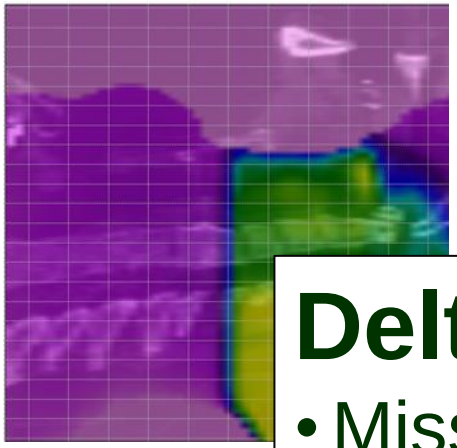
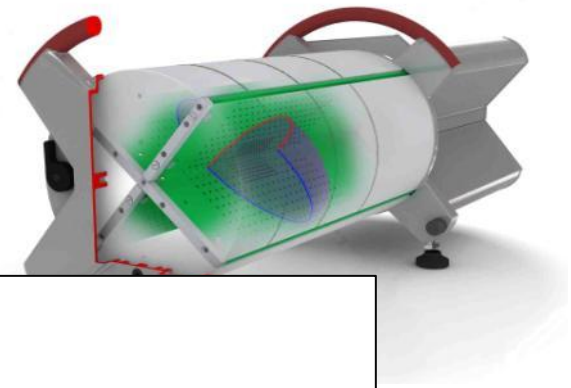
ScandiDos

Delta^{4PT} 3D and DVH Professional + Anatomy Option

Thomas Matzen

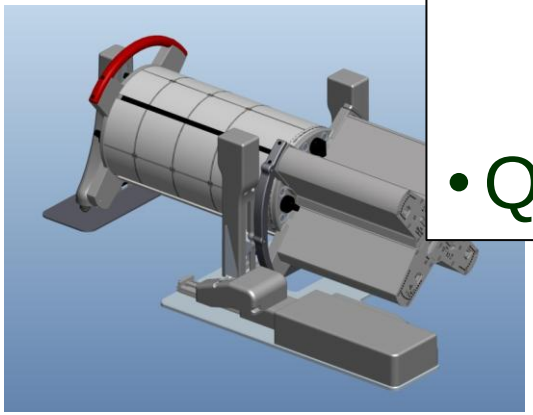
The Growing Delta^4 Family





Delta^{4PT}

- Misst dort, wo's drauf ankommt
- Dosis per Organ…
  - im Phantom
  - im Patienten
- QS: klinische Relevanz (seit 2007!)



ScandiDos

Qualitätssicherung?

Per-beam, planar IMRT QA passing rates do not predict clinically relevant patient dose errors[a)]

Benjamin E. Nelms[b)]
Canis Lupus LLC and Department of Human Oncology, University of Wisconsin, Merrimac, Wisconsin 53561
Heming Zhen
Department of Medical Physics, University of Wisconsin, Madison, Wisconsin 53705
Wolfgang A. Tomé
Department of Human Oncology, Medical Physics, and Biomedical Engineering, University of Wisconsin, Madison, Wisconsin 53792

(Received 29 September 2010; revised 28 December 2010; accepted for publication 30 December 2010; published 31 January 2011)

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Conclusions: There is a lack of correlation between conventional IMRT QA performance metrics (Gamma passing rates) and dose errors in anatomic regions-of-interest. The most common acceptance criteria and published action levels therefore have insufficient, or at least unproven, predictive power for per-patient IMRT QA. © *2011 American Association of Physicists in Medicine*.
[DOI: 10.1118/1.3544657]

Key words: IMRT QA, IMRT, quality assurance

I. INTRODUCTION

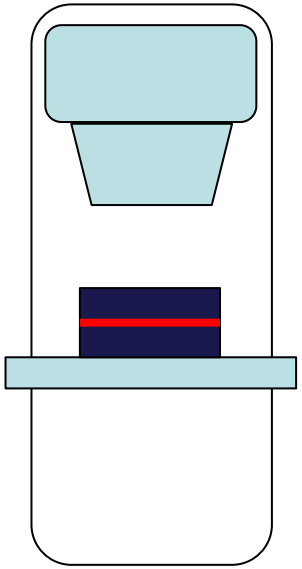
In modern radiation therapy, each patient treatment plan is customized and unique. In the case of intensity-modulated radiation therapy (IMRT), each treatment field can be highly complex and justifies quality assurance (QA) to verify (1) the treatment planning system's (TPS) ability to calculate the dose accurately and (2) the delivery system's ability to deliver the dose accurately. A very common method of per-beam planar IMRT QA is to measure the dose to a flat phantom and compare to the TPS calculated dose in the same geometry, a method summarized in a recent published survey.[1]

I.A. Published studies on IMRT QA acceptance criteria

There have been many studies on suggested acceptance/action levels for planar IMRT QA.[2–7] Some of these studies base action levels on retrospective statistical analysis of the performance levels/metrics that have been achieved over many plans and IMRT beams.[2,3] It has been suggested that meeting such action levels should be a requirement in order to take part in clinical trials.[6] In a recent report of the AAPM Task Group 119 (Ref. 5) and, in fact, the other studies[2–4] as well, the "3%/3 mm" criteria is common, employed as either the composite distance-to-agreement (DTA) metric or the

0094-2405/2011/38(2)/1037/6/$30.00

"Per-beam, planar IMRT QA passing rates do not predict clinically relevant patient dose error"[1]



[1]Nelms *et al*: Per-beam, planar IMRT QA passing rates do not predict clinically relevant patient dose errors. Med. Phys. 38 (2), February 2011

ScandiDos

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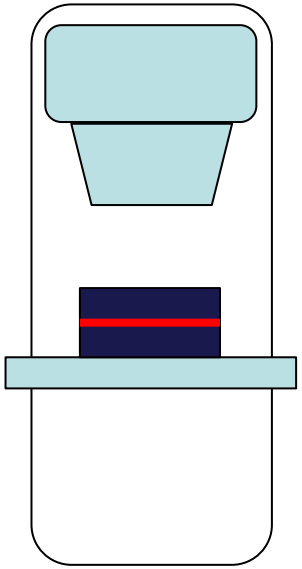

