AbstractID: 9066 Title: Quality assurance (QA) and IGRT of Elekta XVI cone beam system for clinical IMRT

Quality assurance (QA) and IGRT of Elekta XVI cone beam system for clinical IMRT

Purpose: To explore QA and IGRT of XVI cone beam CT (XVICBCT) system for multifarious IMRT with obscure and mobile target(s) to minimize toxicity to the patients.

Methods and Materials: Image quality (IQ) between XVICBCT and planning fan beams CT (TPFBCT), and XVICBCT IQ associated with gantry angular rotation were explored. IGRT functionality of XVICBCT was examined by humanoid pelvis (Rando) Phantom: an artificial target within the Phantom was tested and analyzed for coordinates shift consistency. Radiation exposure by XVICBCT was assessed with a Radcal ion chamber. To evaluate the advantage of XVICBCT for isodose distribution toward the target, a Jar Phantom containing a soap target and rice as tissue was provided. A film was inserted to the soap target center during IMRT +/- XVICBCT. Daily shifts from XVICBCT were recorded. Setup shift analyses of 30 prostate patients with average of 25 daily IGRT were attached.

Results: IQ between XVICBCT/TPFBCT "normalizing" to soft-tissue for head and neck and to bony-tissue for prostate indicates TPFBCT has upper edge for tissue differentiation. XVICBCT is brighter than TPFBCT due to more scattering. Nevertheless, XVICBCT's complementary role as IGRT for IMRT is a contributive asset. XVICBCT radiation exposure measurement shows higher dose for smaller anatomy. Shifting verification of a movable target setup shows XVICBCT detected the coordinate's shifts in agreement with the expected (see Table-1). The radiation distribution relative to the soap target for IMRT +/- IGRT of XVICBCT is convinced. Their Gaussian curve fittings of 30 prostate daily shiftings in X-, Y-, and Z- coordinates indicate the IMRT with XVICBCT are within sub-millimeter.

Conclusions: XVICBCT system is sufficient and accurate for image guided IMRT. Daily IGRT shift analysis demonstrates setup uncertainty is within mm providing conformity to the target(s).

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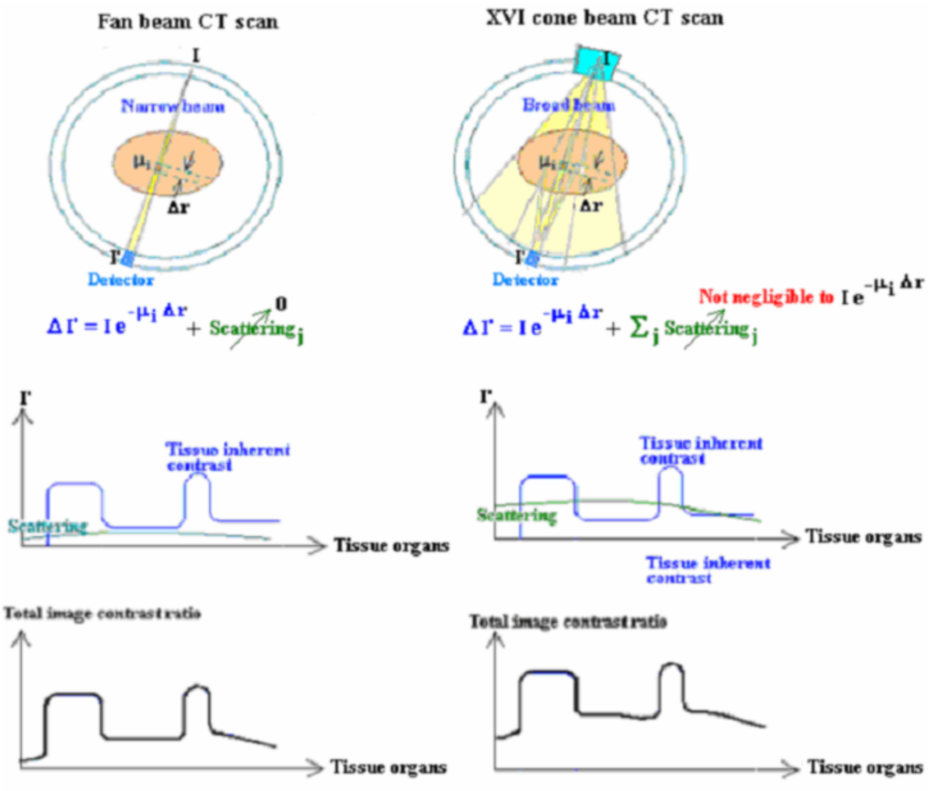

