TWO SHIELDING PROTECTION DISKS SYSTEMS IN BREAST INTRAOPERATIVE IRRADIATION

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Purpose

Intraoperative radiotherapy (IORT) consists of treating tissue suffering from neoplastic processes, made accessible by surgery, with an electron beam. During breast intraoperative irradiation the high dose rate electron beam reaches the tumour volume by specific collimators made of PMMA (Polymethyl methacrylate). Even if the particular characteristics of the beam define the target area, the presence of organ at risk (OAR) around the irradiation field has to be considered. The aim of this study is to evaluate the effectiveness of shielding protection disk used in breast intraoperative irradiation to protect OAR.

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Methods

Mobile Linear accelerator (both made by SIT)

- LIAC® (Light Intraoperative Accelerator), operating at Foligno Hospital, with electronic beam energy 6 to 12 MeV;
- Novac7, operating at Città di Castello Hospital, with electronic beam energy 3 to 9 MeV.

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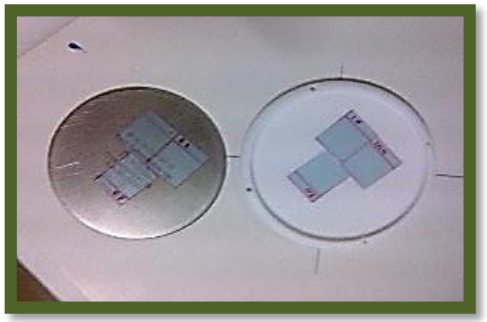
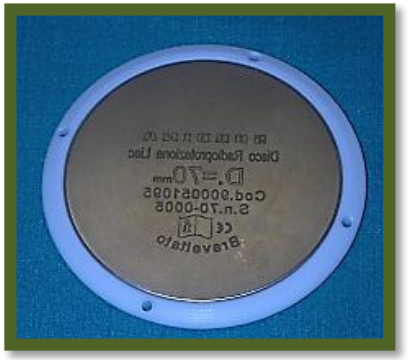
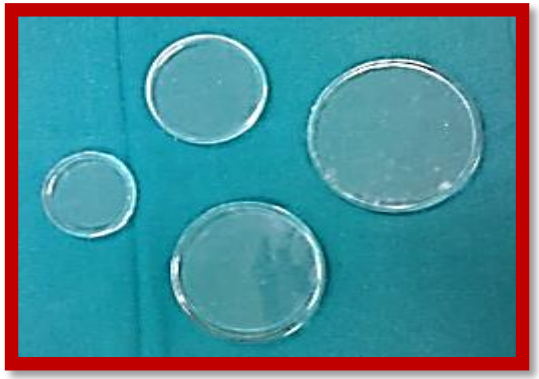


Shielding protection disks (both made by SIT)

- LIAC®: PTFE (Polytetrafluoroethylene) & Stainless Steel, 0.7 cm thick and diameter size up to 9 cm
- Novac7: PMMA with different thickness (from 0.5 to 1 cm) and diameter size up to 12 cm, Al - Pb (NRT) with different thickness and diameter size up to 10 cm





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Measurements system

- Film Gafchromic®EBT & Gafchromic®MD-V2-55

Clear Polyester – 97 µm
Active layer – 17 µm
Surface layer – 3 µm
Adhesive – 15 µm
Clear Polyester – 25 µm
Adhesive – 15 µm
Surface layer – 3 µm
Active layer – 17 µm
Clear Polyester – 25 µm

Clear Polyester – 28 µm
Active layer – 16 µm
Adhesive – 1 µm
Clear Polyester – 1 µm
Adhesive – 1 µm
Active layer – 16 µm
Clear Polyester – 25 µm

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All the dosimetric systems have been calibrated using a linear accelerator for conventional radiotherapy, with an electron beam of 6 MeV energy. The evaluation of the attenuation factor of the shielding disks has been carried out with clinical IORT irradiation of 10 Gy in solid phantom, using Novac7 and LIAC accelerators. The disks were positioned at depth of maximum dose (Dmax) and 90% dose (D90), corresponding to the typical depth of dose prescription in IORT irradiation.

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Results

The measurements made with PMMA disks show an attenuation less than 60% for all beam qualities, using both accelerators; the disks used by LIAC® attenuate almost all the radiation (<1%) due to the presence of stainless steel; the effect of this material, because of the presence of backscatter radiation, is to enhance the dose at buildup position (up to 14%, depending on the beam energy used). The NOVAC™7 disks show attenuation properties similar to LIAC®'s model, with lightly less backscatter (up to 11%) due to the different materials involved.