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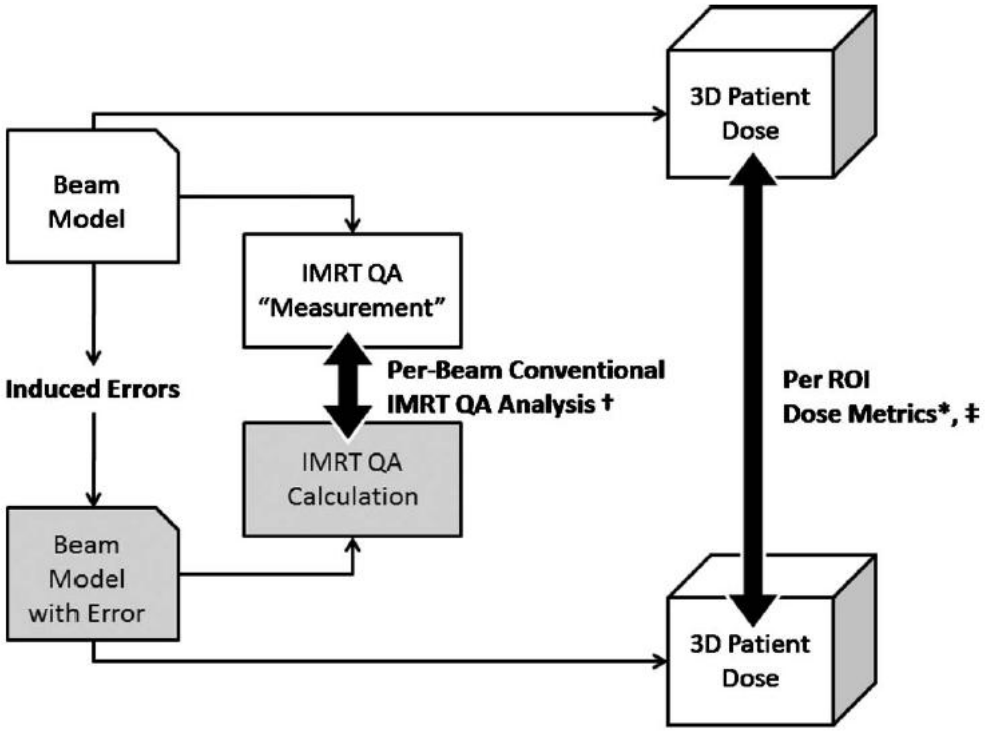

† Using full density (film equivalent) planes and high resolution (1 mm x 1 mm) pixels
* Max dose and D1cc (cord), mean dose (parotids, larynx), and D95 (CTV60)
‡ Comparison metrics were generated blind

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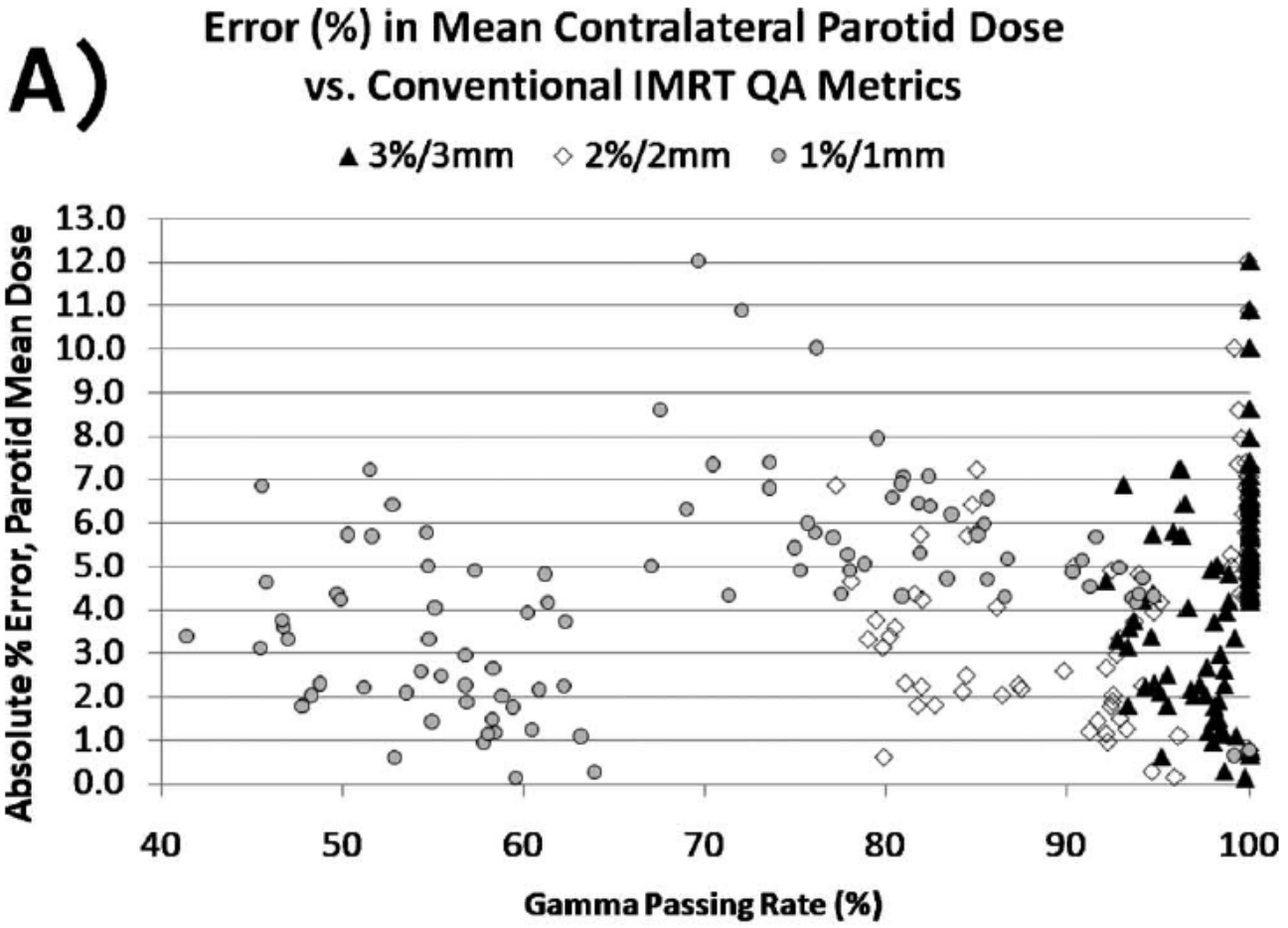

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ScandiDos

Warum?

