

# **Inter-fractional variations in patient setup and anatomic change assessed by daily CT**

**X. A. Li, X. S. Qi, M. Pitterle, K. Kalakota  
K. Mueller, B. A. Erickson, D. Wang  
C. J. Schultz, S. Y. Firat, J. F. Wilson**



**MEDICAL  
COLLEGE  
OF WISCONSIN**

**Medical College of Wisconsin**

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# Inter-fractional variations

setup errors

anatomic change (organ movement,  
deformation)



IGRT

# Siemens Solutions

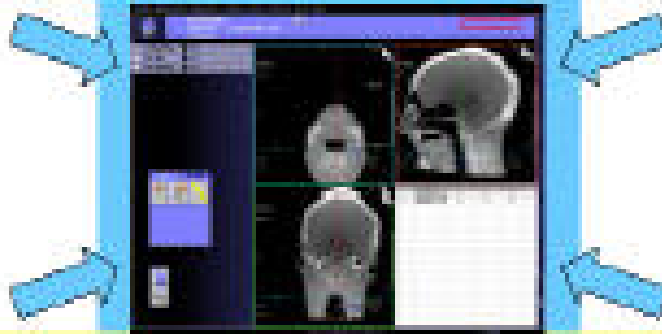
## Adaptive Targeting Imaging Options



CT-on-Rails



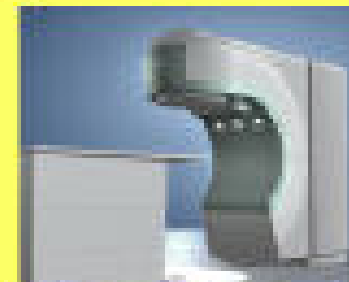
MV Conebeam



Portfolio of ART algorithms