Fig. 1

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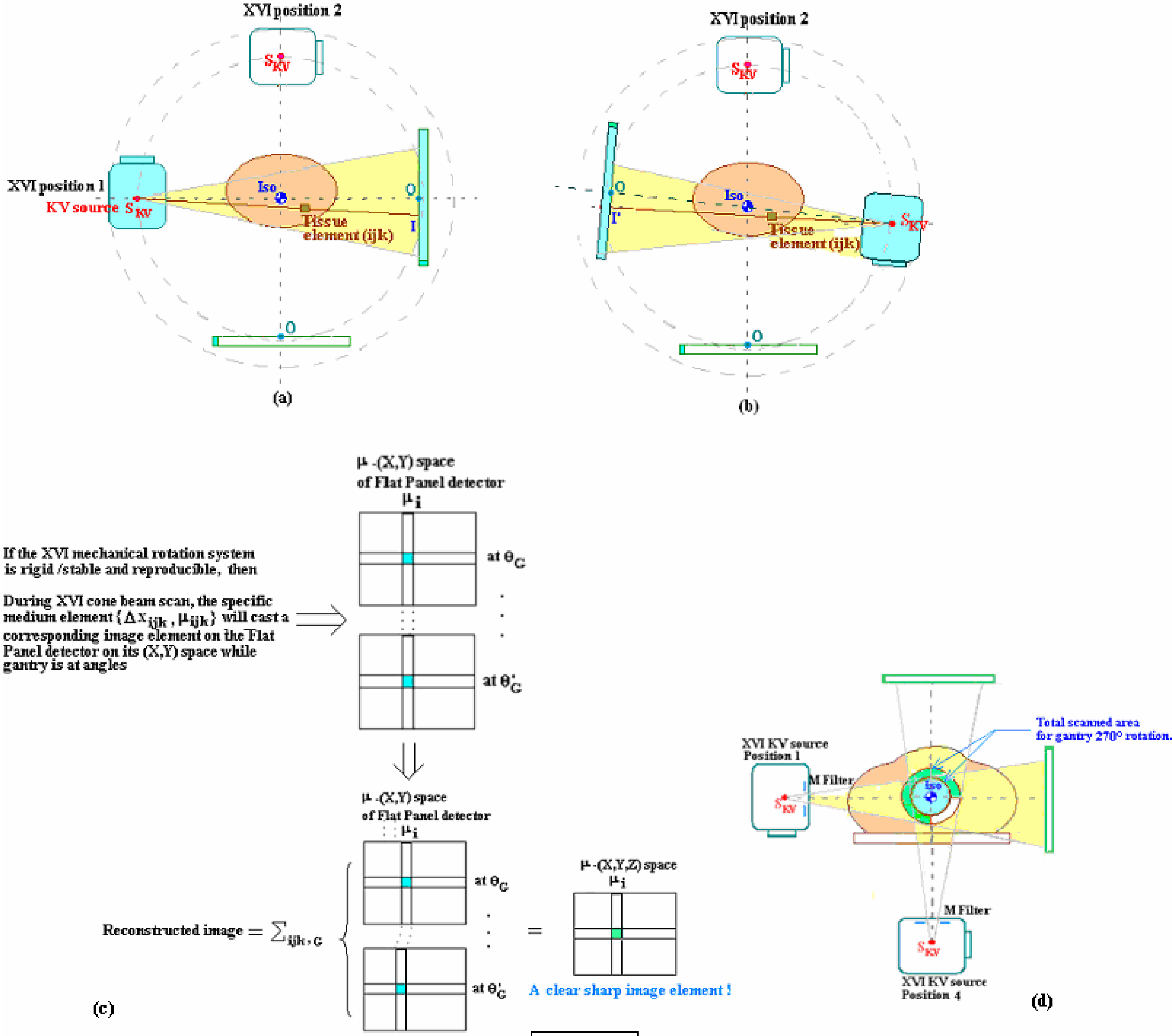