ScandiDos

Lösung

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"First of all, it is intuitive that with per-patient dose errors, **the importance is the location and overlap of these per-beam errors in terms of critical volumes (targets and organs at risk) [...].**"[1]

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ScandiDos

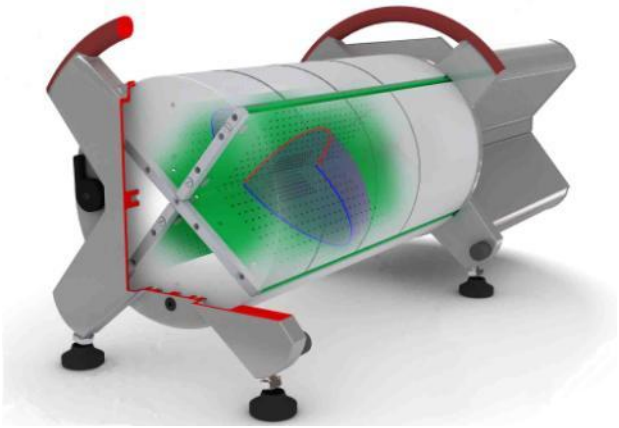
Lösung

“Gläserne Frau”, 1935, Deutsches Hygienemuseum

ScandiDos

Solution: Delta4^{PT}

- Messpunkte dort, wo's drauf ankommt
- Gemessene Fraktionsdosis
- Klinische Relevanz: Überlagerung von Abweichungen mit Patientenstrukturen