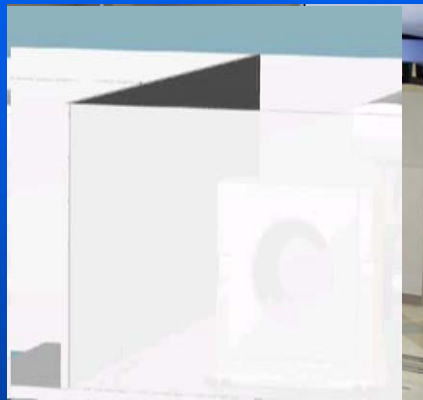


Mobile kV Conebeam

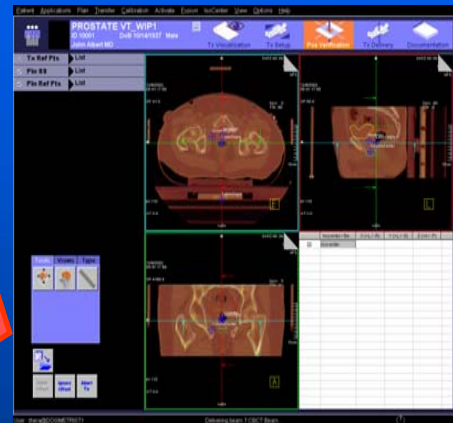


In-line kV and MV Conebeam

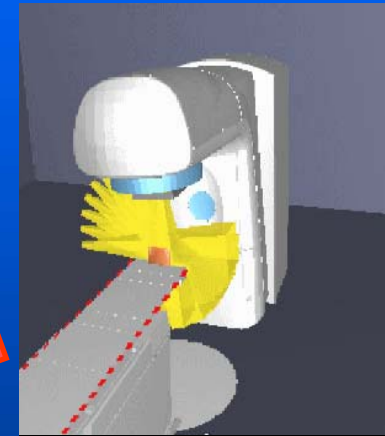
# CT-on-Rail and MV cone beam CT



PRIMATOM



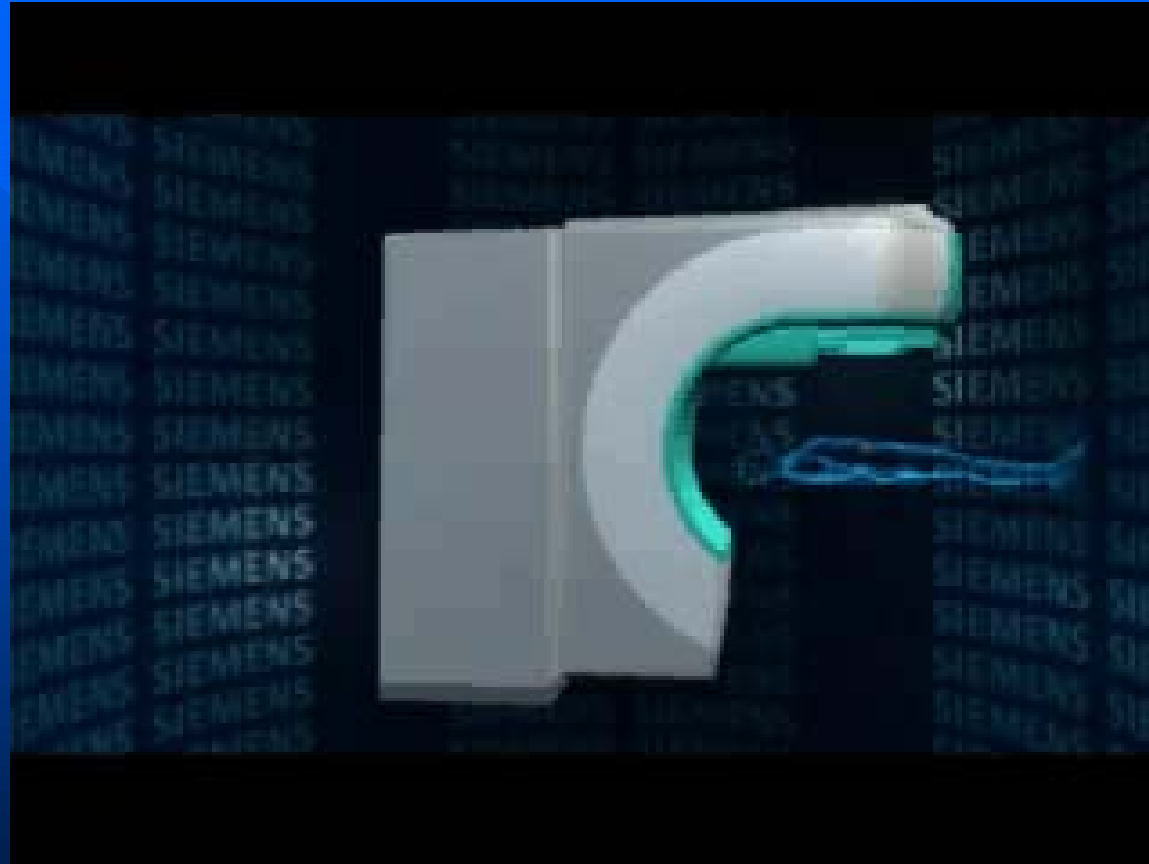
Adaptive Targeting



MV Cone Beam CT

Artiste

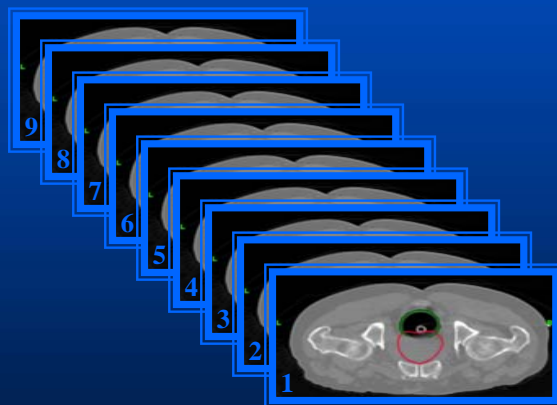
In-line KV fluoro and cone beam CT



# Tomotherapy HI-ART System



Delivery



Planning

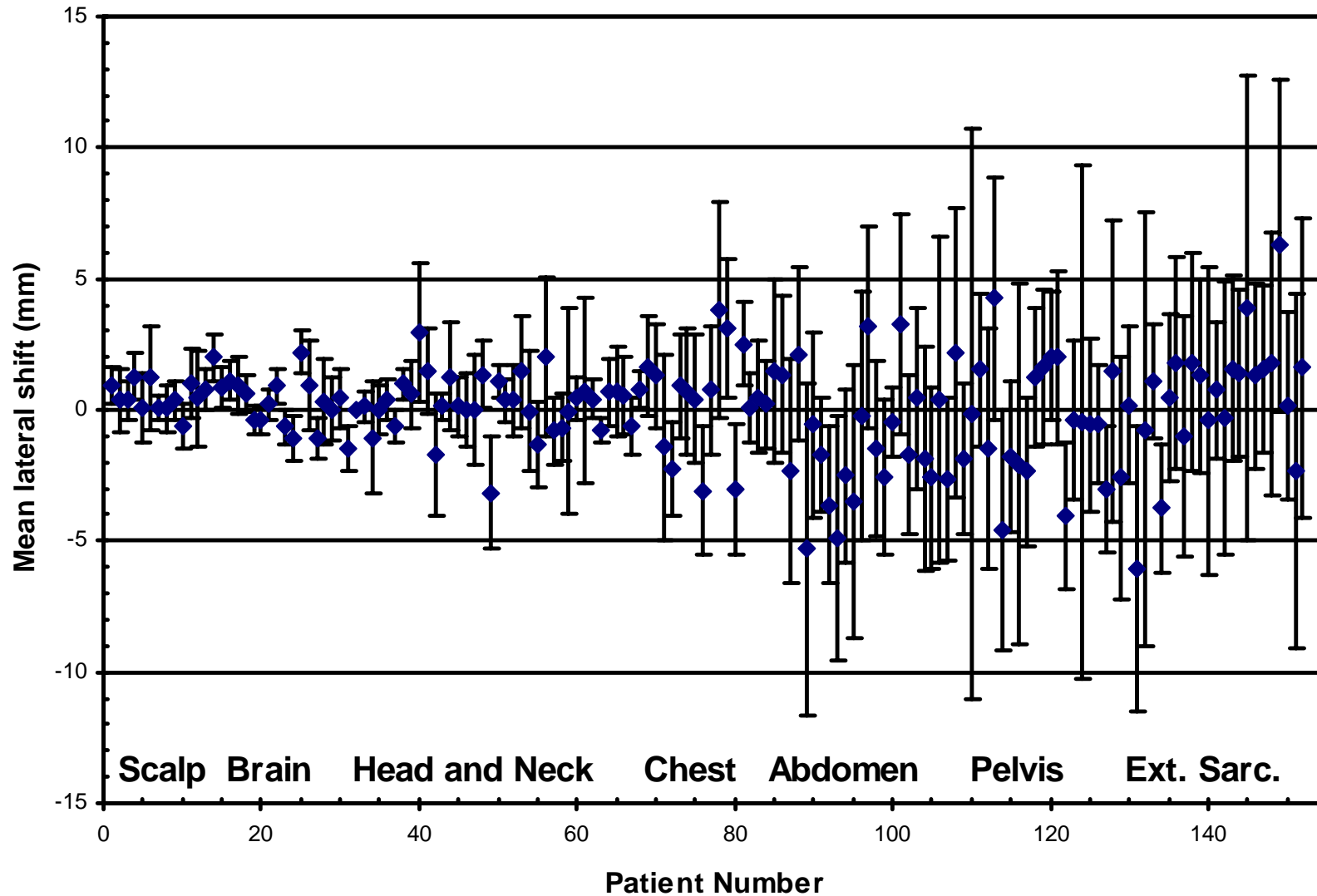


# Analysis of 176 patients treated with Tomotherapy

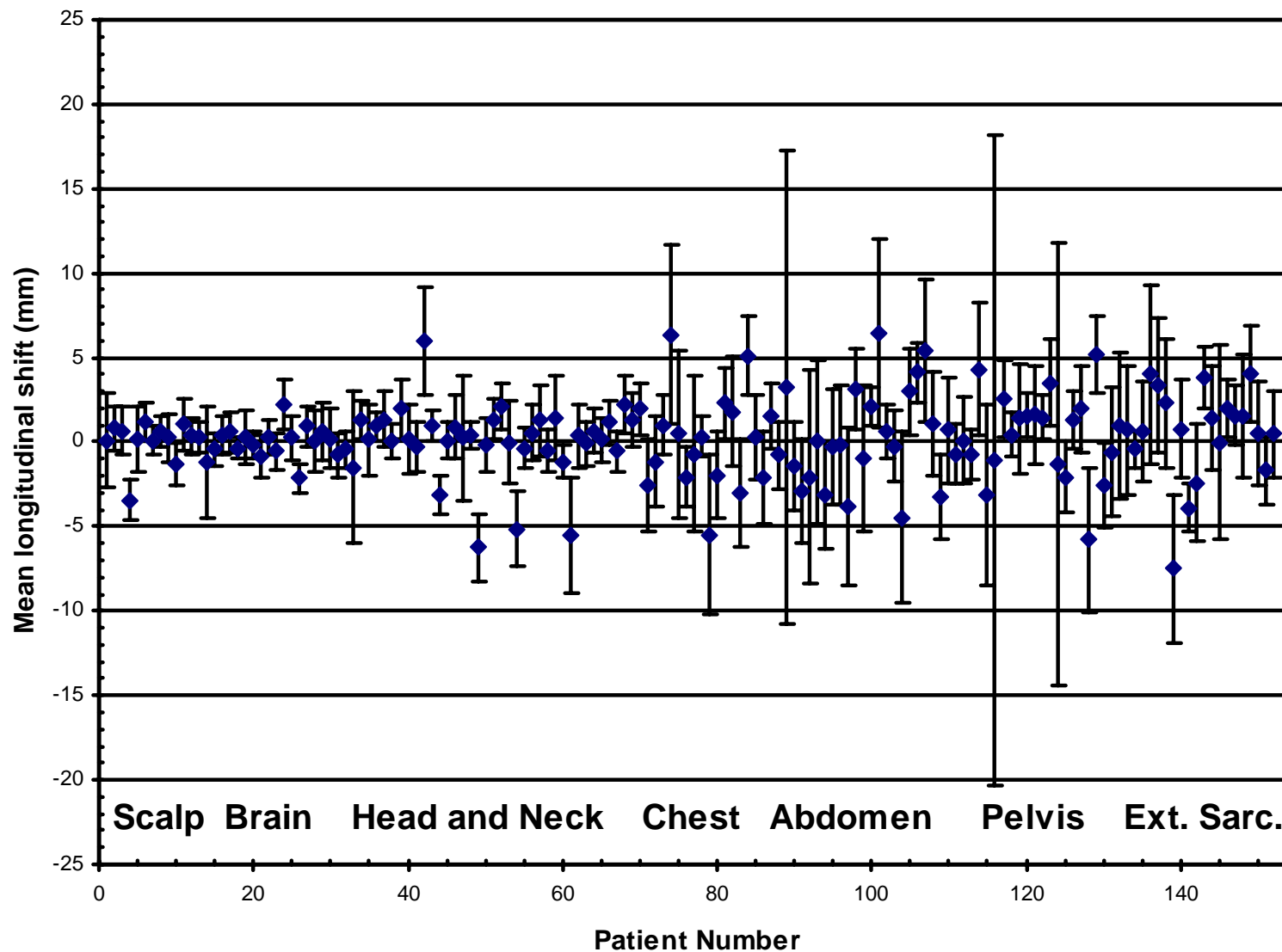
- Scalp 15
- Brain 21
- Head and neck 38
- Chest 25
- Abdomen 24
- Pelvis 38
- Extremities 15