Fig. 2

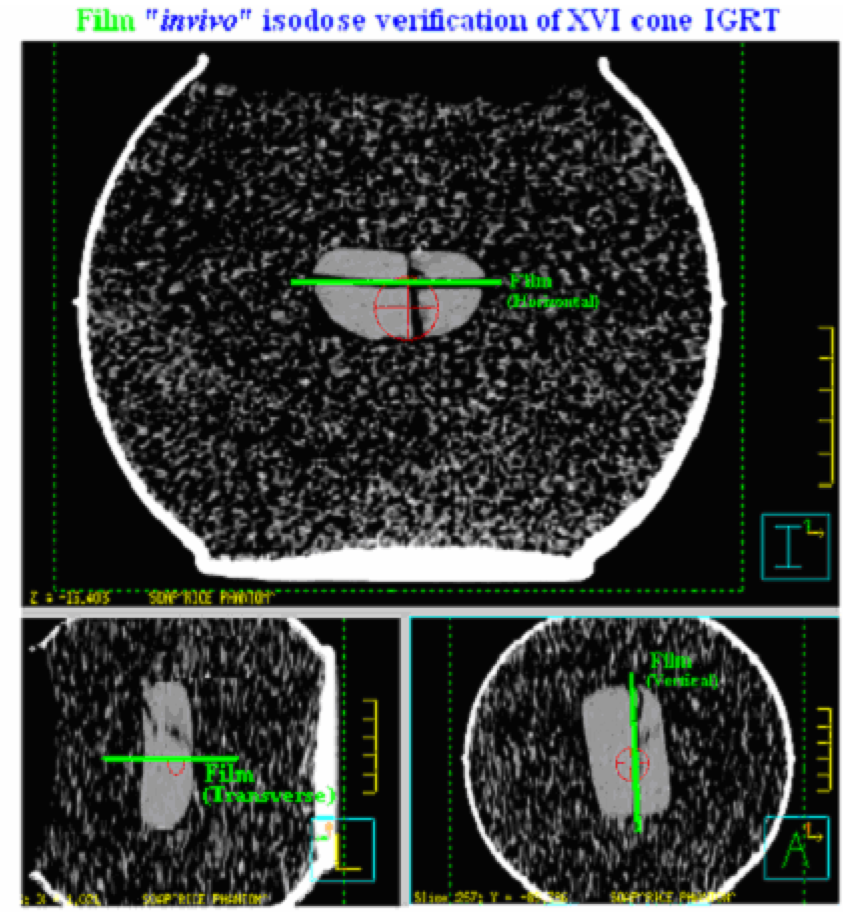
Film "invivo" isodose verification of XVI cone IGRT
Film
Film
(Transverse)
Film