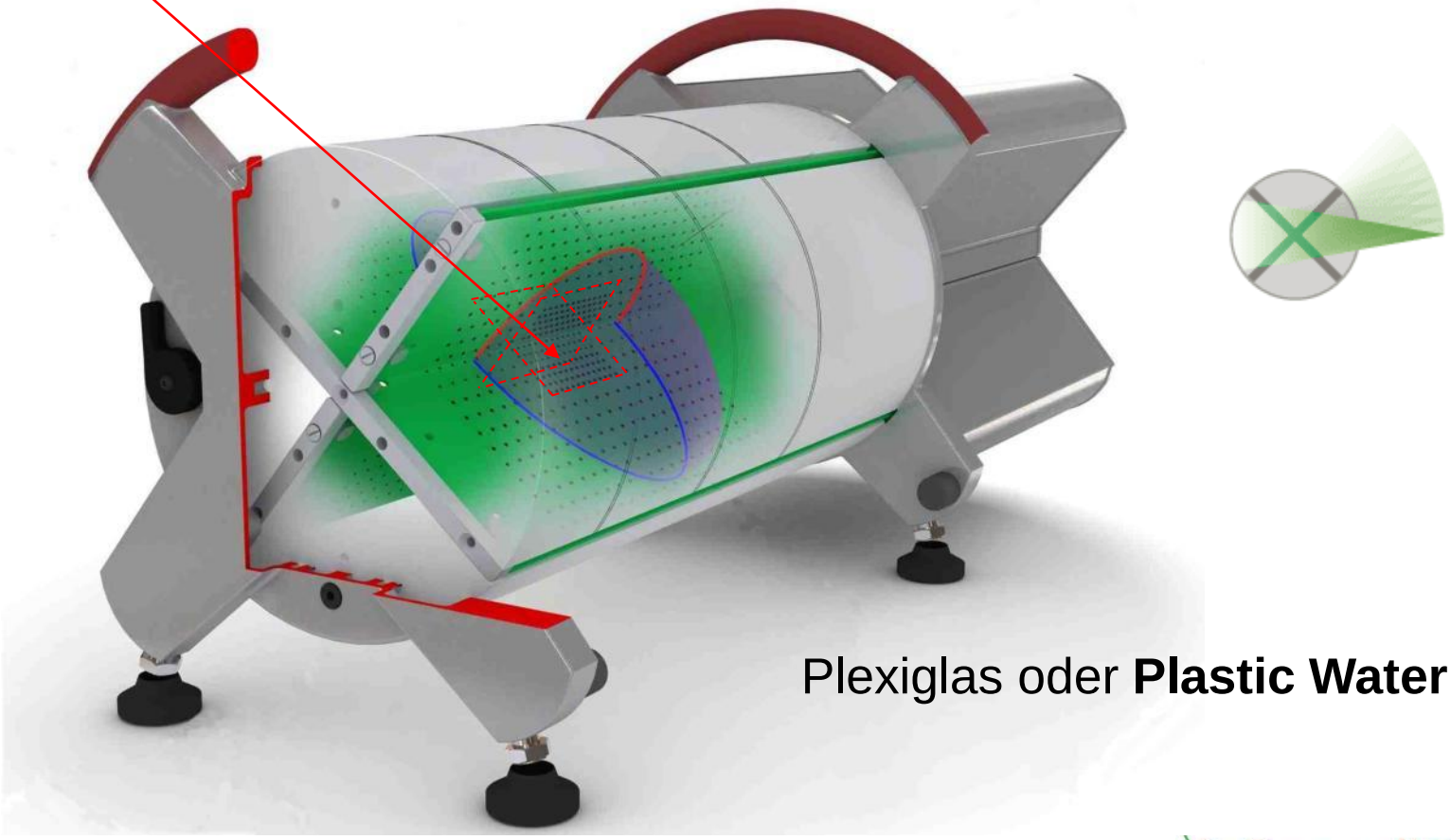
ScandiDos

Delta^{4PT}

Zentralbereich 6x6cm: Ca. 300 Detektoren, Detektorabstand: 5mm

Insgesamt 1069 Detektoren

Diagonale oder horizontelle/senkrechte Orientierung



Plexiglas oder **Plastic Water**

ScandiDos

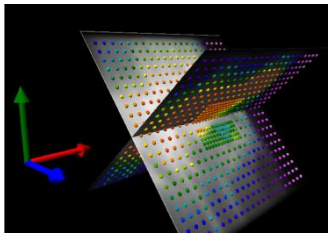
Lösung: Delta^{4PT} 3D and DVH Options

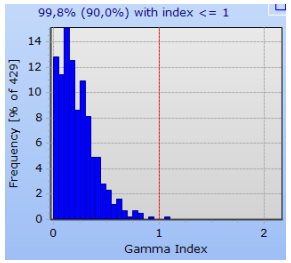
Messen dort, wo's drauf ankommt

Analyse

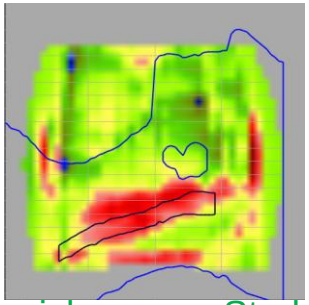
