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“GAMMA INDEX VARIATION IN THE VERIFICATION OF STEP & SHOOT IMRT”

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Introduction and Purpose

Introduction

IMRT plan verification is one of the most important parameters in the modern radiotherapy chain. All clinical protocols consider it mandatory in order to achieve high quality and reproducible treatment delivery.

Purpose

The purpose of this study is to present a detailed analysis of the variation of gamma index (γ -index), which is used as a primary quantitative parameter in IMRT plan verification.

Methods

We retrospectively considered 60 Prostate, 30 Head & Neck (H&N) and 30 other step and shoot IMRT cases treated in our department.

All plans were created on the Oncentra v4.5 TPS (Elekta, Sweden), using 5-7-9 beams, maximum 10 segments/beam and minimum 4cm² segments.

Plan verification was implemented using the ArcCheck phantom (Sun Nuclear, Fl, USA). γ -index was calculated at 3%-3mm and at 2%-2mm using a 10% threshold value with and without global correction.

Results

Pelvis (60 patients)

Anatomical area (No of cases)	γ – index			
	3% - 3mm (using global correction)	3% - 3mm (without global correction)	2% - 2mm (using global correction)	2% - 2mm (without global correction)
Total Pelvic patients (60)	97,1 ± 1,7	88,8 ± 4,5	86,2 ± 5,0	72,6 ± 6,4
Whole pelvis (30)	97,5 ± 1,8	87,9 ± 5,8	87,8 ± 4,9	69,7 ± 9,5
Prostate + seminal vesicles (50)	96,7 ± 1,8	88,3 ± 5,0	85,0 ± 5,2	72,4 ± 7,0
Prostate (60)	96,8 ± 1,5	87,8 ± 4,9	85,3 ± 3,8	71,3 ± 6,1

Results

Pelvis (60 patients) – shift correction effect

Anatomical area (No of cases)	<i>γ – index</i>	
	3% - 3mm (using shift correction)	3% - 3mm (without shift correction)
Pelvic (60)	97,3 ± 2,1	97,1 ± 1,7
Whole pelvis (30)	97,6 ± 1,7	97,5 ± 1,8
Prostate + seminal vesicles (50)	97,1 ± 1,8	96,7 ± 1,8
Prostate (60)	97,2 ± 1,4	96,8 ± 1,5

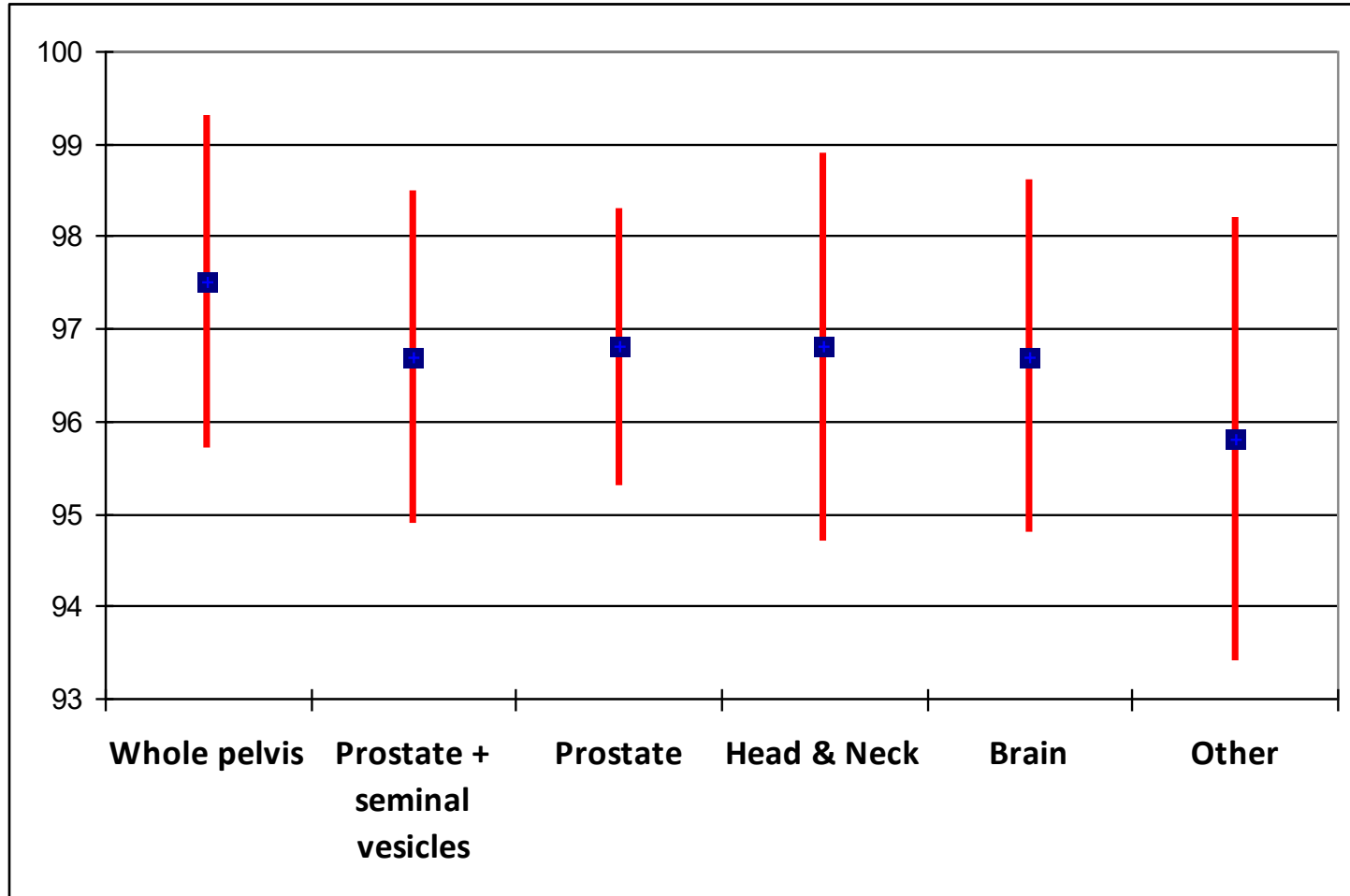
Results

Head & Neck, Brain and other anatomical areas

Anatomical area (No of cases)	γ - index			
	3% - 3mm (using global correction)	3% - 3mm (without global correction)	2% - 2mm (using global correction)	2% - 2mm (without global correction)
Head & Neck (30)	96,8 ± 2,1	88,3 ± 5,6	86,2 ± 6,3	69,8 ± 15,2
Brain (15)	96,7 ± 1,9	90,9 ± 4,0	86,9 ± 4,4	76,4 ± 5,7
Other (15)	95,8 ± 2,4	82,1 ± 9,9	80,7 ± 10,7	66,0 ± 10,6

Results

γ – index variation for various anatomical areas



Conclusions I

- γ – index was 9% less when not using global correction factor
- γ – index showed no dependence upon the number of beams
- γ – index was higher in larger irradiated areas due to better statistics and less steep dose gradients
- γ – index decreases as smaller in volume segments increase
- Further investigation for 2% -2mm γ – index values needs to be done, using calculation grid 2mm, instead of 3mm that was used during this study

Conclusions II

ArcCheck is an efficient QA tool for individual patient verification. γ -index values of more than 97% and high reproducibility of results, were investigated for all pelvic and head & neck plans, calculated using 3mm calculation grid.

Further work is done to correlate γ -index values with ROI specific passing rates, as estimated by the 3DVH software analysis.