Fig. 3

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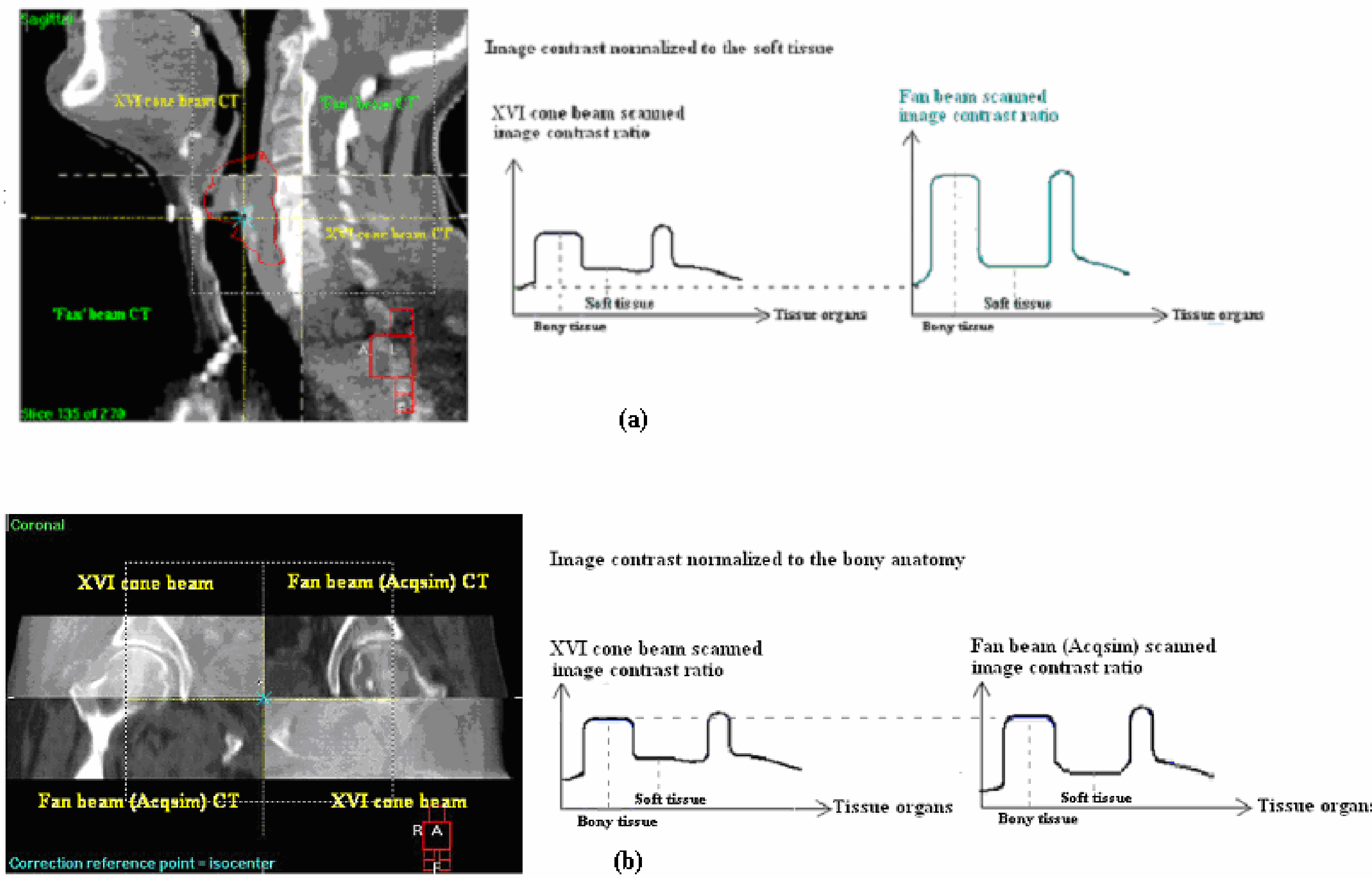