**Daily MV CT fused with planning KV CT**

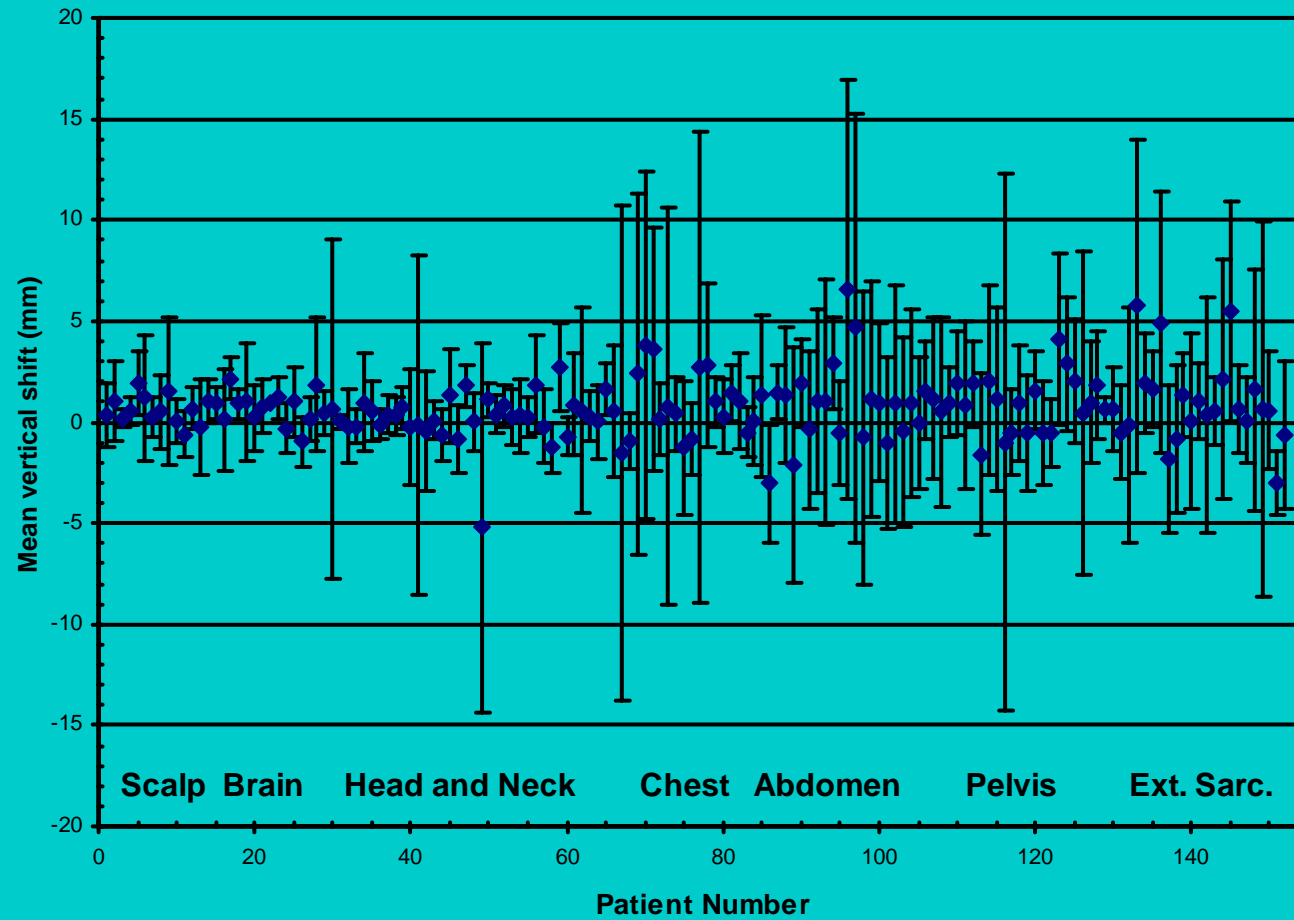
# Mean daily lateral shifts



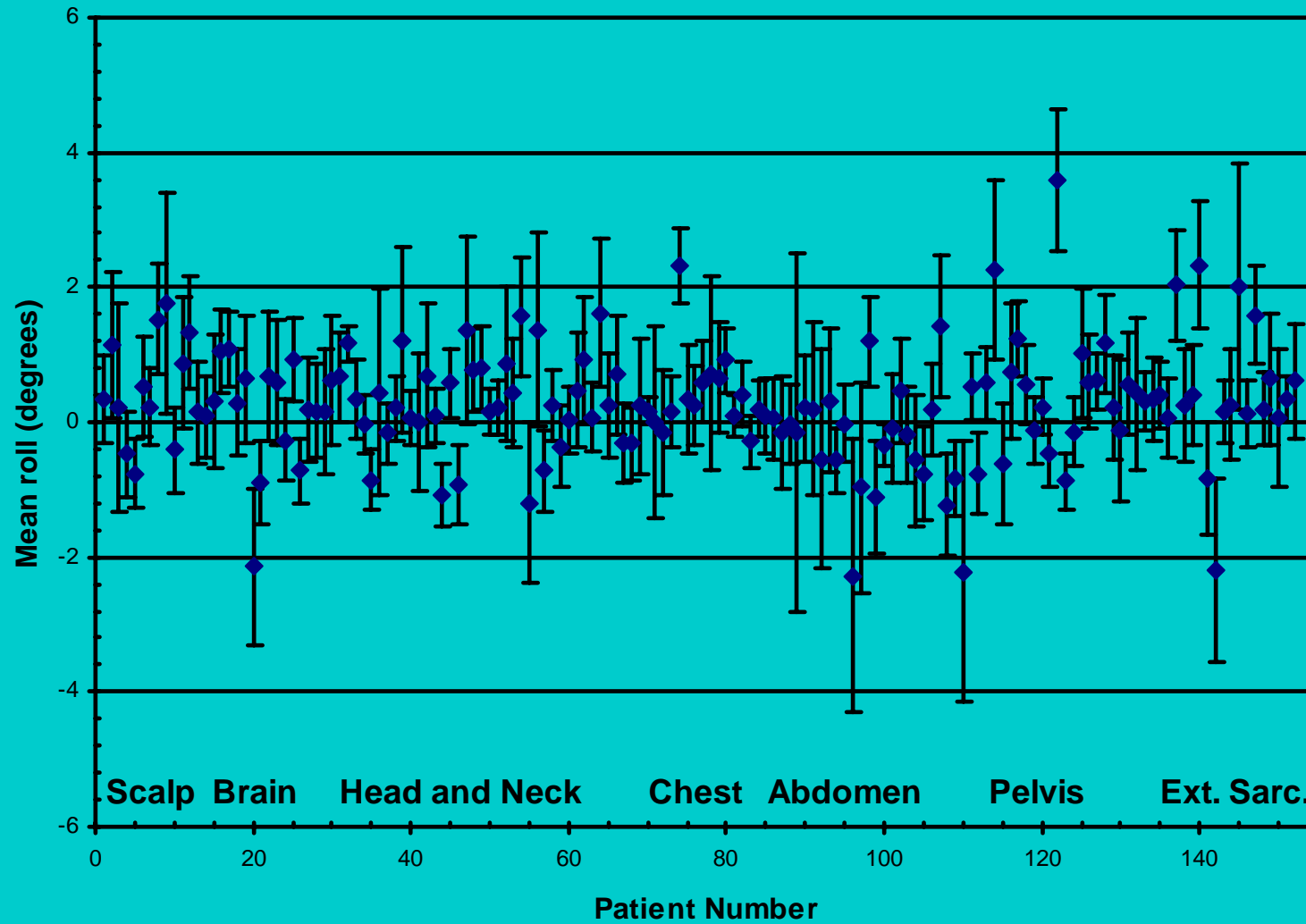
# Mean daily longitudinal shifts



# Mean