

# MIRD

## Construction of MIRD-type Reference Korean male phantom

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63.8kg MIRD 171cm,  
 KMIRD MCNPX2.3 'KMIRD' .  
 7 0.05 10MeV  
 MIRD5 . KMIRD가 MIRD5  
 10% 가 . MIRD5  
 가 .

### Abstract

MIRD-type Korean reference adult male phantom, "KMIRD" was constructed. Organ volume data and physical data of reference Korean adult were used to construct KMIRD. The height and weight of the KMIRD are 171cm and 63.8kg. In the present study, the MCNPX2.3 Monte Carlo transport code was combined with KMIRD to calculate dose conversion coefficients and effective dose in the energy range from 0.05 to 10 MeV. Calculated results were compared with data calculated with MIRD5, based on Caucasian reference man. The dose discrepancy between two phantoms is up to 10%. Due to relatively thicker trunk and added arm model of KMIRD, the effective doses for KMIRD are lower than those of MIRD5.

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Commission on Radiological Protection) 가 (fluence)  
(Dose Conversion Coefficient)  
<sup>1)</sup> MIRD (MIRD-type phantom)  
(Anthropomorphic phantom) (Monte Carlo)  
. MIRD , , , 2  
MIRD5 MIRD 가  
. MIRD  
KMIRD . KMIRD  
, MIRD5 가 .  
2.  
MIRD KMIRD 1997  
<sup>2)</sup> KMIRD  
171cm, 63.8kg, 32.6cm, 22cm . KMIRD  
<sup>3)</sup> .  
<sup>4)</sup> 1 KMIRD

Table 1. Comparison of organ or tissue masses between Reference Korean adult data and KMIRD.

Organ	Reference Korean adult male (g)	KMIRD (g)
Adrenal*	10	10
Brain*	1370	1370
Esophagus*	40	40
Gall bladder*	11	11
GI tracts*	1200	1200
Heart	651	647
Kidneys	325	325
Liver	1467	1466
Lungs*	1000	890
Pancreas	60	56
Skeleton*	10000	8212
Spleen	200	204
Stomach	150	149
Testes	32	31
Thymus*	20	21
Thyroid	20	20
Urinary bladder	45	44

\* ICRP23 values are used due to lack of data.

KMIRD , 가 ,  
 $1.04 \text{ g}\cdot\text{cm}^{-3}$ ,  $0.296 \text{ g}\cdot\text{cm}^{-3}$ ,  $1.4 \text{ g}\cdot\text{cm}^{-3}$  . 1 KMIRD

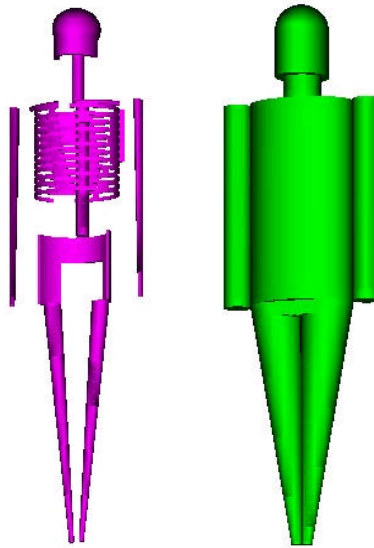


Fig 1. Skeleton and external shape of KMIRD.(rendered by Sabrina)

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 MCNPX2.3 <sup>5)</sup> . AP(Anterior-posterior),  
 PA(Posterior-anterior), LLAT(Left-lateral), RLAT(Right-lateral)  
 , 0.05, 0.1, 0.4, 0.8, 2, 8, 10 MeV

\*F6 tally , 3% 가  
 $5 \cdot 10^6$  history

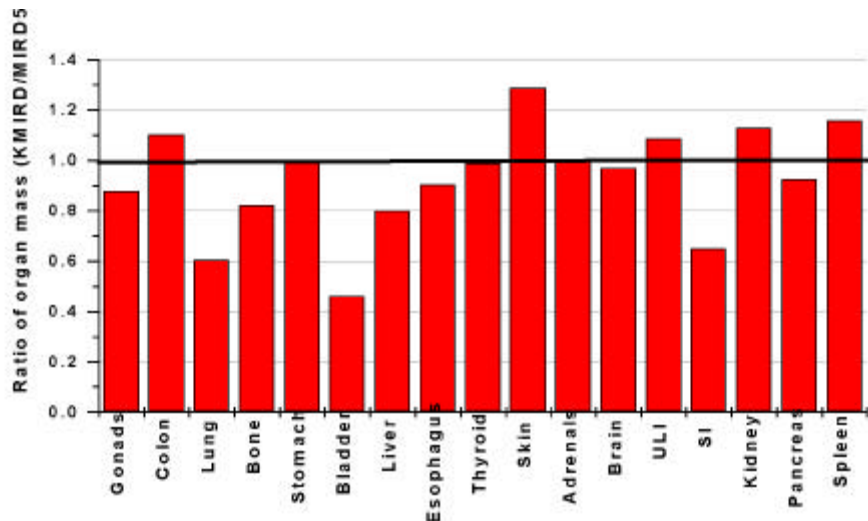


Fig 2. Comparison of organ mass between KMIRD and MIRD5

MIRD5 , KMIRD . KMIRD MIRD5

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2 3 ‘KMIRD’ AP  
 LLAT 3 KMIRD MIRD5  
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 1 KMIRD가 MIRD5

