

(TLD)

_____ : 1996 9 8 1998 8 10

_____ : 91.3 ± 7.8, 98.3 ± 7.5, 95.1 ± 6.3, 98.3 ± 5.5, 95.3 ± 6.3%
 85.0 ± 4.0, 86.6 ± 5.8, 83.9 ± 4.9, 94.8 ± 5.3, 94.8 ± 2.8%
 96.6 ± 2.2, 95.3 ± 3.2, 80.4 ± 1.9, 100.0 ± 3.1, 90.5 ± 2.2%
 1.14 ± 0.06, 1.10 ± 0.09, 0.96 ± 0.05, 1.06 ± 0.06, 0.95 ± 0.02
 103.4 ± 9.0, 107.8 ± 10.5, 91.1 ± 6.1, 93.8 ± 4.5, 104.5 ± 9.3%
 _____ : -8.9 +7.8% , 가 +5% 가

_____ : 가

_____ : 가

_____ : 9

_____ : 10 Gy

_____ : (Fanconi) .1.2)

_____ : 2 Gy

_____ : 3 Gy

_____ : 1998

_____ : 1999 8 6 1999 11 6

_____ : 가 가 가 가 가 가

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3 :

가 MU/min) 0.1 Gy/min (0.095 ± 0.0057 Gy/min)
 가 가 274 cm
 40 × 40 cm² 가 109.6 × 109.6 cm²
 1 cm acryl
 30 cm
 가

3) ± 7%

± 10%
 Report 17
 -10 + 5%

T_{Pb} = {T_R - T_M} over 2 ~rm x ~ 0.07

(TPb;

TR;

TM;

0.07;

10 MV X

Clinac 2100C

(electrometer)가

4)

가 ± 4%

3)

12)

가 2.

(Humanoid phantom, Hestis, USA)

가 9 11)

가

가

1.

1996 9

1998 8

10

가

2

8

가

8 cm,

32 cm

15 30

가 5 , 가 3

가

400 MU/min

0.48 Gy/min

7

가 1

8

Associates, USA)

10 MV X

3.

7

3 Gy

4 12 Gy , 1

3.5 Gy

3 , 10.5 Gy

. Clinac 2100C

(80

7.5% Li-6 92.5% Li-7
 가 3.1 mm x 3.1 mm x 0.89 mm , LiF 28
 mg , 가 195 TLD-100 (Harshaw Chemie
 BV, The Netherlands)

3%
 (PTW-TLD
 oven, PTW-Freiburg, Germany) 400 1
 100 가 1
 (Harshaw/QS TLD System 4000 reader, Solon Technologies, USA)
 100 10 , 100 400
 30

4.

SAS system for Windows version 6.12. SAS Institute Inc., 1989)

1.

Fig. 1

95.7 ± 7.2%

Fig. 2

(Mean ± S.D.)

가 91.3 ± 7.8%, 가 98.3 ± 7.5%, 가 95.1 ± 6.3%,
 가 98.3 ± 5.5%, 가 95.3 ± 6.3%

2.

1)

(Mean ± S.D.)

가 85.0 ± 4.0%, 가 86.6 ± 5.8%, 가 83.9 ± 4.9%, 가
 94.8 ± 5.3%, 가 94.8 ± 2.8% (Fig. 3).

