

1

: ACR(American College of Radiology)

: 3 (2 Giotto Hi-Tech Mammography, IMS, Bologna, Italy, 1
 Senographe 500T, GE Medical Systems, Milwaukee, Wis, U.S.A.) 26-33 kV
 , (Entrance Dose) (Average Glandular Dose)

(Stereotactic method)
 : 3 1 kV 3.400-6.077,
 4.383-11.403, 3.790-6.497 mSv 0.74-1.96 mGy
 1 17.14, 18.00 mSv 3.73, 3.92 mGy ,
 , 1
 2.41-2.92 mSv 0.50-0.61 mGy (± 5%)

:

, 500T, GE Medical Systems, Milwaukee, Wis, U.S.A., 1 ;
 Machine 1 , Giotto Hi-Tech Mammography, IMS,
 Bologna, Italy 2 ; Machine 2 machine 3 ,).
 ACR (2-4) ; 1. kVp
 (1), (Table 1), (Table 2), 2.
 가 (Table 3), 3. 가 (Table 4). 4.

가 가 가 () 5.

가
 (ionization chamber), (electrometer),
 (filters; Aluminium, 0.1mm thick), (phantom)
 (acrylic block)
 (mammography) Victoreen 07-492 ,
 Victoreen 660-4A, Victoreen 660-1, 0.1
 mmAl filter (RMI) Mammo Phantom
 18-220(Victoreen); 4.5cm breast thickness

3 (Senographe

1

1998 12 10 1999 5 24

(compression device)
 5:1, UM
 Mammo FINE(Fuji, Japan) IN-R(Kodak, U.S.A.),
 UM-MA HC(Fuji, Japan) XRD-
 776(), XRD-901(,
) 90 , 35 °C,
 (Table 5), 19-106mAs, Source-Image Distance 50-60 cm, 0.1-1 1 3 , 2
 kV mAs 33/24, 28/24 3 molybdenum, 0.03
 , Source-Detector Distance 29, 31cm, Source-Image Distance mm molybdenum
 65cm, 1.8 1.9
 kV mAs 31/14 , Source-Image Distance 57.5cm, 1.08
 Source-Detector Distance 53cm, 1.008
 24 °

$$= \times CF \times \times$$

CF ; Conversion Factor (Table 6)

(Grid ratio),

, x- (3), ,

Table 1. Recommended Mean Glandular Dose in United States

Organization	For Screen-Film Mammography	For Xeromammography	Year
NCRP	< 4 mGy	< 4 mGy	1985
MQSA	< 3 mGy		1994
California State	< 2 mGy	< 3 mGy	1990
ACR	< 3 mGy	< 4 mGy	1992

NCRP ; National Council on Radiation Protection & Measurements

MQSA ; Mammography Quality Standards Act

ACR ; American College of Radiology (cf. ref. 5)

Table 4. Measurement of Half Value Layer (HVL) for Machine 2

kV	mAs	Filter	%	Dose(mSv)	HVL
28	50	non	100	5.34	0.37 mmAl
		0.3	56.5	3.02	
		0.4	47.9	2.56	
29	50	non	100	6.04	0.38 mmAl
		0.3	57.4	3.47	
		0.4	48.7	2.94	
30	40	non	100	5.43	0.39 mmAl
		0.3	58.2	3.16	
		0.4	49.5	2.69	
31	36	non	100	5.55	0.40 mmAl
		0.3	59.8	3.31	
		0.4	50.6	2.80	
		0.5	43.1	2.39	
32	32	non	100	5.54	0.41 mmAl
		0.3	59.7	3.31	
		0.4	51.1	2.83	
		0.5	43.8	2.43	
33	28	non	100	5.33	0.41 mmAl
		0.3	60.2	3.21	
		0.4	51.6	2.75	
		0.5	44.5	2.37	

Table 2. Results of kVp Measurement for Each Machine for 30 kV

Exposure Machine	Exposure 1	Exposure 2	Exposure 3	Mean	Error	Acceptable Error Range
1	29.7	29.8	29.7	29.7	+ 1.9%	± 5%
2	32.4	32.4	32.4	32.4	-8%	
3	33.4	33.4	33.3	33.4	-11.3%	

Table 3. Measured Values of Entrance Dose for Machine 1

KV/mAs		27/1.06	28/76	30/44.7	32/29.1	33/24.6	34/20.2
ED Exposure 1		11.40	9.27	6.78	5.32	4.83	4.38
(mSv) Exposure 2		11.41	9.29	6.76	5.30	4.81	4.39
Exposure 3		11.40	9.29	6.77	5.32	4.80	4.38
Mean		11.403	9.283	6.770	5.313	4.813	4.383