Automatische OK/Nicht OK Indikation

Akzeptanz

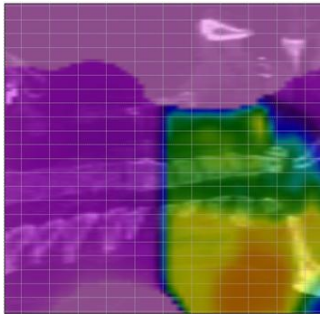




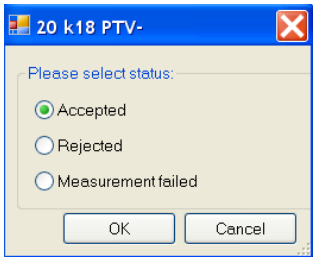
Messpunkte



Abweichung per Struktur in Phantom…

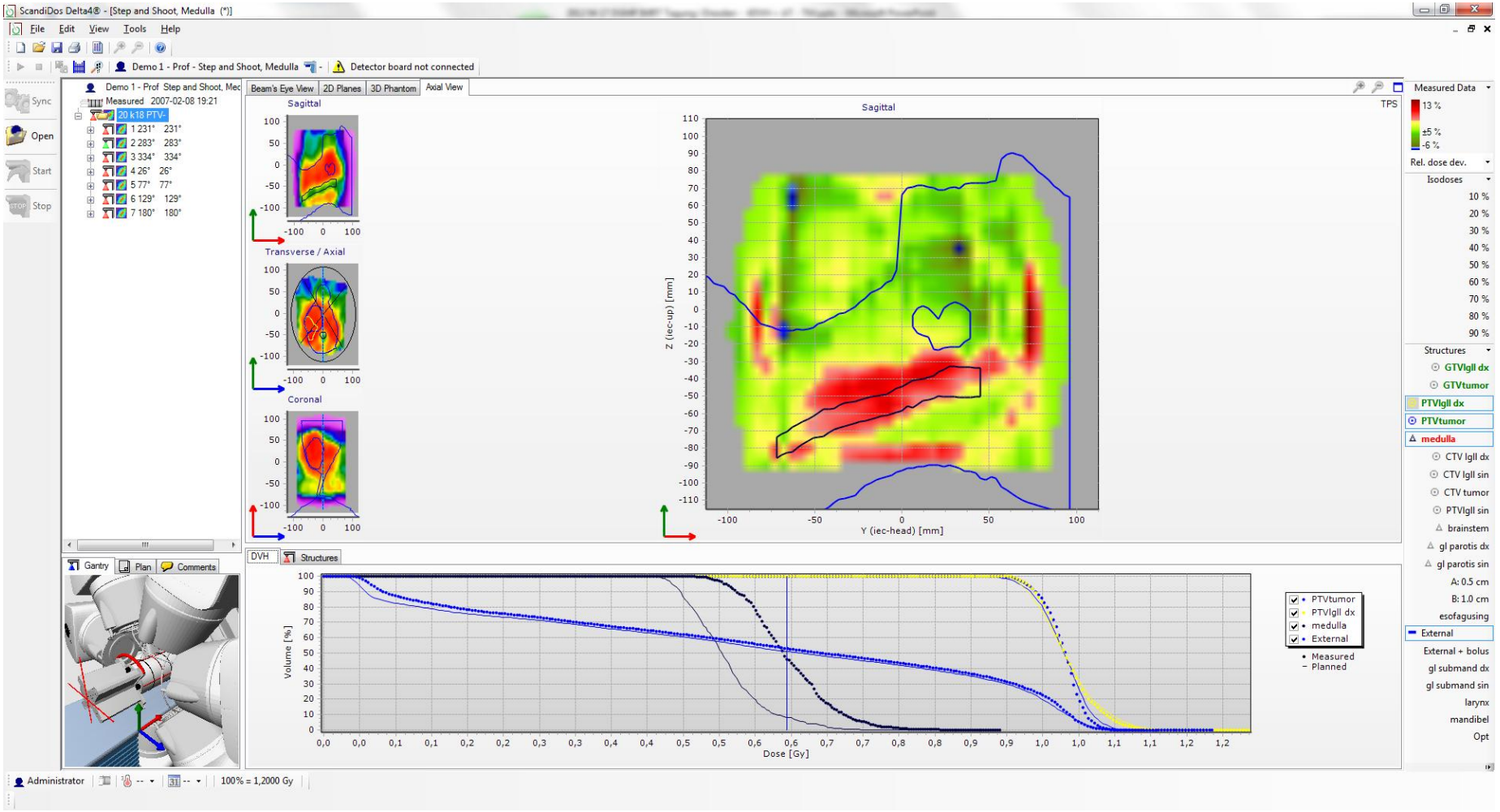


…oder im Patienten



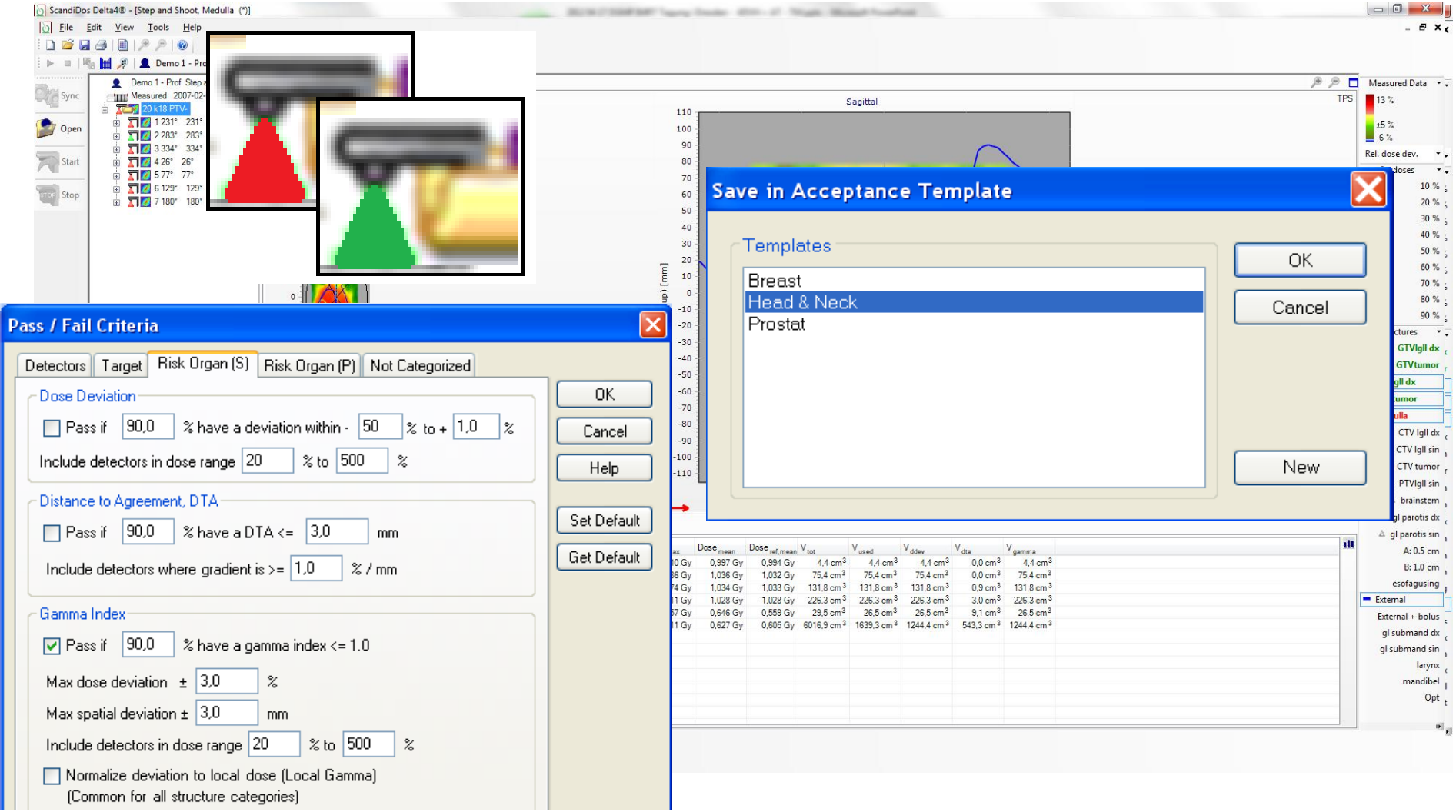
ScandiDos

DVH



ScandiDos

D-Abw, DTA, Gamma… per Organ



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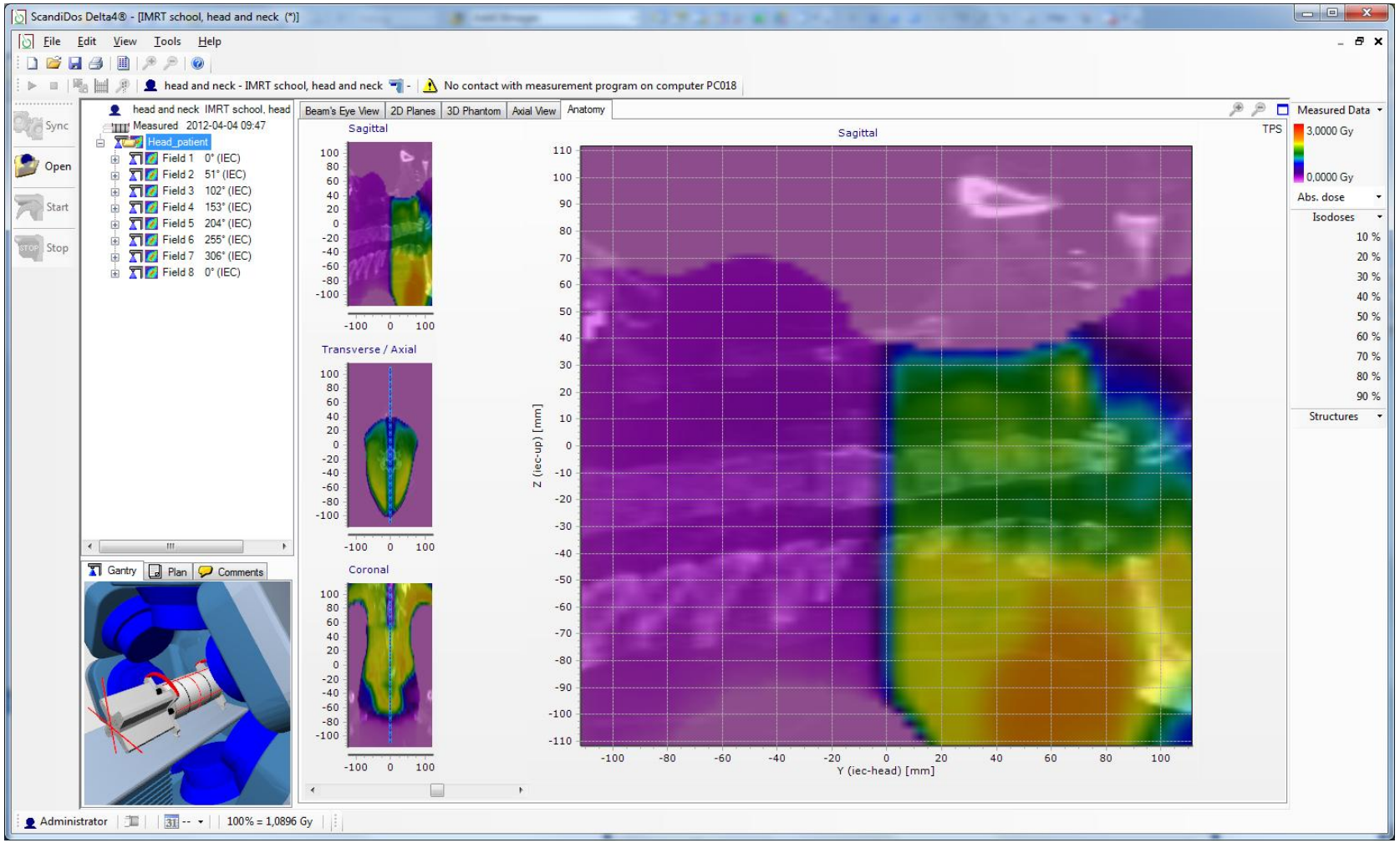