daily vertical shifts



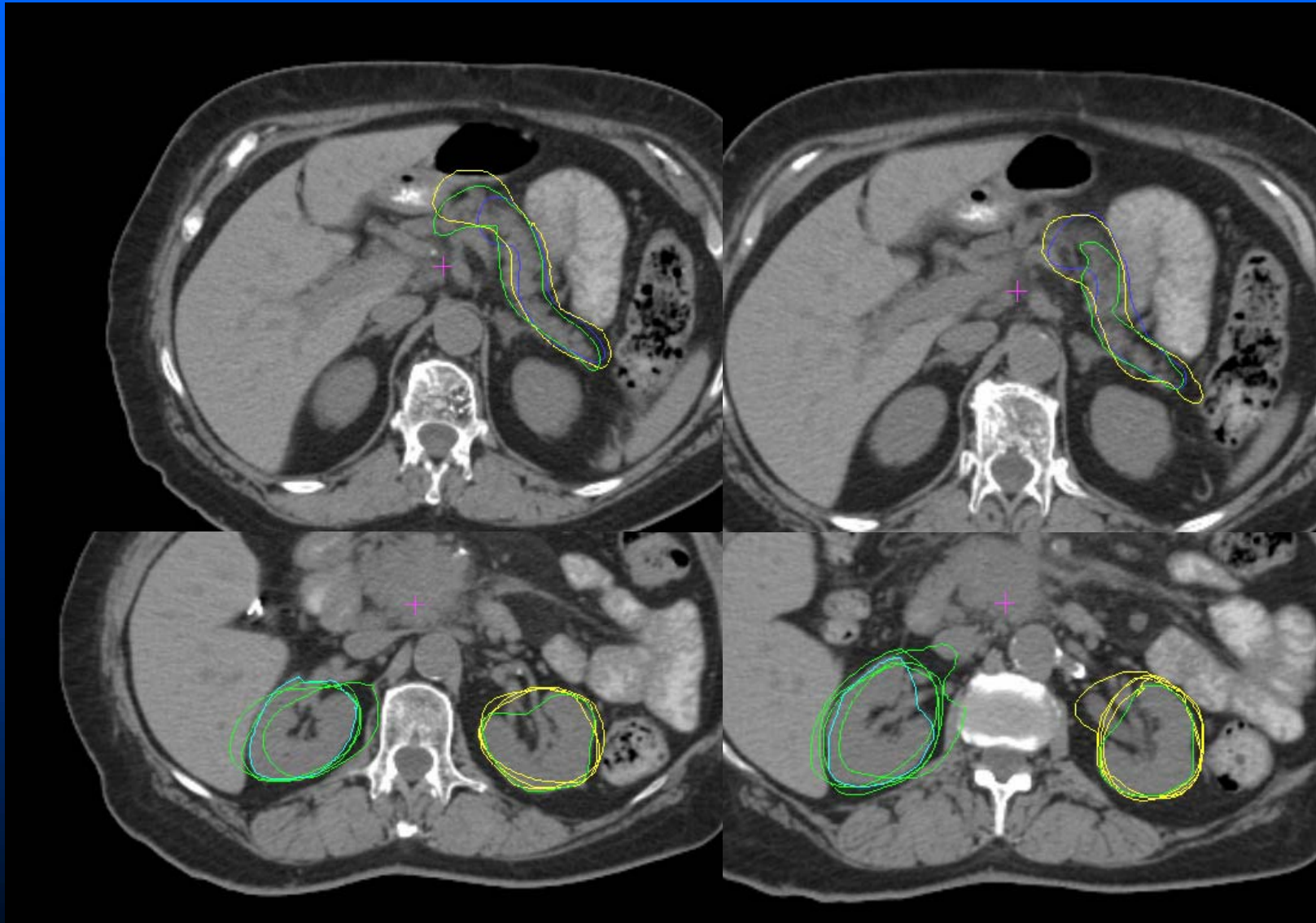
# Mean daily rotations in coronal plane



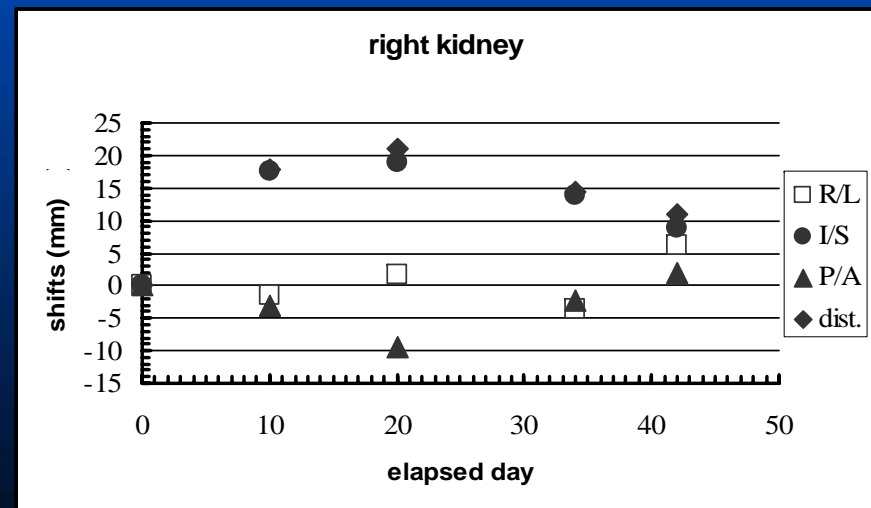
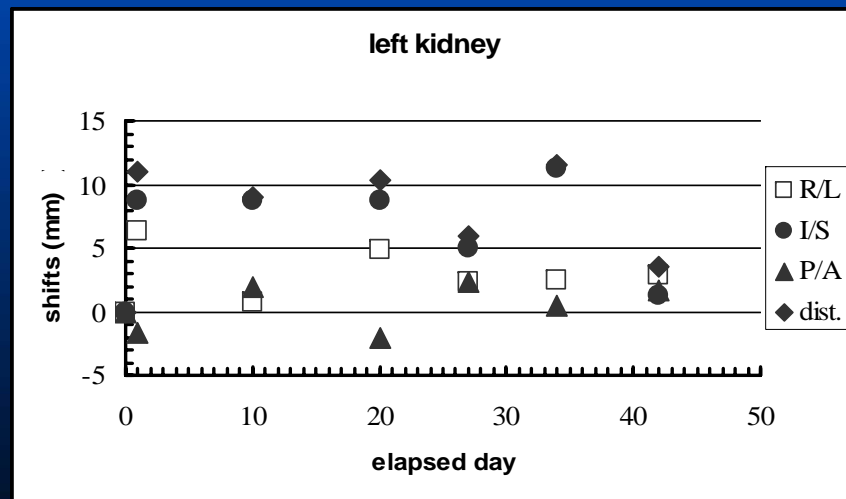