*ED ; Entrance Dose

; 1.008

3.400-6.077, 4.383-11.403, 3.790-6.497 mSv

(Table 3), 0.74-1.96 mGy

(°C) 24.5 °C
(mmHg) 760.5 mmHg

(Table 7-9) NCRP (National Council on Radiation Protection
& Measurements) 가
ACR (American College of Radiology)

$$= \frac{273.2 + \quad \times 760}{295.2 \times}$$

17.14, 18.00 mSv 3.73, 3.92 mGy 2.41-2.92 mSv

Table 6. Conversion Factor for a Mo-Target/Mo-Filter X-Ray Tube

Glandular dose(mrad) for 1R Entrance Exposure
4.5Cm Breast Thickness
50% Adipose/50% Glandular Breast Tissue

Mo-Target/Mo-Filter X-Ray Tube Voltage(kVp)

Table 5. Applied kV in 151 Patients

kV	No. of Patients
25	5
26	7
27	17
28	15
29	22
30	43
31	24
32	15
33	3

HVL \ kVp	29	30	31	32	33
0.36	173	174	175	176	176
0.37	177	178	178	179	180
0.38	181	182	182	183	184
0.39	185	186	186	187	188
0.40	189	190	191	192	192
0.41		194	195	196	196
0.42				200	200
0.43					204

* HVL ; Half Value Layer

Table 7. Measured Values of Average Glandular Dose (AGD) for Machine 1

kVp	HVL(mm)	ED(mSv)	CF	Environmental Correction Factor	Chamber Correction Factor	AGD(mGy)
26	0.33	11.40	158			1.96
28	0.37	9.28	176			1.78
30	0.41	6.77	194	1.008	1.08	1.43
31	0.41	5.31	196			1.13
32	0.42	4.81	200			1.05

* CF ; Conversion Factor, ED ; Entrance Dose, HVL ; Half Value Layer

Table 8. Measured Values of Average Glandular Dose (AGD) for Machine 2

kVp	HVL(mm)	ED(mSv)	CF	Environmental Correction Factor	Chamber Correction Factor	AGD(mGy)
28	0.37	6.497	176			1.24
29	0.38	5.26	181			1.04
30	0.39	4.387	186	1.008	1.08	0.89
31	0.40	4.39	191			0.91
32	0.41	3.79	196			0.81
33	0.41	3.79	196			0.81

* CF ; Conversion Factor, ED ; Entrance Dose, HVL ; Half Value Layer

Table 9. Measured Values of Average Glandular Dose (AGD) for Machine 3

kVp	HVL(mm)	ED(mSv)	CF	Environmental Correction Factor	Chamber Correction Factor	AGD(mGy)
27	0.36	5.977	171			1.11
29	0.38	6.077	181			1.20
30	0.39	4.813	186	1.008	1.08	0.97
31	0.40	3.95	191			0.82
32	0.42	3.97	200			0.86
33	0.42	3.40	200			0.74

* CF ; Conversion Factor, ED ; Entrance Dose, HVL ; Half Value Layer

0.50-0.61 mGy

ACR

(Table 2),

가 -8% -11.3%
($\pm 5\%$)

(Normalized average glandular dose)
(6).

(5).

($\pm 5\%$)

Mammography Quality Standards Act (MQSA)

가
(X_a),
(D_{mid}),

(D_s),
(D_g)
(X_a)

ACR 6800

4

2.5 mGy

(5)

MQSA(Mammography Quality Standards Act)

가
가

(accumulative dose)

(D_s) X_a

가

가

가

가

(D_{mid})

가 가

(D_g)
(5).

가
가

가,

가

가

NCRP 1
1
3

1 mGy

0.75 mGy

, ACR

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Mammographic Radiation Dose Measurement¹

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Purpose : To measure the mammographic radiation dose of different mammographic units and views as compared to the American College of Radiology Recommendations.

Materials and Methods : We measured the kVp, entrance dose and average glandular dose for three mammographic units (two Giotto Hi-Tech Mammography, IMS, Bologna, Italy, one Senographe 500T, GE Medical Systems, Milwaukee, Wis., U.S.A.) in the 26-33 kV range. Dose measurement for magnification compression view was obtained for two machines and dose measurement for stereotactic views was obtained for one machine.

Results : For each machine, the entrance dose was within the range of 3.400-6.077, 4.383-11.403, 3.790-6.497 mSv, respectively, and the average glandular dose was within the range of 0.74-1.96 mGy. The entrance and average glandular dose were 17.14, 18.00 mSv, and 3.73, 3.92 mGy for the magnification compression view and 2.41-2.92 mSv, 0.50-0.61 mGy for stereotactic views. The error range of kVp was $\sim 11.3 \sim + 1.9 \%$.

Conclusion : The entrance dose and average glandular dose were above the limit of the American College of Radiology Recommendations. It is necessary to develop a Korean standard on the basis of the above data.

Index words : Breast radiography, quality assurance
Breast radiography, radiation dose

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