Software and algorithms for online medical dosimetry with luminescence detectors

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Outline:
1. Luminescence signals
2. System (including software)
3. Treatment terminology
4. In vivo online measurements

Luminescence dosimetry using Al₂O₃:C crystals

1. Spontaneous luminescence
   - Radioluminescence (RL)
   - "Prompt signal" ~ dose rate

2. Stimulated luminescence
   - Thermoluminescence (TL)
   - Optically stimulated luminescence (OSL)
   - Delayed signal ~ dose (passive dosimetry)

Brachytherapy needle

Optical fibre cable

Lighttight probe w. crystal

Improved dose verification for brachytherapy

Arhus University Hospital & Rise
Danish Medical Research Council

Improved dose verification

for brachytherapy

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Key features:
- All optical (remote readout)
- Small size
- Suitable for in vivo use
- High precision
- High sensitivity

Lighttight probe w. crystal

System software

Acquisition hardware interface
- Realtime
- Standardization
- Flexibility (different protocols)
- Documentation

How?
- Tailored hardware-near software
  with text scripts

Programmed in Labview (National Instruments)

Vision – Improved safety in brachytherapy

Dose verification

Direct online comparison of time-resolved in vivo point measurements and the treatment plan dose predictions for those positions.
Online clinical measurements

Arhus University Hospital & Risø

Two Risø ME03 luminescence readers

Data acquisition and presentation

The Al₂O₃:C dosimeter probes

Brachytherapy with Ir-192 gamma source (~1 Ci)

Medical dosimetry at Risø 2008

Now part of the Technical University of Denmark (DTU)

Close collaboration with the University hospitals in Malmö, Århus and Copenhagen (Rigshospitalet and Herlev)

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Conclusions

1. Single windows application with text scripts (job files) for different protocols
2. Online medical dosimetry example:
   Improved safety for brachytherapy with Århus Univ. Hospital
3. Time resolved measurements contain much information (good for point measurements)

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