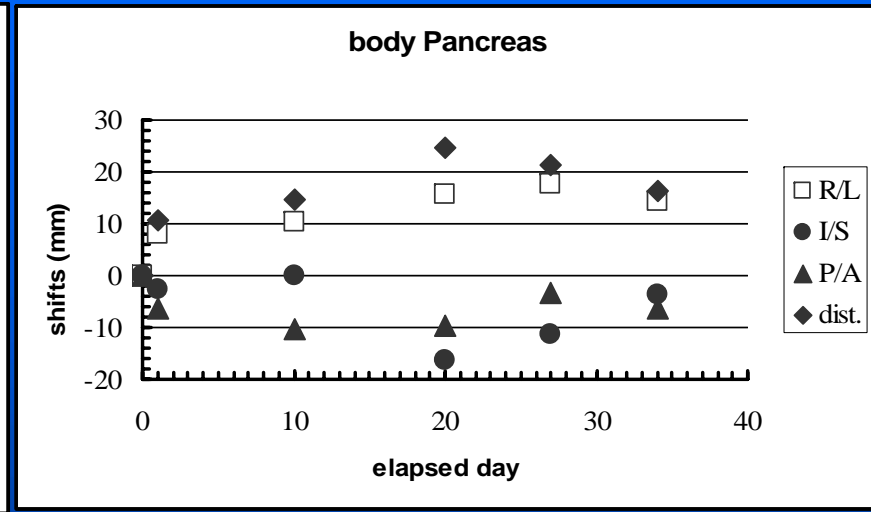
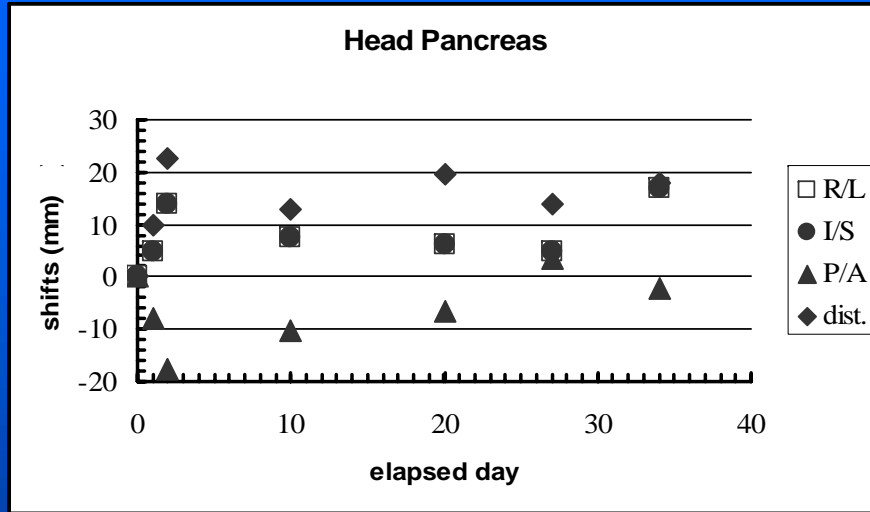
	CTV-to-PTV Margin (mm) to account for setup error
Scalp	3.4
Brain	2.8
H & N	5.6
Chest	8.0
Abdomen	8.1
Pelvis	8.3
Extremity	7.9