Fig. 4

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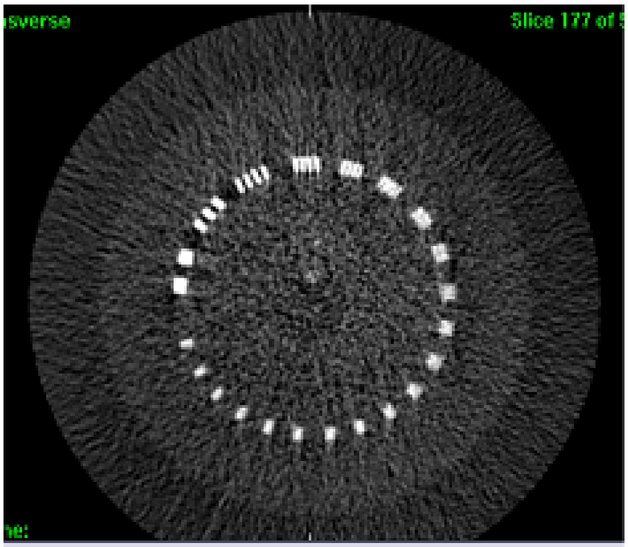
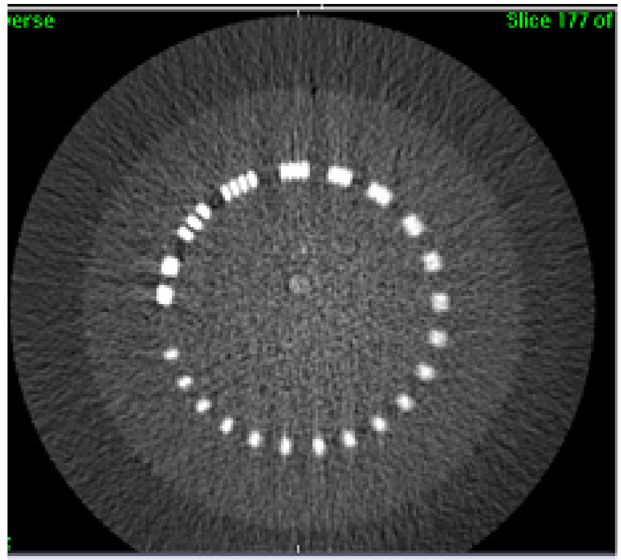
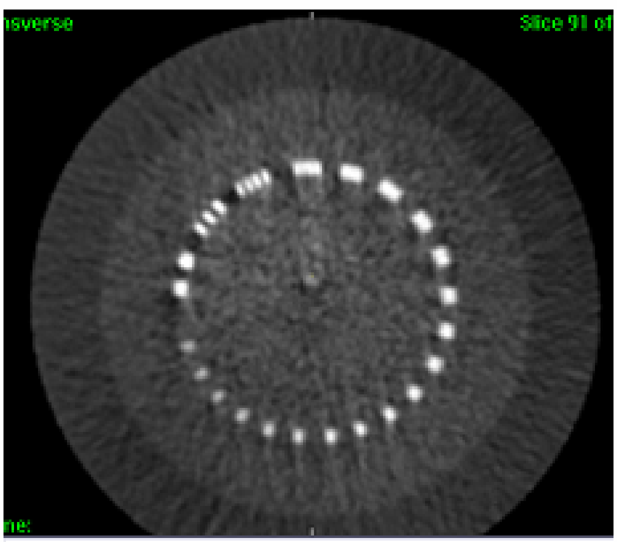
XVI cone beam image quality comparison for a given filter size, for instance S-filter, at different gantry angular interval scan



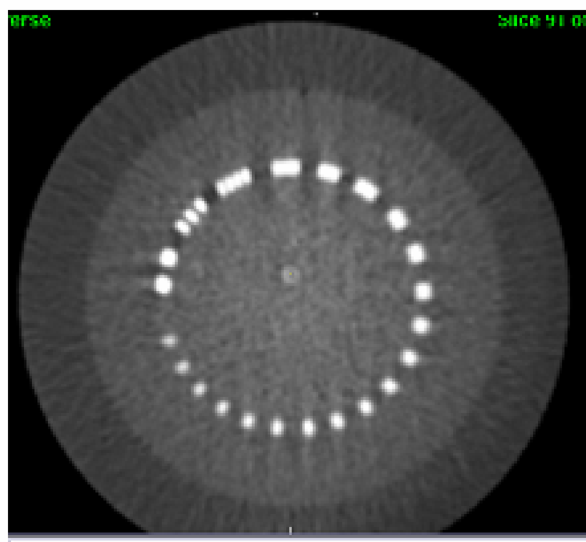
S20-filter, 1024 resolution, 200° gantry scan



S-20 filter, 1024 resolution, 360° gantry scan



S20-filter, 512 resolution, 200° gantry scan



S20-filter, 512 resolution for 360° gantry scan

Fig. 5

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Radiation exposure measured during XVI cone beam scan at various size of the anatomy.