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Lösung

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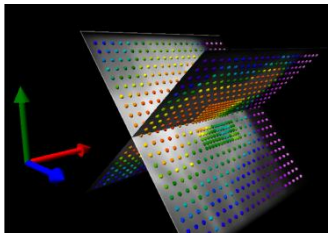
Delta^{4DVH}

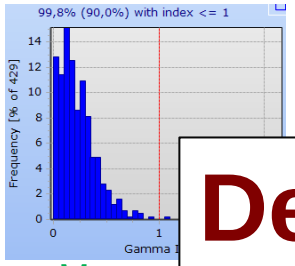
Messen dort, wo's drauf ankommt

Analyse

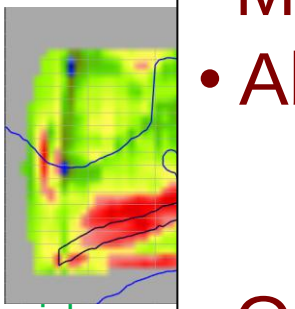
Automatische OK/Nicht OK Indikation

Akzeptanz

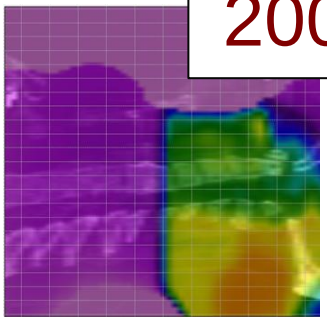




Messpu



Abweichung p
in Phant



…oder im Patienten

Delta^{4PT}

- Misst dort, wo's drauf ankommt
- Abweichung per Organ…
  - im Phantom
  - oder im Patienten
- QS: klinische Relevanz (seit 2007!)

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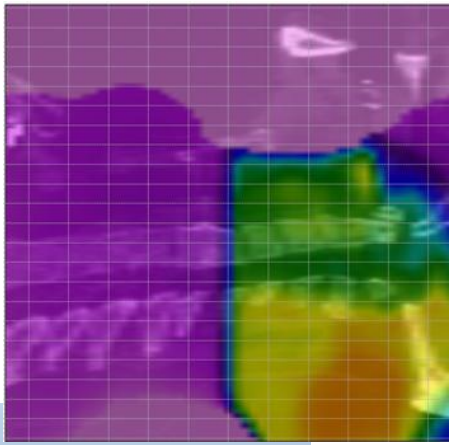
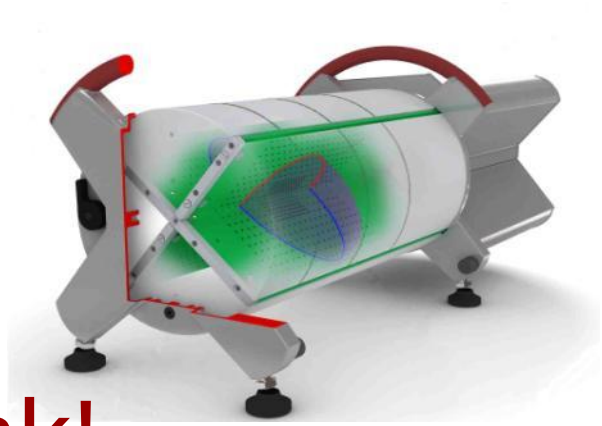
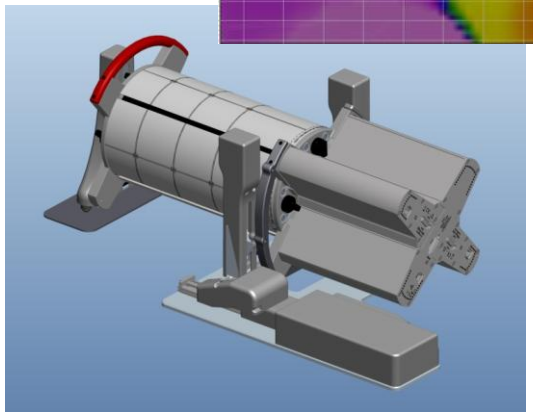
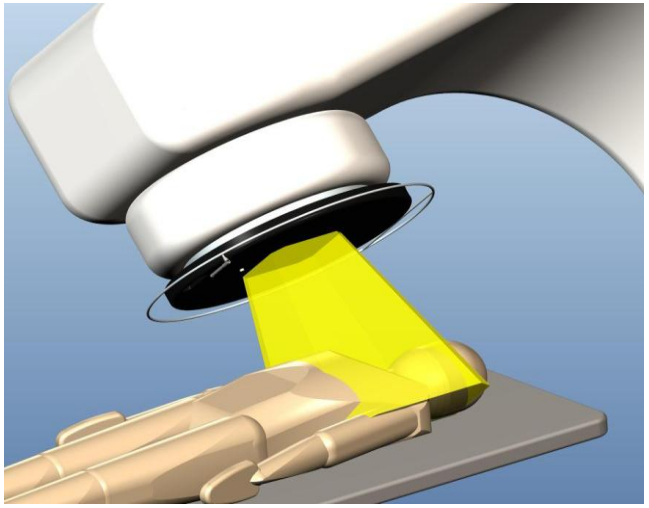




Vielen Dank!