Table 2. Absorbed dose per unit air kerma free-in-air,  $D_r/K$ , in AP direction. ( $Gy \cdot Gy^{-1}$ )

Organ	Energy(MeV)						
	0.05	0.1	0.4	0.8	2	8	10
Testes	1.7777	1.8535	1.3492	1.2446	1.1691	1.0934	1.0907
RBM <sup>†</sup>	0.3314	0.6298	0.7644	0.7850	0.8192	0.8067	0.8021
Colon	0.9168	1.3219	1.0046	0.9593	0.9592	0.9415	0.9441
Lungs	0.9549	1.2399	1.0170	1.0017	1.0080	0.9963	1.0015
Stomach	1.1706	1.4630	1.0906	1.0182	0.9958	0.9637	0.9628
Bladder	1.2360	1.5670	1.1301	1.0340	1.0273	0.9930	0.9925
Liver	1.0402	1.3602	1.0313	0.9756	0.9661	0.9550	0.9581
Esophagus	0.4043	0.7959	0.7366	0.7440	0.7942	0.8502	0.8544
Thyroid	1.4454	1.5605	1.2146	1.1038	1.0246	0.9506	0.9501
Bone surface	1.9565	1.6931	0.8769	0.8511	0.8715	0.9268	0.9451
Skin	0.9576	1.1233	0.9906	0.9780	0.9912	0.9829	0.9859

RBM : Red bone marrow

Table 3. Absorbed dose per unit air kerma free-in-air,  $D_r/K$ , in LLAT direction. ( $Gy \cdot Gy^{-1}$ )

Organ	Energy(MeV)						
	0.05	0.1	0.4	0.8	2	8	10
Testes	0.2510	0.4610	0.5978	0.7136	0.7867	0.8698	0.8727
RBM	0.2301	0.4467	0.5750	0.6173	0.6953	0.7321	0.7307
Colon	0.2230	0.4564	0.4172	0.4892	0.6073	0.7502	0.7658
Lungs	0.3113	0.5131	0.4974	0.5560	0.6736	0.7948	0.8066
Stomach	0.6216	0.8622	0.7368	0.7717	0.8286	0.8980	0.9022
Bladder	0.2816	0.5163	0.5389	0.6276	0.7223	0.8505	0.8633
Liver	0.1032	0.2309	0.2997	0.3853	0.5290	0.6963	0.7085
Esophagus	0.1930	0.4465	0.4683	0.5687	0.6289	0.7644	0.7876
Thyroid	1.0823	1.3321	1.2246	1.1723	1.1767	1.1274	1.1287
Bone surface	1.3623	1.1672	0.6544	0.6683	0.7398	0.8403	0.8602
Skin	0.6548	0.8109	0.8076	0.8391	0.8927	0.9255	0.9308

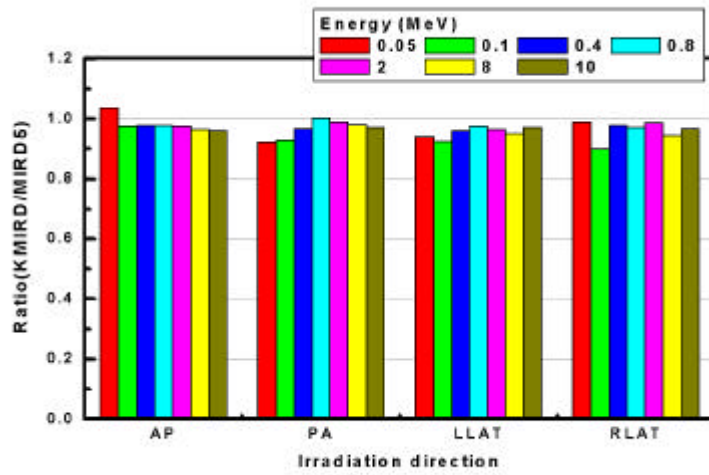


Fig 3. Comparison of effective doses between KMIRD and MIRD5.