$$\textit{Margin} = 2\Sigma + 0.7\sigma$$

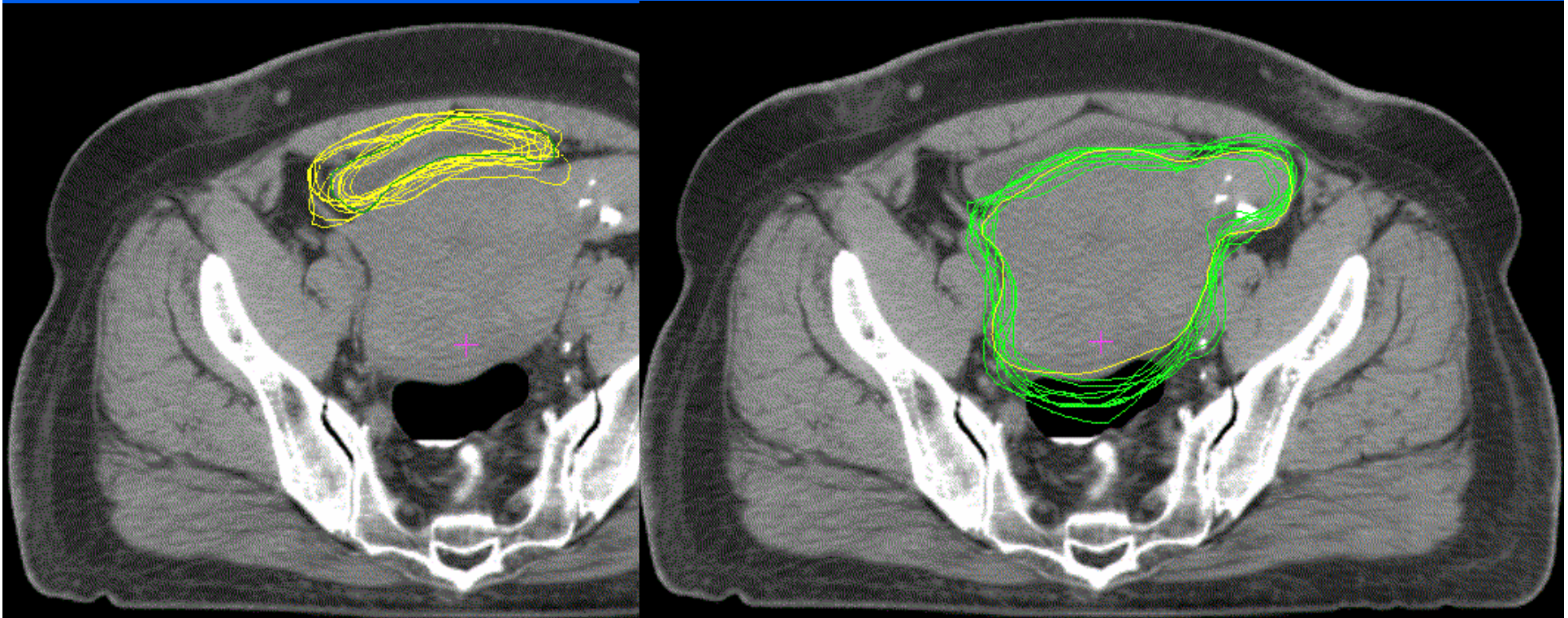
# Inter-fractional variations



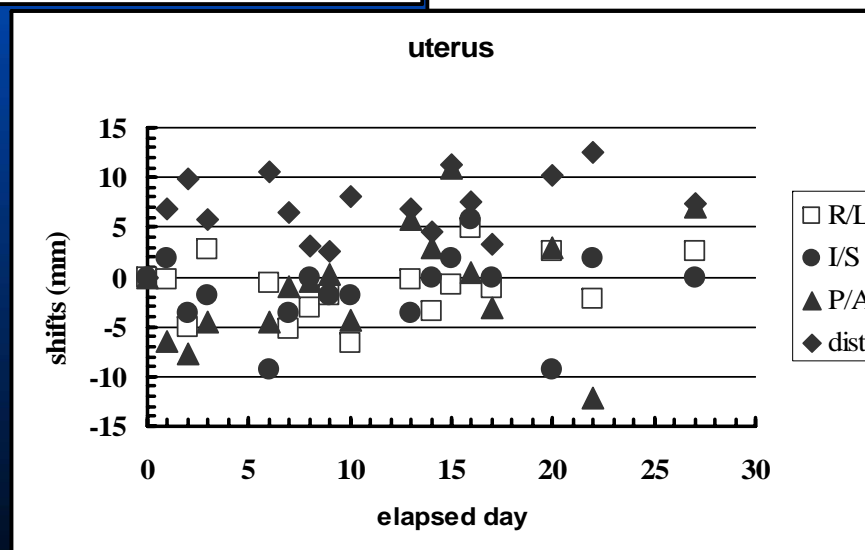
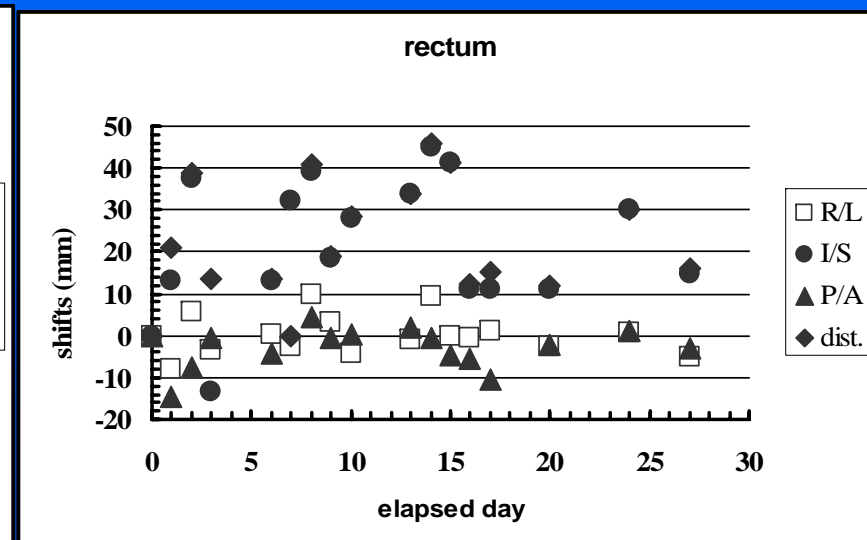
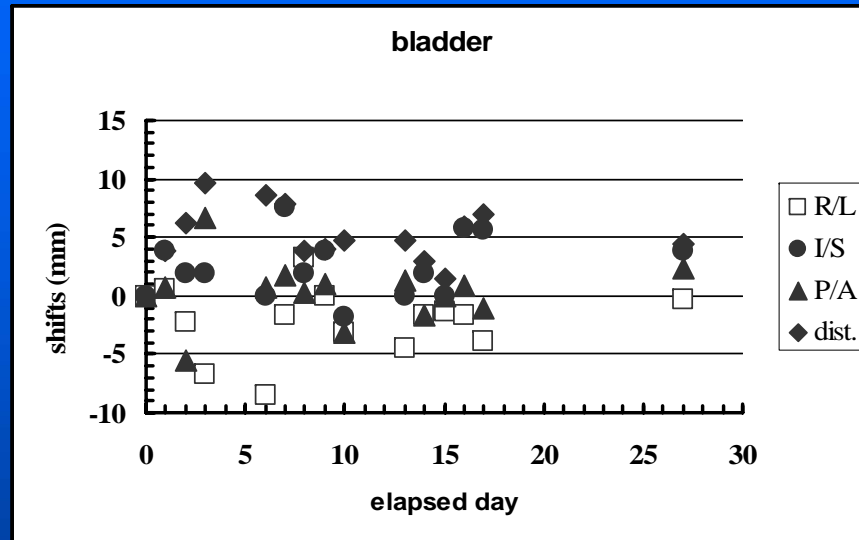
# Shifts of center of mass