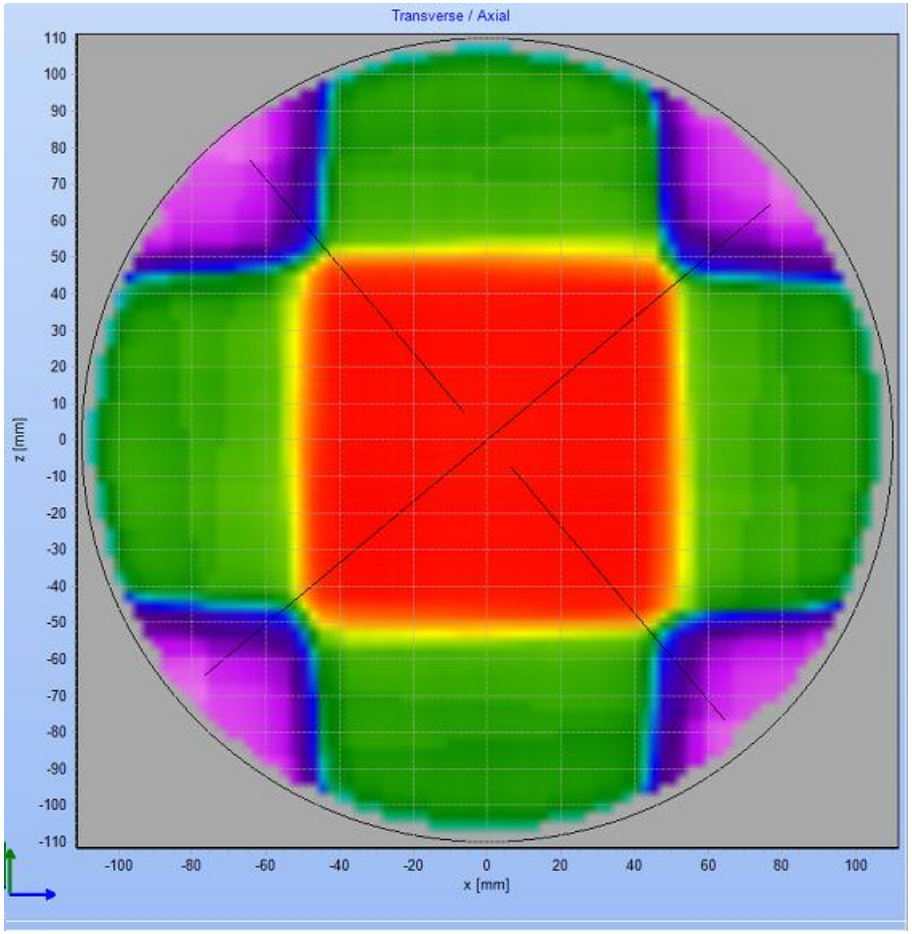


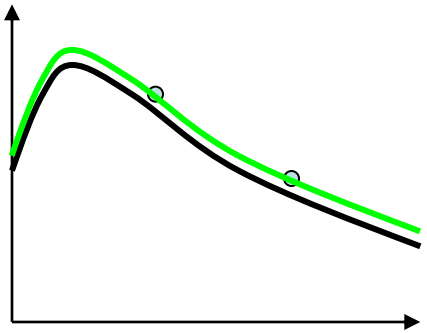
ScandiDos

2012-05-01

3D Dose:TPS method

- Beam level: Ray tracing



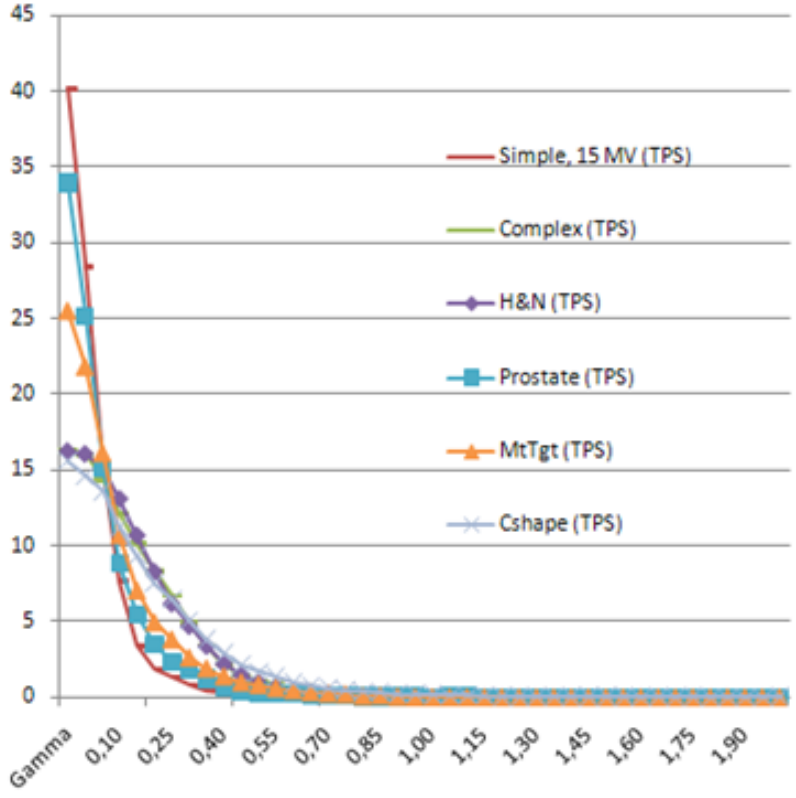


ScandiDos

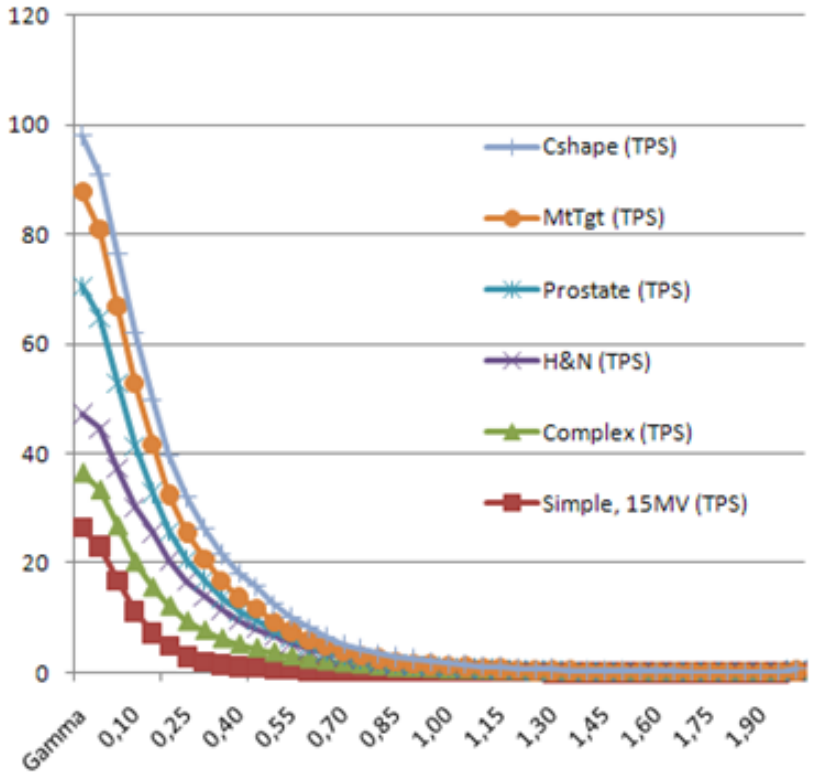
Accuracy in 3D calculation using current TPS-method in Delta^4

Six treatments cases (ref 2) where used in the evaluation; H&N, Prostate, C-shape tumor and various energies. The pass rate for Gamma-index (3%, 3mm) was always above 99% and Gamma-index (2%,2mm) varied from 95.3% to 99.5% when data points above 20% were included.