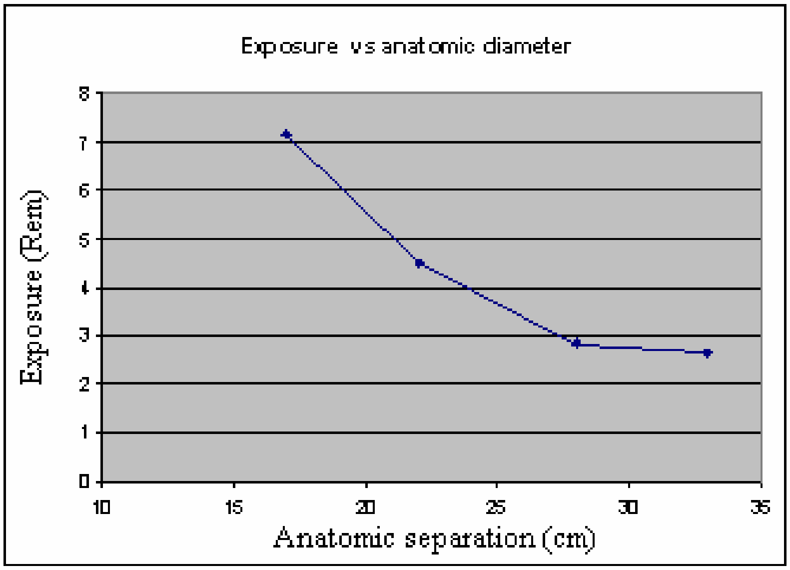
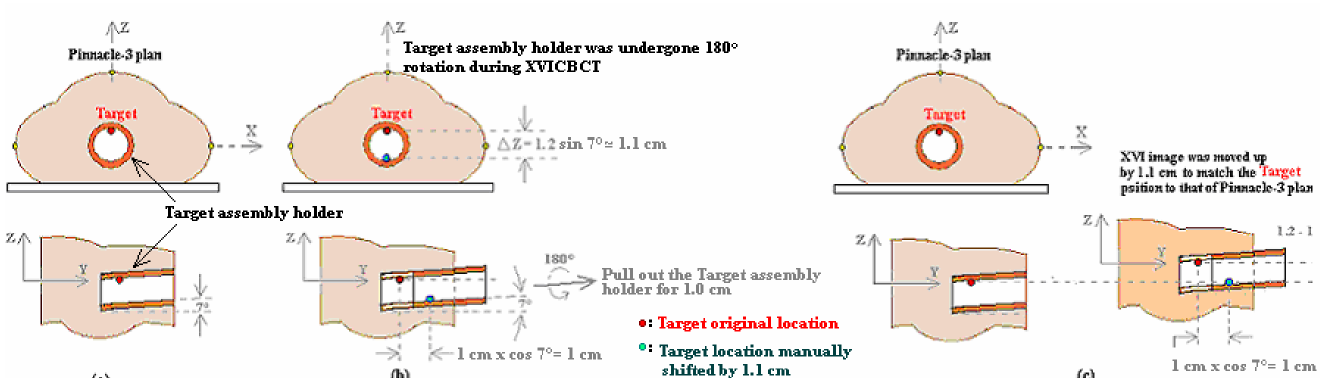