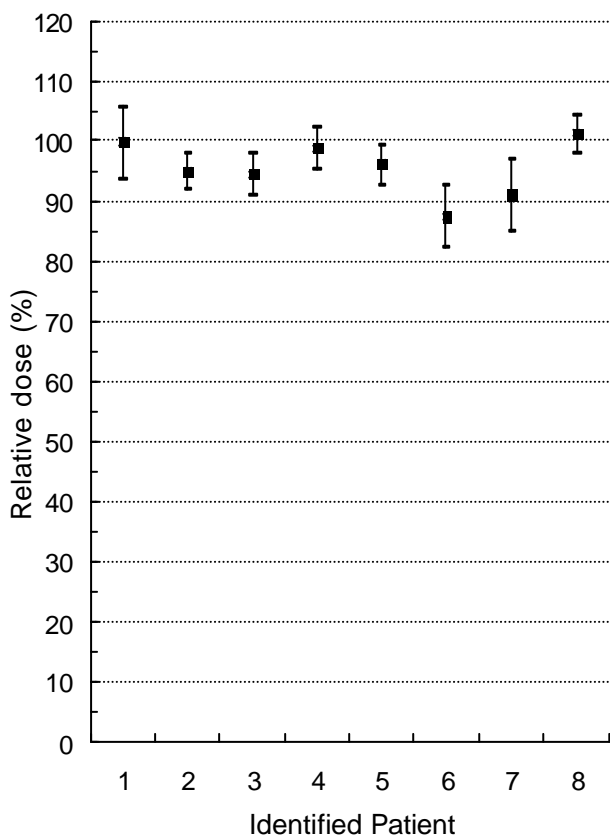


Fig. 1. Radiation doses measured with TLD chips on the surface of the patients relative to midline dose prescribed to umbilicus level in 3 measurements for case #7 or 4 measurements for all others per treatment (Mean ± S.D.).

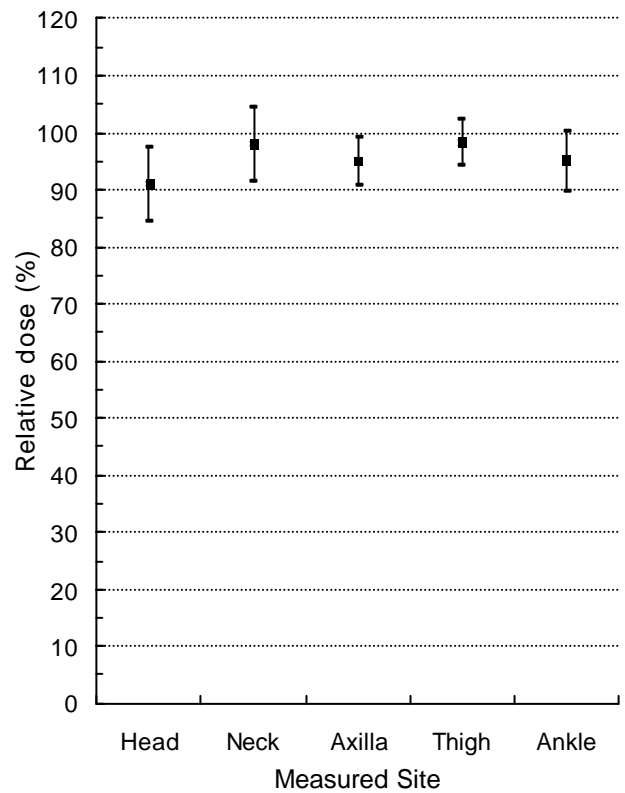


Fig. 2. Radiation doses measured with TLD chips for different levels on the surface of the patients relative to midline dose prescribed to umbilicus level in the 8 patients (Mean ± S.D.).

3 :

2)

(Mean ± S.D.)
 가 $96.6 \pm 2.2\%$, 가 $95.3 \pm 3.2\%$, 가 $80.4 \pm 1.9\%$, 가
 $100.0 \pm 3.1\%$, 가 $90.5 \pm 2.2\%$ (Fig. 4).

3)

가 1.14 ± 0.06 , 가 1.10 ± 0.09 , 가 0.96 ± 0.05 ,
 가 1.06 ± 0.06 , 가 0.95 ± 0.02 .

3.

$\pm 9.0\%$, $107.8 \pm 10.5\%$, $91.1 \pm 6.1\%$, 103.4
 $93.8 \pm 4.5\%$,
 $104.5 \pm 9.3\%$ (Fig. 5).