## Inter-fractional variations of bladder & uterus

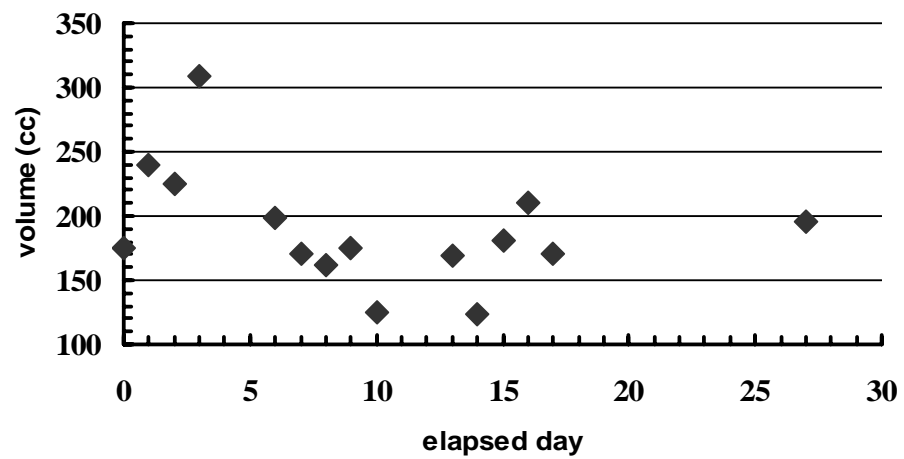


# Shifts of center of mass

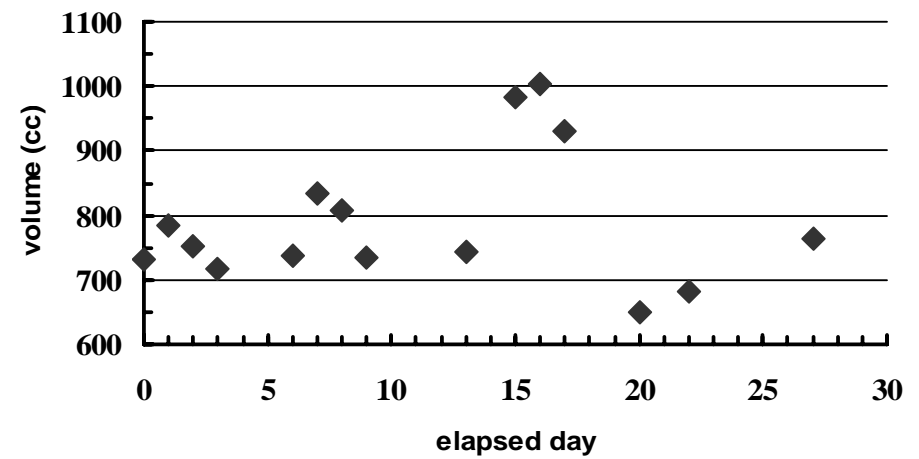


# Inter-fractional variation of volume

bladder

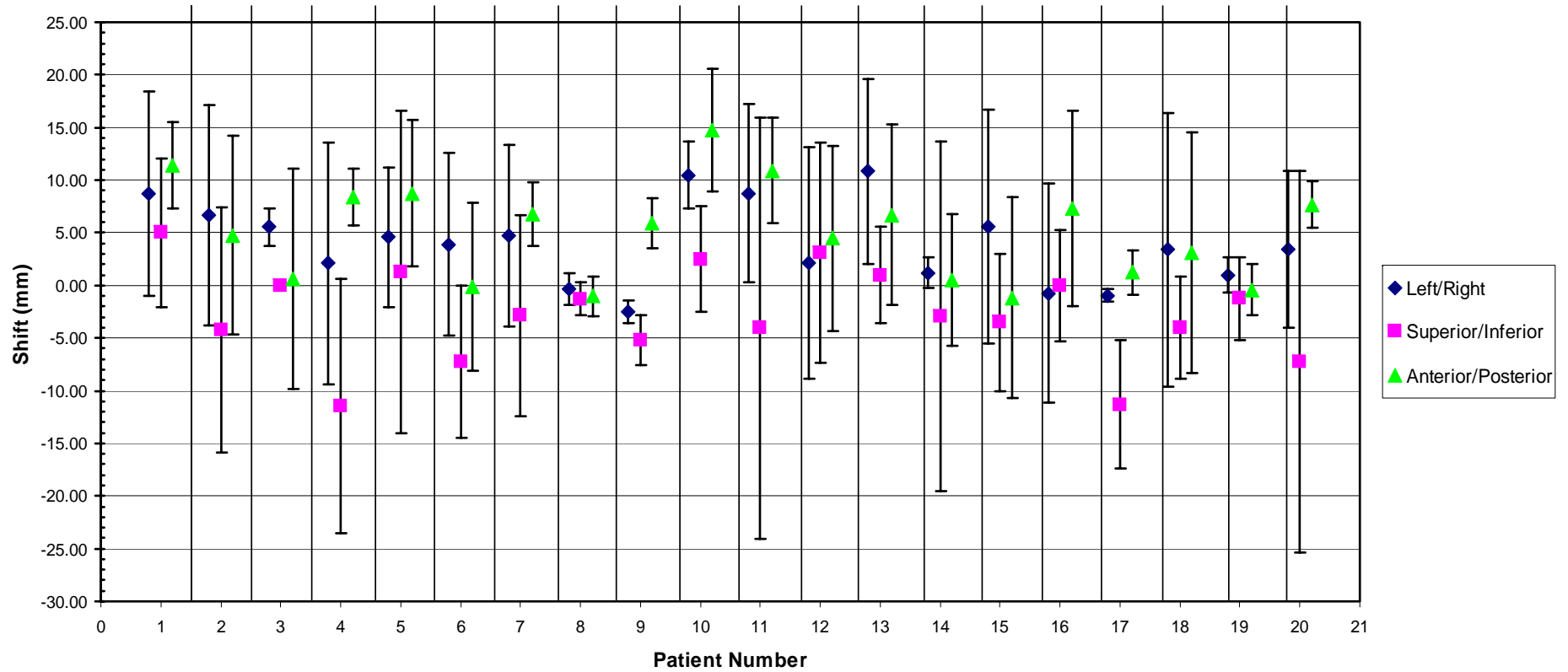


uterus



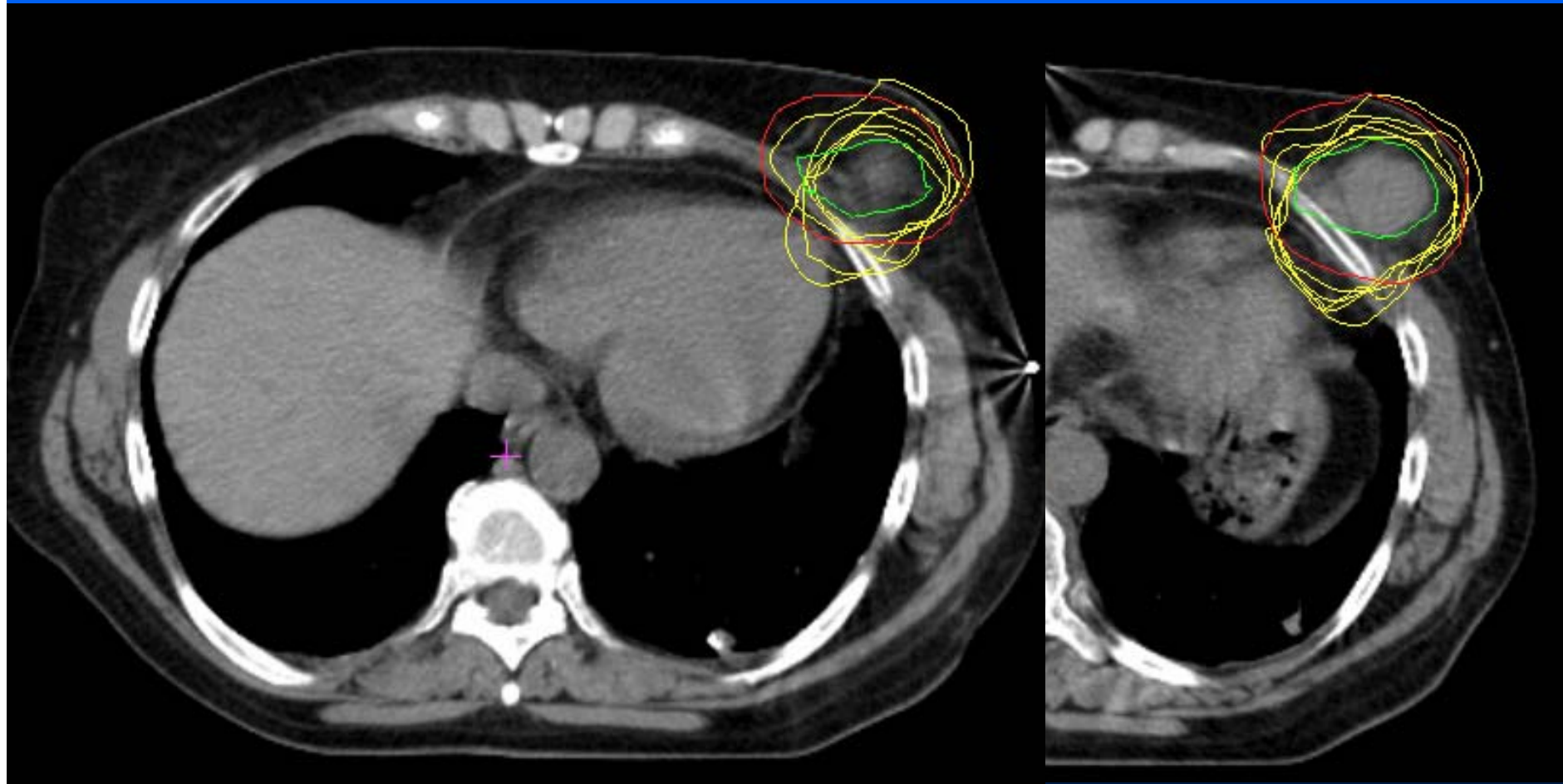
# Kidney movement

Kidneys Internal Organ Movement

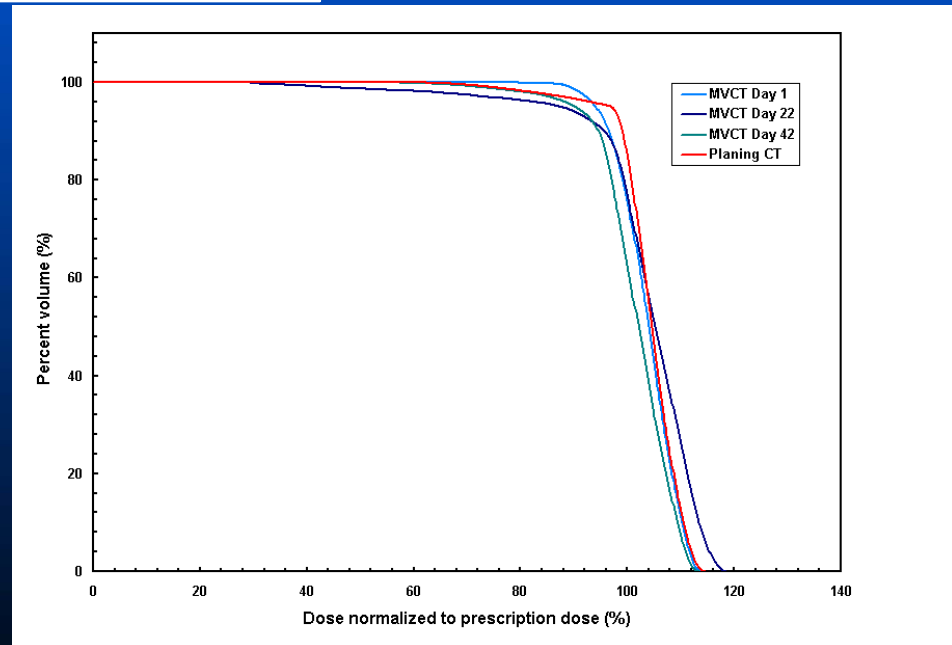