Fig. 6



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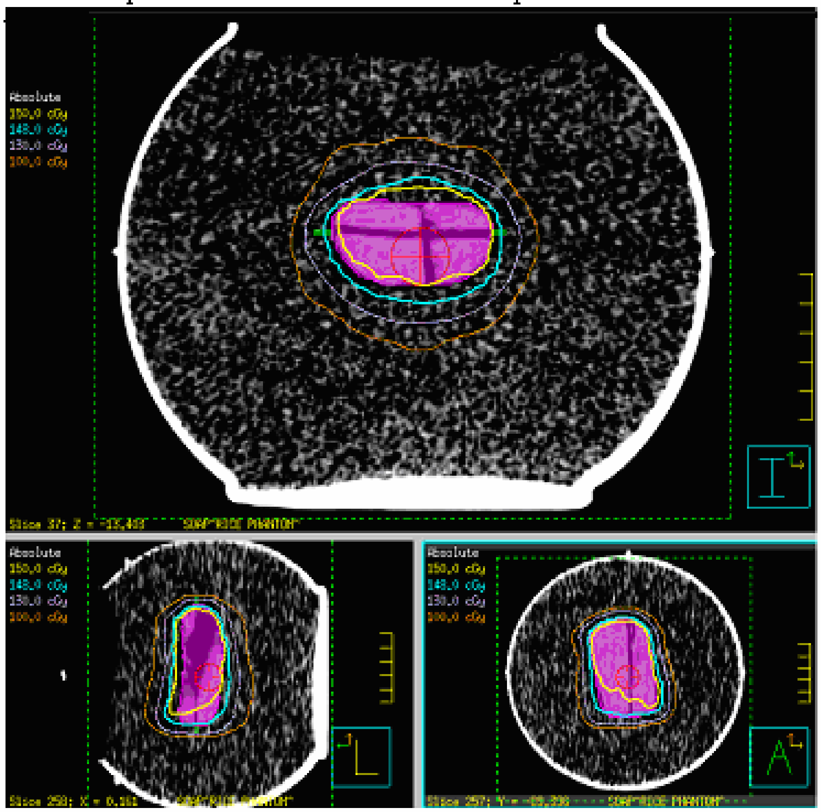
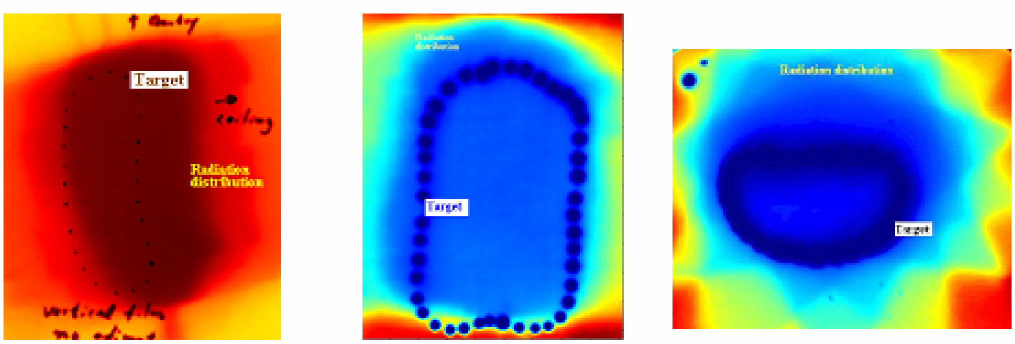
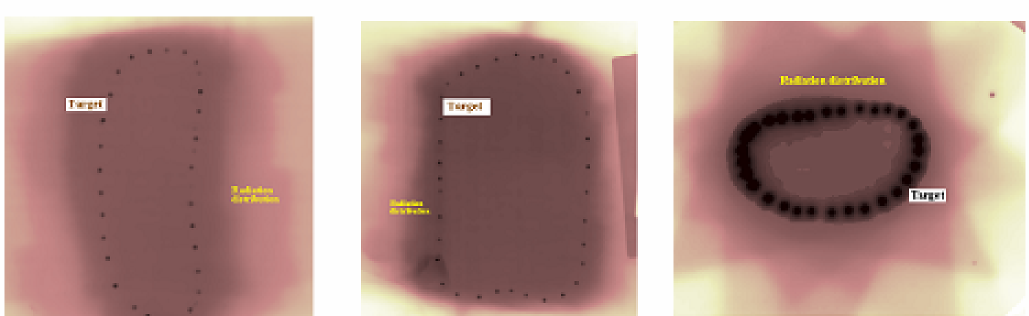
(a) Treatment plan isodose distribution the Jar phantom



(b). Radiation distribution of the Jar phantom with XVI cone beam scan.



(c). Radiation distribution of the Jar phantom with XVI cone beam scan.