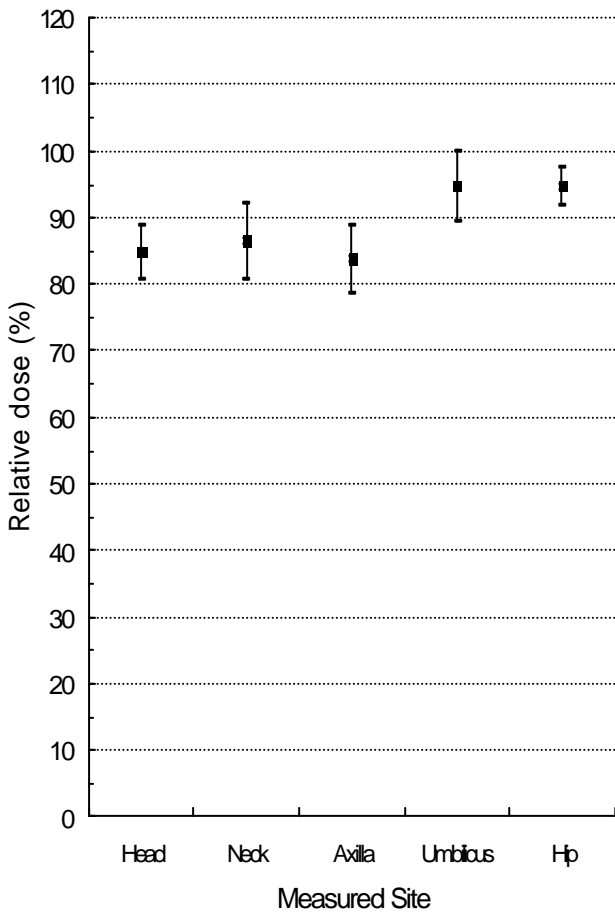


Fig. 3. Radiation doses measured with TLD chips for different levels on the surface of the Humanoid phantom relative to midline dose prescribed to umbilicus level of 8 different measurements (Mean ± S.D.).

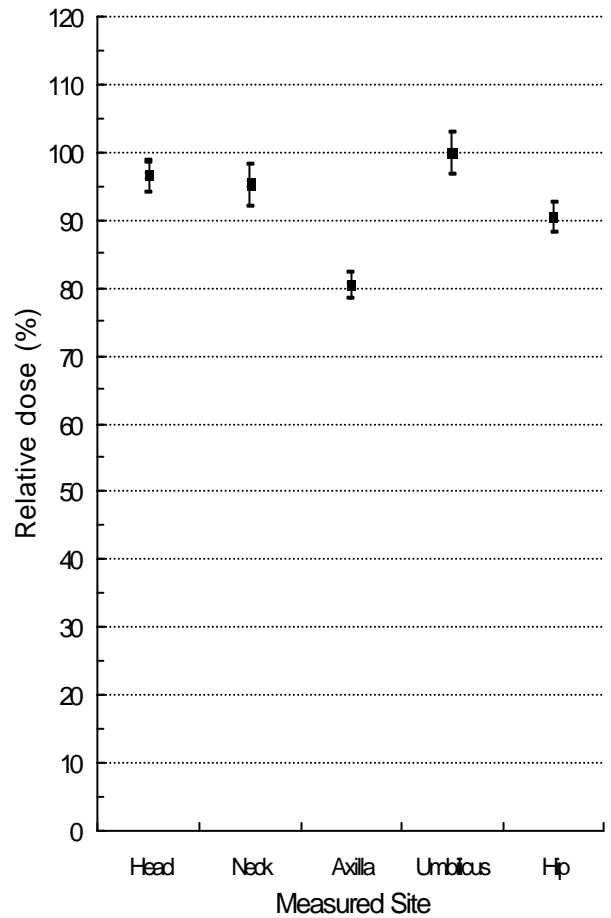


Fig. 4. Radiation doses measured with TLD chips for different levels in the midline of the Humanoid phantom relative to midline dose prescribed to umbilicus level of 8 different measurements (Mean ± S.D.).

