitoba
Winnipeg, Manitoba

Disclosure

Our research group receives funding from Varian Medical Systems

Introduction
Impetus

- TG-142 outlines a number of linac QA tests to be performed daily, monthly, and annually.
- Due to constrained resources, efficiency is desired in performing these tests!
- EPIDs are well suited for performing many daily and monthly tests.
- We will review several EPID QA tests performed at our centre, including outputs, picket fences, profile constancy.

EPIDs

- EPID – electronic portal imaging device.
- Developed in the 1980’s and 1990’s for anatomic imaging of the patient.
- Investigated for dosimetry applications sporadically in the 1990s.
- Significant interest for dosimetry applications in 2000s.

EPIDs suited for QA dosimetry

- Commonly available.
- Automated deployment.
- Real-time digital imaging.
- Imager properties are favourable (linear, no deadtime…).
- Automated analysis and reporting.
**EPID** – uses megavoltage x-rays (therapy beam)

4MV imaging system – diagnostic quality imaging

Good geometric reproducibility (1mm lat/long, 3mm vert sag)

- Current EPID design – aSi flat panel imager
- Metal plate, phosphor scintillator, array of photodiodes
- 40cm x 30cm size, 1024x768 (aSi1000)

Automated QA framework
Image Acquisition Infrastructure

LINUX BOX

Daily Output Checks

QA fields
Photon Outputs

- Run by therapists during morning warm up
- Delivered in QA mode
- Fully automated analysis, PDF emailed to dosimetry group in the event of marginal/fail results.

Process flow (for photons)

What about electron outputs?

D’OH!
The process (for electrons)

EPIDReporter GUI
Who watches the watchers?

- Secondary monthly solid water check/cal in addition to yearly TG-51 cal.
- Monthly calibration of EPID baselines as necessary.

Who watches the watchers?

- Scheduled task running on a separate Windows machine ensures that all outputs have been gathered and processed.
- Checks photons at noon and electrons at 8pm

Picket Fence/RapidArc QA
RapidArc QA

Commissioning and quality assurance of RapidArc radiotherapy delivery system.

PURPOSE: The purpose of this study was to determine the accuracy of RapidArc, a new radiotherapy treatment system, in terms of dose delivery and treatment planning.

MATERIALS AND METHODS: The study was performed on a RapidArc radiotherapy system. The accuracy of the system was evaluated using a phantom and patient-specific plans. The results were compared with those of a conventional radiotherapy system.

RESULTS: The accuracy of the RapidArc system was found to be comparable to that of the conventional system. The results showed a mean deviation of 0.1 mm for the phantom and 0.15 mm for the patient-specific plans.

CONCLUSIONS: The results of this study demonstrate the accuracy and reliability of the RapidArc system in delivering radiotherapy treatments. The system is a promising new technology for improving the precision of radiotherapy treatments.
EPID profile constancy is not trivial.
Epid profile constancy is not trivial

For 40x30 cm² field (Epid+arm)-(Epid) = Max 6%

Important profile information removed

Cannot simply reverse the operation
So we fit the flood field

- Keep the beam profile, remove other nonsense
- Divide flood field into radial 'sectors'
- Fit n-degree polynomial to each sector
- Final corrected image is applied to acquired EPID image via division to “reintroduce” the actual profile
- This ASSUMES backscatter component of FF = 20x20
- Do this once a month.

Winston-Lutz
AWOL pixels

400 MU? 380 is fine, right??

RTU-K EPID – Output World Tour
Complicated hardware

The big payoff, aka it's worth the headache

Discussion

- EPIDs provide a fast, convenient, efficient, and cheap solution to some of the challenges of routine linac QA
- It's not a panacea. EPIDs themselves must be QA'd and kept on a tight leash
- There is a significant overall benefit and increase in QA throughput however.
Thank you, eh?

MEANWHILE

IN CANADA