With XVI cone beam IGRT Transverse plane

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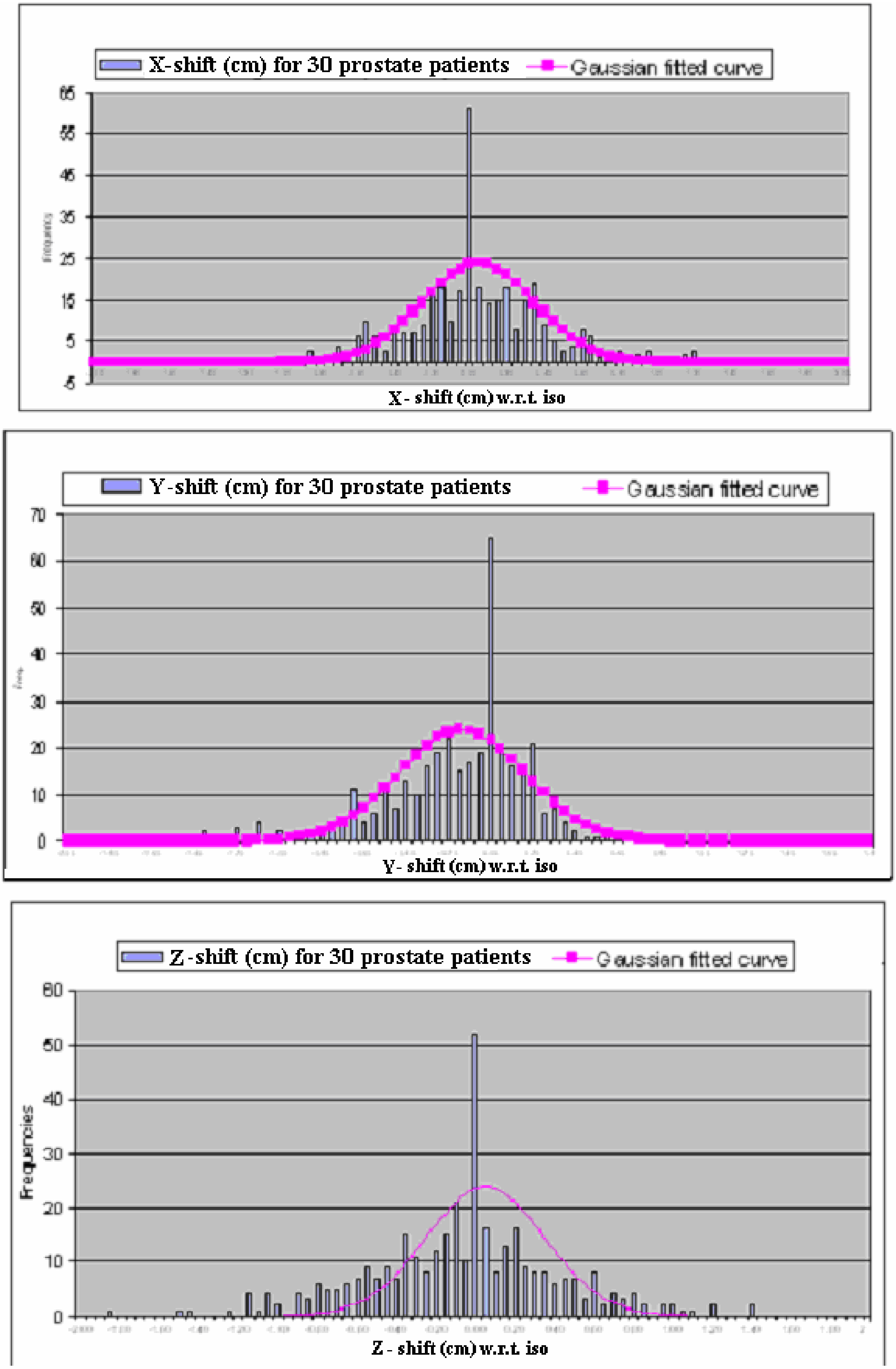

Fig. 9

Table-1. Rando Phantom test of XVI system for the target coordinates movements

Table 1. Rando Phantom test of XVI system for the target coordinates movements

Target location status	Target coordinates (cm) obtained from XVI cone beams scan		
	X_o	Y_o	Z_o
Initial setup XVI scan of the target location	0.12	0.06	-0.01
	X_1	Y_1	Z_1
Target had 1 cm movement within the Phantom	0.04	-0.94	1.06
	$X_1 - X_o$	$Y_1 - Y_o$	$Z_1 - Z_o$
XVI system detected shift of target	**-0.08**	**-1**	**1.07**
Real target movement with the Phantom	**0**	**-1**	**1.1**
	X_2	Y_2	Z_2
Table dropped down by 2.0 cm	0.16	-0.01	-2.05
	$X_2 - X_o$	$Y_2 - Y_o$	$Z_2 - Z_o$
XVI system detected the Target shift from table dropping down 2.0 cm	**0.04**	**-0.07**	**-2.04**
Actual target movement by dropping table down 2.0 cm	**0.00**	**0.00**	**-2.00**