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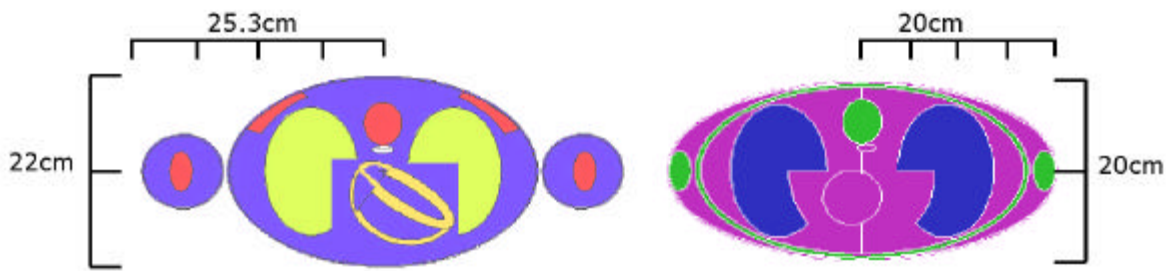


Fig 4. Axial slices of the KMIRD(left) and the MIRD5(right).

5 KMIRD MIRD5 KMIRD가 MIRD5 6

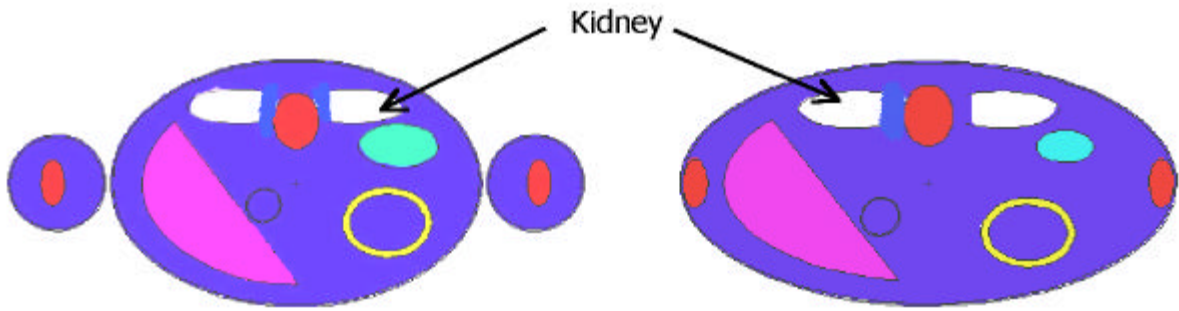


Fig 5. Axial slices through center of the kidney of the KMIRD(left) and MIRD5(right).

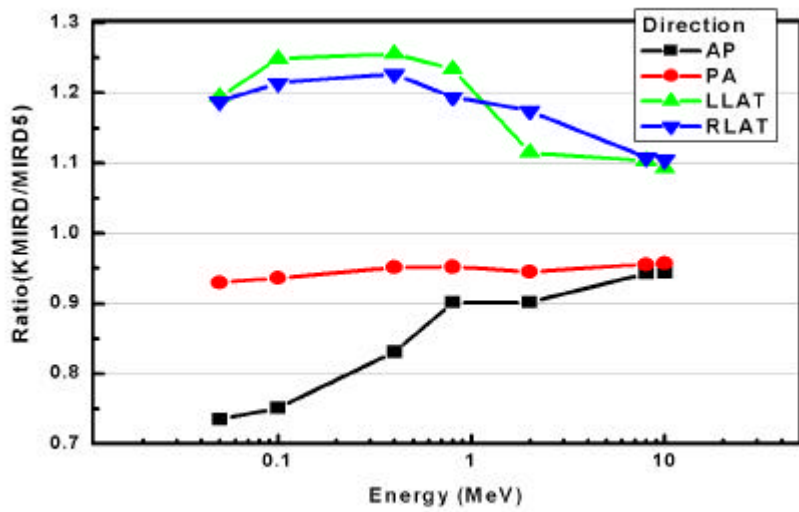


Fig 5. Comparison of kidney dose in various direction between KMIRD and MIRD5.

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- 1) Internal Commission on Radiological Protection 1996 Conversion coefficients for use in radiological protection against external radiation *ICRP Publication 74* (Oxford: Pergamon)
- 2) <http://www.ats.go.kr/kor-docs/stdbody/stdbody.htm>

- 3) “Formulation of the Reference Korean for Radiation Protection Purposes”, ITRS/TR-2002-02 (2002).
- 4) Jin Lee, Yeun Ju Lee, Young-khi Lim, Eun Sil Kim, Eung Jo Kim, Jae Ki Lee, "Study on Structure of Target Organs in Radiation Protection" 2001, pp. 120- 122, 2001.11.1- 2,
- 5) Laurie S. Waters, Editor, "MCNPX user's manual, version 2.3.0,"Los Alamos National Laboratory report LA-UR-02-2607 (2000)