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Disk transmission factors normalized @ Dmax

Film position	NOVAC - 9 MeV			LIAC 12 MeV		
	PMMA	NOVAC	LIAC	PMMA	NOVAC	LIAC
Surface	0,87	0,87	0,87	0,91	0,92	0,91
Build up	1	1,03	1,05	1,00	1,11	1,14
Half disk (*)			1,13			0,39
Bottom disk	0,66	0,00	0,00	0,91	0,00	0,0

(*) Only LIAC's type

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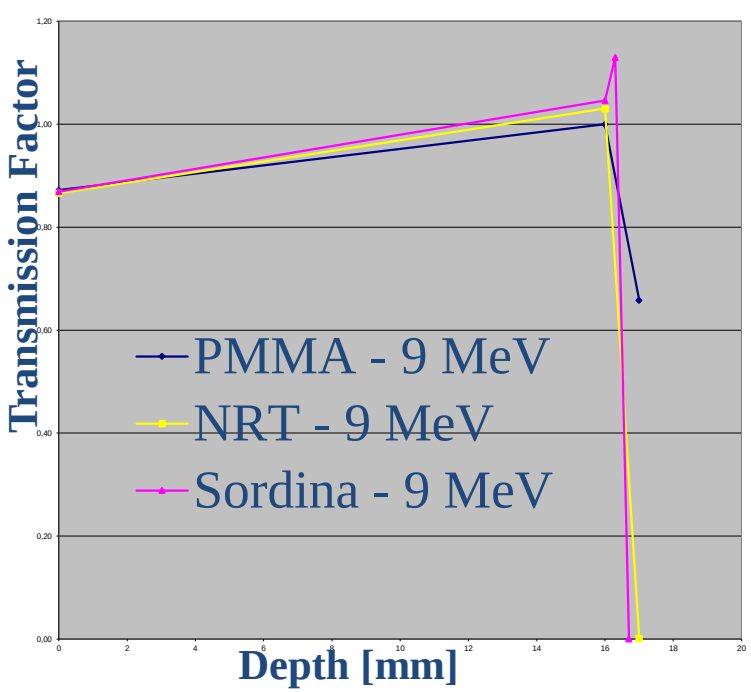

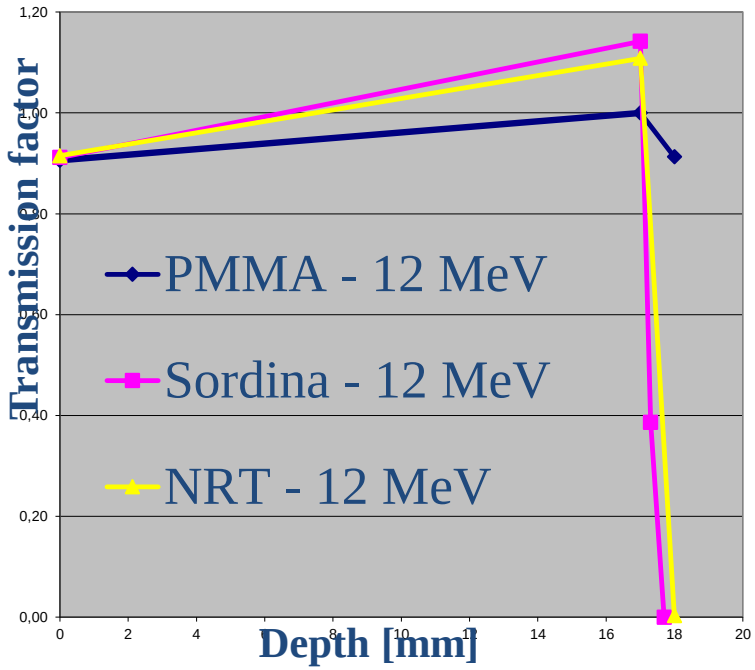

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Conclusions

The disks made for LIAC® show better attenuation characteristics compared to the PMMA ones, despite the presence of backscattering involves a slight overdose in the tumor area; their use is suitable as protection device in the intraoperative radiotherapy of the breast. The consistency of these different dosimetric systems lead to a feasible application for in-vivo dosimetry.