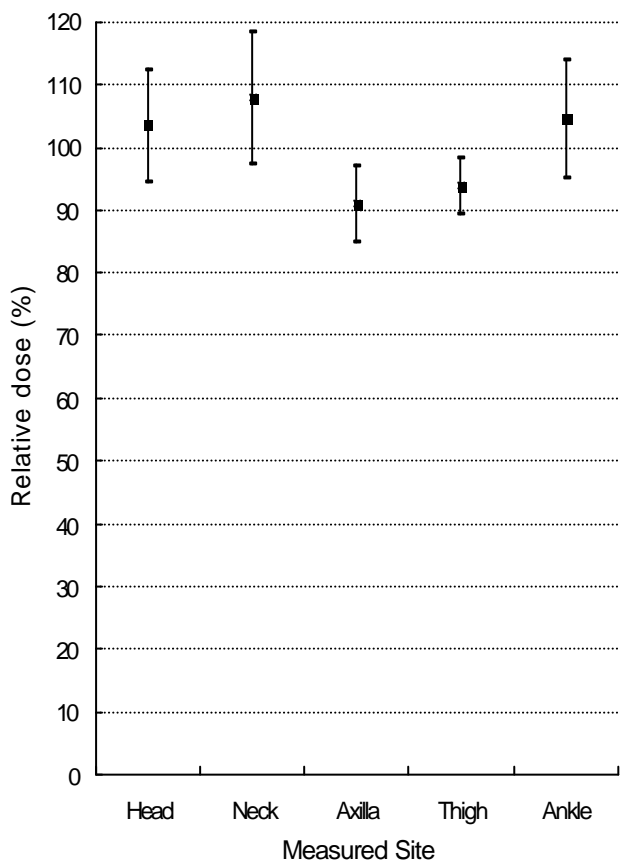


Fig. 5. Estimated midline doses of patients from the surface-to-midline ratios obtained with the Humanoid phantom.

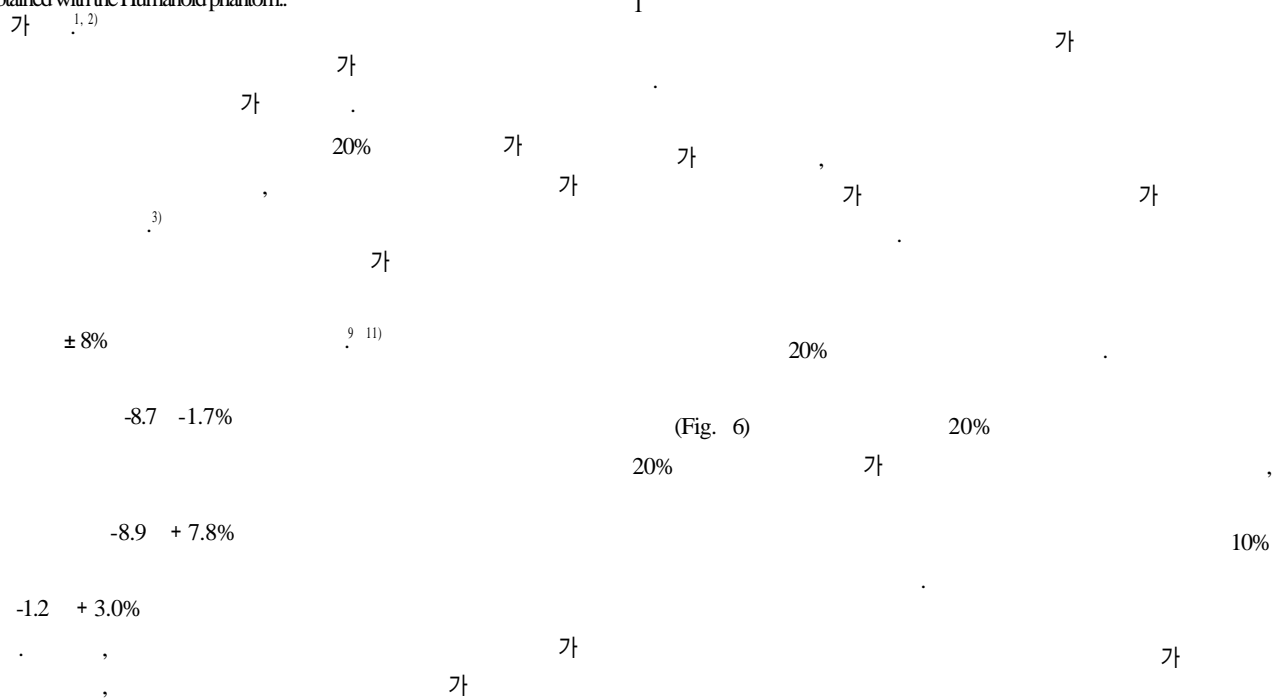
Table 1. Comparison of Thickness of the Patients and the Humanoid Phantom

