

Electronic Portal Imaging Device(EPID) Portal Image

* . † . * . * . * . * . † . †

Evaluation of Usefulness of Portal Image Using Electronic Portal Imaging Device (EPID) in the Patients Who Received Pelvic Radiation Therapy

Woo Chul Kim, M.D.* , Won Park, M.D. † , Heon Jong Kim, M.D.*
Seong Young Park, Ph.D.* , Young Kap Cho, M.D.* , John J K Loh, M.D.*
Chang Ok Suh, M.D. † and Gwi Eon Kim, M.D. †

* *Department of Radiation Oncology, Inha University Hospital, Incheon, Korea*

† *Department of Radiation Oncology, Yonsei Cancer Center, Yonsei University, Seoul, Korea*

Purpose : To evaluate the usefulness of electronic portal imaging device through objective compare of the images acquired using an EPID and a conventional port film.

Materials and Methods : From Apr. to Oct. 1997, a total of 150 sets of images from 20 patients who received radiation therapy in the pelvis area were evaluated in the Inha University Hospital and Severance Hospital. A dual image recording technique was devised to obtain both electronic portal images and port film images simultaneously with one treatment course. We did not perform double exposure. Five to ten images were acquired from each patient. All images were acquired from posteroanterior (PA) view except images from two patients. A dose rate of 100-300 MU/min and a 10- MV X-ray beam were used and 2-10 MUs were required to produce a verification image during treatment. Kodak diagnostic film with metal/film imaging cassette which was located on the top of the EPID detector was used for the port film. The source to detector distance was 140 cm. Eight anatomical landmarks (pelvic brim, sacrum, acetabulum, iliopectineal line, symphysis, ischium, obturator foramen, sacroiliac joint) were assessed. Four radiation oncologist joined to evaluate each image. The individual landmarks in the port film or in the EPID were rated - very clear (1), clear (2), visible (3), not clear (4), not visible (5).

1996

1998 8 5

1998 9 25

: , 37 7-206

AP				image	10MU				
	17cm	20cm	PA						double
EPID	Siemens	video camera based type ¹		exposure					EPID
	source to detector distance	140 cm		Varian	matrix ion chamber type ³				
	port film source	140cm		source to detector distance	140cm				
	cassette	beam energy	10MV	film cassette	140cm				
X-ray	dose rate	300MU/min		beam energy	10MV	X-ray			
port film	Kodak diagnostic film ²	film		port film	dose rate	300MU/min			
	cassette			, portal image	100MU/min				
	port film	2MU	portal	port film	10MU	, portal image	10MU		
						double exposure			

Table 1. The Relative Score according to the Image Acquisition Technique of Video Camera Based EPID in Each Anatomical Landmarks

Film									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator	
1	45	0	1	4	0	0	0	0	0
2	30	0	27	25	0	4	14	2	2
3	25	0	53	57	37	45	61	67	67
4	0	20	19	14	40	36	25	31	31
5	0	80	0	0	23	14	0	0	0

EPID no enhancement									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator	
1	49	0	2	4	0	0	0	0	0
2	33	0	21	23	0	4	11	3	3
3	18	0	51	51	31	36	53	51	51
4	0	27	26	22	41	37	36	46	46
5	0	73	0	0	28	23	0	0	0

EPID window level									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator	
1	58	0	4	12	0	0	0	0	0
2	27	1	33	31	4	15	22	22	22
3	15	12	49	46	43	44	64	58	58
4	0	45	14	11	35	26	14	20	20
5	0	42	0	0	18	15	0	0	0

EPID CLAHE enhancement									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator	
1	81	0	11	14	7	1	9	11	11
2	17	6	51	48	31	48	72	64	64
3	2	42	36	35	37	42	19	22	22
4	0	38	2	3	17	9	6	3	3
5	0	14	0	0	8	0	0	0	0

score-1 : very clear, 2 : clear, 3 : visible, 4 : not clear, 5 : not visible

¹BeamviewPLUS1.2, Siemens, Concord, CA

²Kodak Diagnostic film, Eastman Kodak Company, Rochester, NY

³Varian Portal Vision 3.2, Varian Associates, Palo Alto, CA.

Table 2. Comparison between Video Camera Based EPID Image and Port Film in Each Anatomical Landmarks

		pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator
film	vs.	0.324	0.244	0.283	0.346	0.312	0.112	0.117	0.062
EPID(N)									
film	vs.	0.039	0.001	0.1	0.026	0.091	0.107	0.029	0.001
EPID(W)									
film	vs.	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
EPID(C)									
EPID(N)	vs.	0.259	0.001	0.009	0.003	0.009	0.003	0.001	0.001
EPID(W)									
EPID(N)	vs.	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
EPID(C)									
EPID(W)	vs.	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
EPID(C)									

film : port film, EPID(N) : no enhanced portal image, EPID(W) : Adjustment of window level of portal image, EPID(C) : CLAHE enhancement of portal image

4
 port film enhancement
 가 (pelvic portal image
 brim), (sacrum), (acetabulum), portal image window level
 (iliopectineal line), (symphysis), sacrum obturator
 (ischium), (obturator foramen), portal image
 (sacroiliac joint) very clear(1), clear(2), CLAHE enhance
 visible(3), not clear(4), not visible(5) film
 port film enhance window level
 , port film portal image pelvic brim
 . port film
 portal image (enhance) , CLAHE enhance
 port film 가
 window level , portal
 CLAHE(contrast limited adaptive histogram image port
 equalization) feature , 3 film 가 ,
 matrix ion chamber type EPID
 mode가 matrix ion chamber type EPID
 window level
 .(Table 3, 4) port film
 Mantel-Haenszel chi- portal image pelvic brim, symphysis, ischium
 square test , portal
 image window level port
 film iliopectineal line, SI joint
 video camera based EPID window level portal image
 .(Table1, 2) film

