MOSFET Dosimetry for Evaluation of Gonad Shielding during Radiotherapy

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I. Introduction

Recent technological advances in radiation therapy like Intensitiy Modulated RadioTherapy (IMRT) enables us to deliver prescription dose to the tumour precisely. But It still has a risk of radiation exposure to the Organ At Risk (OAR) around the tumour caused by the scattered rays from the collimator as well as the patient himself (Fig 1). Especially, the NCRP and the ICRP define the weighting factor to calculate the effective dose equivalent for gonads as 0.25 and 0.08, respectively. It means that **gonad is the one of radio-sensitve OARs** and is needed an additional protection against the scattered ray. For that reason, we have clinically used a gonad shielding material usually for rectal cancer patients. In order to evaluate the dose reduction effect by the shielding material, we **measured gonadal dose by using MOSFET dosimeter** (Fig 2).

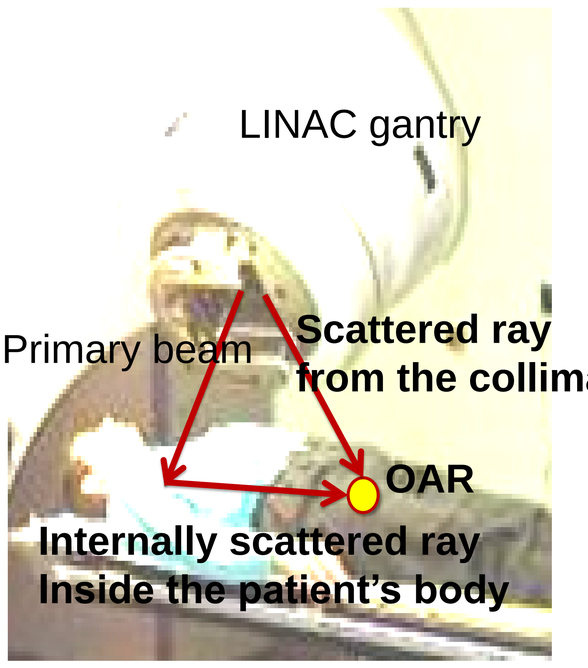

Fig 1. Possible scattered rays to the outside of beam field

Fig 2. MOSFET dosimeter
(Best Medical Canada Ltd., Canada)

II. Objectives

Evaluation of gonad shielding in order to **minimize gonadal dose** of patients undergoing radiotherapy by using **MOSFET** modality.

III. Methods

We **measured gonadal dose** of 9 patients who underwent radiotherapy for rectal cancer in the department of radiation oncology of Seoul National University Hospital between June 2009 and August 2011. 6 MV and 15 MV photon beams emitted from Varian 21EX LINAC were used for radiotherapy. In order to minimize exposed dose caused by scattered ray not only from collimator of the LINAC but also from treatment region inside radiation field, we used **box-shaped lead shielding material**. The shielding material was made of the lead block and consists of 7.5 cm × 9.5 cm × 5.5 cm sized case and 9 cm × 9.5 cm × 1 cm sized cover (Fig 3). Dosimetry for evaluation of gonad shielding was done with **MOSFET** modality.

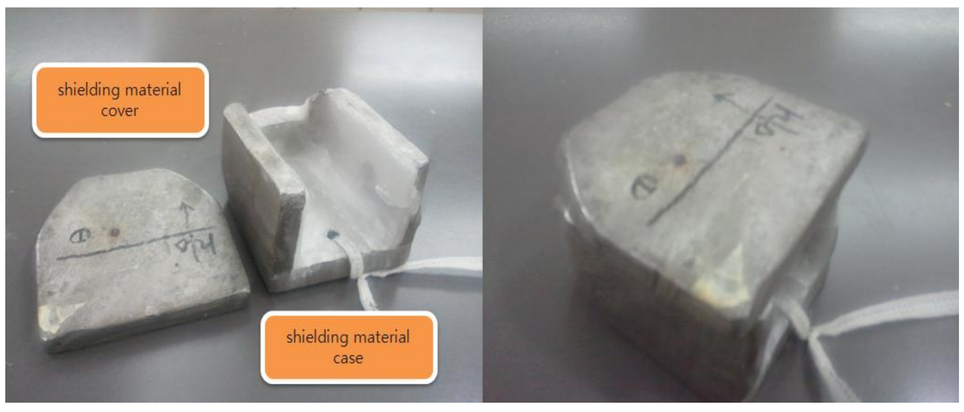

Fig 3. Gonad shielding with lead shielding material.

Site		Patients			
		A	B	C	D
Inside	1	0.02	0.01	0.01	0.01
	2	0.00	0.02	0.01	0.00
	3	0.00	0.00	0.00	0.00
	4	0.01	0.00	0.01	0.00
	5	0.05	0.03	0.03	0.03
	6	0.06	0.01	0.03	0.05
	7	0.01	0.01	0.01	0.03
	8	0.02	0.02	0.01	0.00
	Average	0.02	0.01	0.01	0.01
Outside	9	0.10	0.07	0.06	0.04
	10	0.09	0.07	0.07	0.04
	Average	0.10	0.07	0.07	0.04
Shielding Ratio (%)		**22.87**	**19.01**	**18.76**	**38.20**

Notes: $Shielding Ratio = \frac{average dose on inside}{average dose on outside} \times 100\,(\%)$

Table 1. MOSFET measurement of gonadal doses

IV. Results

By protecting with gonad shielding material, **average gonadal dose of patients was decreased by 29.88 %** (Table 1) compared with reference dose outside of the shielding material. Average delivered gonadal dose inside the shielding material was **0.01 Gy.**

V. Conclusions

By the result of MOSFET dosimetry, we verified that gonadal dose was decreased by using gonad shielding material. In compare with TLD dosimetry, we could measure the exposed dose **easily and precisely with MOSFET** modality.

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