Site	Patient		Humanoid phantom	
	Thickness(cm) (Mean ± S.D.)	Ratio* (Mean ± S.D.)	Thickness (cm)	Ratio
Head	16.1 ± 0.6	0.61 ± 0.10	16.0	0.60
Neck	10.6 ± 1.7	0.39 ± 0.04	13.0	0.49
Shoulder	43.0 ± 5.0	1.59 ± 0.19	50.5	1.91
Axilla	28.9 ± 2.7	1.12 ± 0.09	34.5	1.30
Umbilicus	27.3 ± 5.0	1.00	26.5	1.00
Hip	34.1 ± 2.6	1.28 ± 0.20	32.0	1.21

* ratio of the thickness relative to the reference level (umbilicus)

TLD	3%	가	가
		가	가
			가
			10%

Table



(Fig. 6)

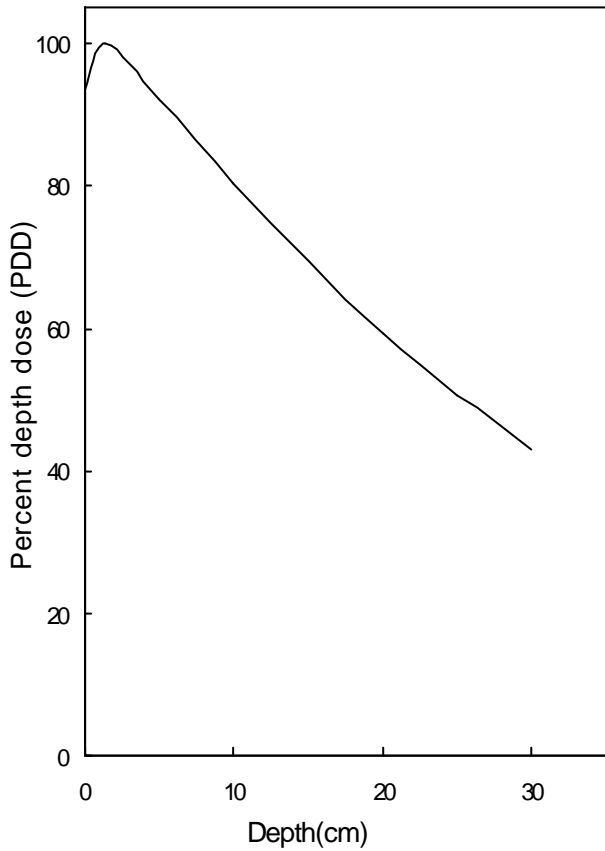
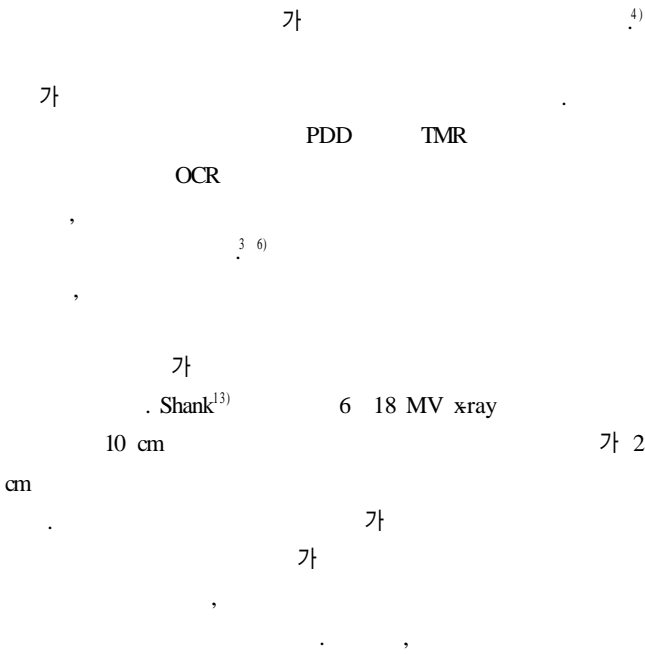
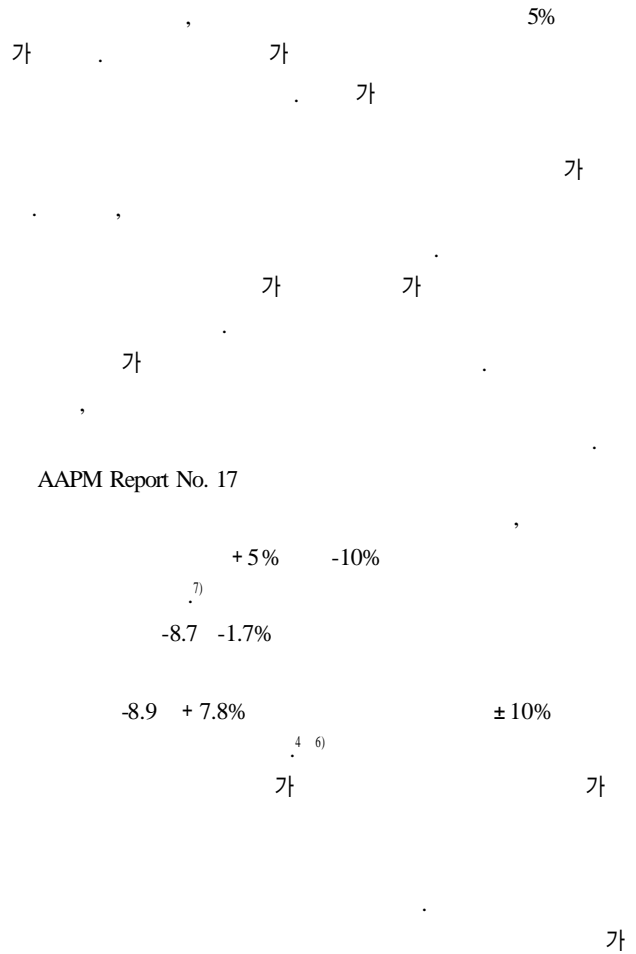