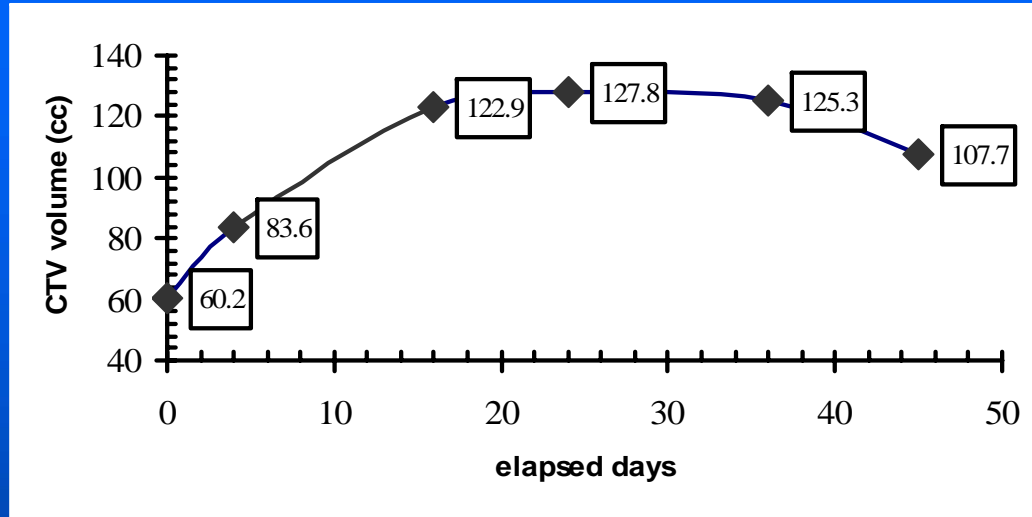


Need a margin of 17 mm

# Inter-fractional variations of sarcoma



# Variation of sarcoma CTV



# Conclusions

- 1. Site specific inter-fractional variations may be used to determine margins for both targets and normal structures .**
- 2. The data presented dealing with several anatomic sites may be useful in developing adaptive radiotherapy.**