Online dosimetry with the Integral Quality Monitor

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Overview

First clinical tests from Sept 2015 to Oct 2016, followed by long-term constancy checks from Oct 2016 to Feb 2017. Pre-treatment QA is then followed by irradiation and online plan verification.

Clinical implementation.
IQM-Detektor in general

- **one** ionization chamber
- ⇒ **loss** of distinct spacial resolution of dose distribution
- one signal per segment
- ⇒ **online intra-fraction plan** verification
IQM user interface ("MonitorApp")
Long-term signal stability (cumulative)

- Maximum deviations: ±1% & no systematic long-term trend
- ⇒ for clinical use: good stability of cumulative signals
Long-term signal stability (segment-by-segment)

- After linac maintenance: signal deviations per segment increase
Long-term signal stability (segment-by-segment)

Definition of new reference required, after maintenance
Error detection sensitivity: introducing plan errors

![Graph showing the original field and IQM-reference](Image)

- Leaf # vs. Position [cm]
- Orig. field
- IQM-reference
Error detection sensitivity: introducing MLC-errors

\[ \text{IQM-signal?} \]
Error detection sensitivity: introducing MLC-errors

![Graph showing the impact of MLC-errors on IQM-signal](image)
Error detection sensitivity: introducing MLC-errors

\[ \Rightarrow \text{IQM-signal?} \]
Error detection sensitivity: introducing dosimetric errors

IQM vs. DVH-Pmetrics bzw. $\gamma$-values

- Error detection sensitivity: introducing dosimetric errors

- IQM-signal?
Impact of errors on IQM-signals

- 15 VMAT-plans: 5 prostate (PC), 5 breast (MC), 5 head-and-neck (HN)
- 10 different errors over all segments, each
Correlation: IQM vs. $D_{\text{mean}}(\text{PTV})$ bzw. $\gamma$ (3% / 3 mm)

![Graph showing correlation between IQM and $D_{\text{mean}}(\text{PTV})$](image1)

![Graph showing correlation between IQM and $\gamma$ values](image2)

- $R^2 = 0.97$
- $R^2 = 0.89$
- $R^2 = 0.82$
Treatment plan verification (cumulative)

- calculation vs. measurement
- baseline shift of IQM-signal deviations indicates slight systematic miscalculation
- → all plans were verified with the 2D array + octavius phantom
Conclusion and outlook

- IQM can potentially replace 2D-array plan verification
- very good dosimetric properties and sensitivity
- calculated signal needs to be improved

- definition of error tolerances
- comparision of the IQM with other transmission detectors