Table 3. The Relative Score according to the Image Acquisition Technique of Matrix Ion Chamber EPID in Each Anatomical Landmarks

Film									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator	
1	5	0	0	0	0	0	0	0	0
2	19	0	4	9	1	0	3	3	3
3	21	0	13	13	5	3	14	14	17
4	5	10	17	10	12	13	27	18	18
5	0	40	16	18	32	34	6	12	12

EPID no enhancement									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	Obturator	
1	10	0	0	0	0	0	0	0	0
2	22	0	0	0	0	3	0	3	3
3	17	3	16	12	24	17	14	14	18
4	1	18	25	20	22	22	26	25	25
5	0	29	9	18	4	8	8	4	4

EPID window level									
score	pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	Obturator	
1	29	0	0	0	1	0	0	0	0
2	17	0	7	3	7	9	5	8	8
3	4	6	15	16	27	28	23	26	26
4	0	28	24	19	11	12	19	14	14
5	0	16	4	12	4	1	3	2	2

score-1 : very clear, 2 : clear, 3 : visible, 4 : not clear, 5 : not visible

Table 4. Comparison between Matrix Ion Chamber EPID Image and Port Film in Each Anatomical Landmarks

		pelvic brim	sacrum	acetabulum	iliopectineal line	symphysis	ischium	SI joint	obturator
film EPID(N)	vs.	0.036	0.009	0.81	0.054	0.001	0.001	0.596	0.268
film EPID(W)	vs.	0.001	0.001	0.029	0.767	0.001	0.001	0.038	0.001
EPID(N)	vs.	0.001	0.001	0.023	0.057	0.01	0.001	0.01	0.009

film : port film, EPID(N) : no enhanced portal image, EPID(W) : Adjustment of window level of portal image

가 set up
 EPID
 film port film double exposure
 3 가 extra dose가 가
 (verification) double exposure 가
 EPID 가 (bony structure)가
 가

3 film cassette
cassette

exposure 가 double film film 가 .
가

double exposure 가 가 . port film portal image

portal image 가 . portal image

double exposure EPID 가 . portal image

EPID가 . Yin ⁹⁾ matrix ion chamber type EPID
portal image port film

가 Yin ⁹⁾ vertebral body, acetabulum, symphysis port film , pelvis
lateral image port film portal image

가 가 standard acquisition mode monitor 가

Yin ⁹⁾ 4 가 가 . video camera based

가 EPID chamber type video camera based type

enhance mode EPID 가 가 .

2 EPID

film (sex) (bone camera setting, EPID port film
density) gantry angle, image processing , window level

image mode portal 가 enhance port film
monitor 가 port film

matrix ion chamber type calibration double exposure
calibration calibration

dose rate beam energy calibration
acquisition mode
film cassette
가 .

1. Boyer AL, Antonuk L, Fenster A et al. A review of electronic portal imaging devices(EPIDs). Med Phys

1991; 19:1-16

2. **Bijhold J, Lebesque JV, Hart AAM, Vijlbrief R.** Maximizing setup accuracy using portal images as applied to a conformal boost technique for prostatic cancer. *Radiother Oncol* 1992; 24:261-271
3. **Van Tienhoven G, Lanson JH, Crabeels D, Mijnheer BJ.** Accuracy in tangential breastsetup : A portal imaging study. *Radiother Oncol* 1991; 22: 317-322
4. **Bel A, Herk MV, Bartelink H Lebesque JV.** A verification procedure to improve patient set-up accuracy using portal images. *Radiother Oncol* 1993; 29:252-260
5. **Reindstein LE, Pai S, Meek A.** Assessment of geometric treatment accuracy using time-lapse display of electronic portal images. *Int J Radiat Oncol Biol Phys* 1992; 22:1139-1146
6. **Ezz A, Munro P, Porter AT, et al.** Daily monitoring and correction of radiation field placement using a video-based portal imaging system; A pilot study. *Int J Radiat Oncol Biol Phys* 1991; 22: 159-165
7. , , , , .
Electronic Portal Imaging Device

1996; 14:69-76
8. **Meertens H, Herk MV, Bijhold J et al.** First clinical experience with a newly developed electronic portal imaging device. *Int J Radiat Oncol Biol Phys* 1990; 18:1173-1181
9. **Yin FF, Rubin P, Schell MC et al.** An observer study for direct comparison of clinical efficacy of electronic to film portal images. *Int J Radiat Oncol Biol Phys* 1996; 35:985-991
10. **Verellen D, Neve WD, Heuvel VD et al.** On-line portal imaging : image quality defining parameters for pelvic fields - A clinical evaluation. *Int J Radiat Oncol Biol Phys* 1993; 27:945-952

= =

Electronic Portal Imaging

Device(EPID) Portal Image

* , † * , * , * , † †

: matrix ion chamber type EPID video camera based EPID portal image
 film port film 가 EPID

: 1997 4 10

10 1 5-10 port film EPID
 portal image 32 79 2 AP
 PA 17cm 20cm
 beam energy 10MV X-ray dose rate 100-300MU/min 2-10MU
 port film Kodak diagnostic film film cassette
 source to detector(film) distance 140cm

4 pelvic brim, sacrum, acetabulum,
 iliopectineal line, symphysis, ischium, obturator foramen, sacroiliac joint very
 clear(1), clear(2), visible(3), not clear(4), not visible(5)

: video camera based EPID film

port film enhancement portal image
 portal image window level sacrum
 obturator portal image CLAHE enhance
 film matrix ion chamber type
 EPID port film portal image
 , portal image window level

port film
 : EPID port
 film 가 , window level enhance
 port film port film