Fig. 6. Beam data for TBI setup at Seoul National University Hospital using 10 MV x-ray from Clinac 2100C (Varian Associates, USA) with phantom size 25 × 25 × 30 cm³, SSD 274 cm, and field size 104.9 × 104.9 cm², measured with Farmer type chamber



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In vivo and *in vitro* Confirmation of Dose Homogeneity in Total Body Irradiation with Thermoluminescent Dosimeter

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Purpose : Total body irradiation (TBI) or whole body irradiation is used to acquire immune suppression, to treat malignant lymphoma and leukemia, and as an conditioning regimen for bone marrow transplantation. For these purposes, many methods were developed to obtain homogenous dose distribution. The objective of this study was to analyze and confirm the accuracy and the homogeneity of the treatment setup, the parallel opposed lateral technique, currently used in Seoul National University Hospital.

Materials and Methods : Surface dose data, measured with a thermoluminescent dosimeter, of 8 patients among 10 patients, who were given total body irradiation with the parallel opposed lateral technique between September 1996 to August 1998, at Seoul National University Hospital were analyzed. Surface doses were measured at the head, neck, axilla, thigh, and ankle level. Surface and midline doses were measured with similar set-up and technique in the Humanoid phantom.

Results : Measured surface doses relative to prescribed dose for the head, neck, axilla, thigh, and ankle level were 91.3 ± 7.8 , 98.3 ± 7.5 , 95.1 ± 6.3 , 98.3 ± 5.5 , and $95.3 \pm 6.3\%$, respectively. The midline doses of the head, neck, axilla, thigh, and ankle level estimated from the surface-to-midline ratios in the Humanoid phantom were 103.4 ± 9.0 , 107.8 ± 10.5 , 91.1 ± 6.1 , 93.8 ± 4.5 , and $104.5 \pm 9.3\%$, respectively. Measured surface doses and estimated midline doses ranged from -8.9% to $+7.8\%$. Midline doses at the neck and the axilla level deviated more than 5% from the prescribed doses. The difference of the estimated midline doses at the neck and the axilla level and the actual doses were attributed to the thickness differences between the Humanoid phantom and the patients.

Conclusion : Distribution of the midline doses as well as the surface doses were measured to be within -8.7 + 7.8% range. Actual dose distribution in the patient is expected to be better than the measured dose range mainly attributed to thickness difference between the patient and the Humanoid phantom.

Key Words : Total body irradiation, Thermoluminescent dosimeter, Dose distribution