Gammaindex (3%, 3mm)

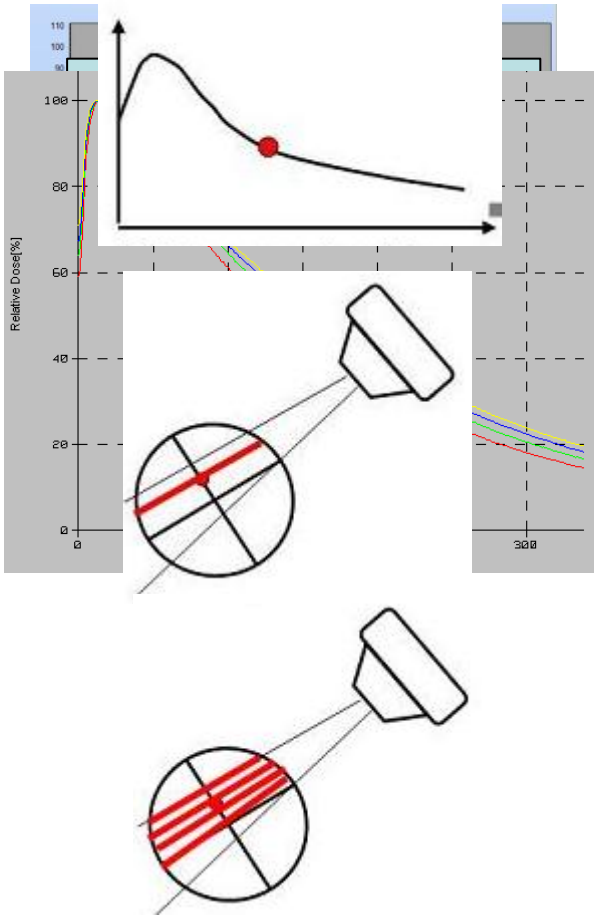


Gammaindex (2%, 2mm)



Fast-3D Dose, independent on TPS data

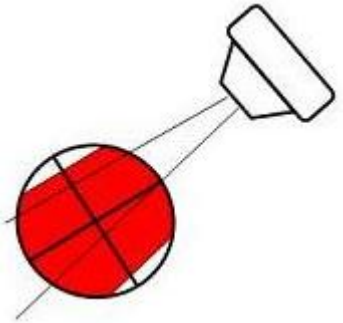
- Depth doses for various field sizes are calculated in Delta^4 phantom using TPS
- The equivalent field size for each control point is calculated
- The depth dose for the equivalent field size is interpolated
- The depth dose is normalized to the measured dose
- All “depth doses” are calculated

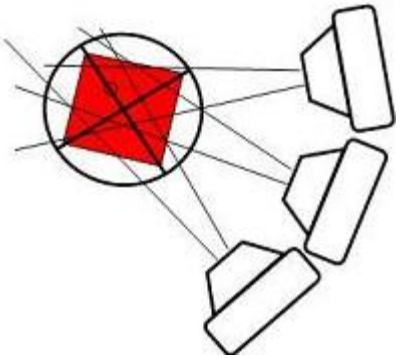


ScandiDos

3D Dose independent on TPS data

- Depth doses for various field sizes are calculated in Delta^4 phantom using TPS
- The equivalent field size for each control point is calculated
- The depth dose for the equivalent field size is interpolated
- The depth dose is normalized to the measured dose
- All “depth doses” are calculated
- All control points doses are calculated



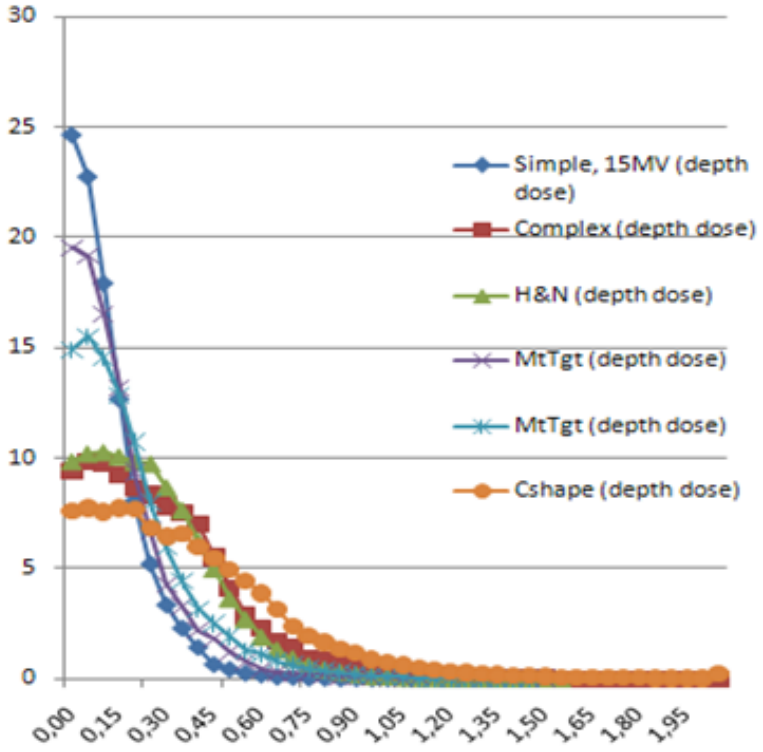


ScandiDos

Accuracy in 3D calculation using FAST-3D calculation method in Delta^4

The same six treatments cases as above where used in the evaluation; H&N, Prostate, C-shape tumor and various energies.
The pass rate for Gamma-index (3%, 3mm) was close or above 99% for all but the C-shape case (96%) and Gamma-index (2%,2mm) varied from 84% to 99% when data points above 20% were included.

Gammaindex (3%, 3mm)



Gammaindex (2%, 2mm)