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DOSIMETRIC EVALUATION OF BREAST RADIOTHERAPY TREATMENTS USING MAGNETIC VALVE EXPANSION PROSTHESES (LASSD-2021)

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Introduction: Two-stage breast reconstruction is a common procedure for patients undergoing mastectomy. In this process, temporary implantation of the expansive prosthesis occurs first. The valve in the prosthesis has a magnet that guides the surgeon where to inject small saline solutions to create a cavity that will later be filled with a permanent prosthesis. The problem due to the presence of this metal during radiotherapy is the generation of artifacts by the magnet in the computed tomography (CT) image acquisition. This work intends to verify the influence on the dose distribution that the expansive prosthesis (SILIMED/470), containing a magnetic valve, generates in postoperative radiotherapy treatments.

Material and method: A Tuppware® brand plastic was used as a breast phantom. A hole in its center was made, and a support for the magnet and 2.5 mm thick acrylic layers for positioning the radiochromic films above and below the metal at four different depths was used (Figure 1). The phantom was filled with water for the planning CT images acquisition. At this step, the magnet was not positioned in the phantom to not generate magnet artifacts, and only the acrylic layers were used. Consequently, the inhomogeneity due to the magnetic valve was not considered in the treatment planning at XiO-CMS RTP software. Two opposing beams were used to simulate the tangential beams usually employed for breast treatments. Two plans were created with different energies, 6 MV and 15 MV, from an Oncor (Siemens) linear accelerator. The film calibration was performed by irradiating 3 cm² film strips with doses of 50 to 300cGy using a 20 x 20 cm² field. The films used inside the phantom were cut circularly with 2.30 ± 0.05 cm diameter. The optical density measurements were done using a digital densitometer (CQ-01 MRA) which was factory calibrated with an accuracy of ± 0.02 OD. Five measurements were taken at the center of each film, avoiding one centimeter of their borders. The densitometer was turned five minutes before the measurements to achieve thermal stability.

Results: The measured doses were compared with planned doses without the presence of the metal. The films irradiated with 6 MV had a dose increase of 7.56% for all films, but the region just above the magnet increased 14.39%. With the 15 MV beam, the films above the magnet had a 10.42% dose increase, but 10 mm below it, a decrease of 1.28% was observed. The distance between the first layer and the magnet was 5 mm, but the distance between the acrylic disks was 2.5mm each. The system only allowed dose verification of doses on a 5 mm step due to the CT image resolution and, for this reason, there is no dose information at the third layer on Table 1.

Conclusions: The film measurements at the internal region of the prosthesis surrounding the metal showed a dose increase just above the magnet region for both energies. This hot spot region inside the prosthesis can be a problem if the metal is close to the surface of the saline prosthesis. A cold spot was observed only for the 15 MV beam at 10 mm distance of the metal.

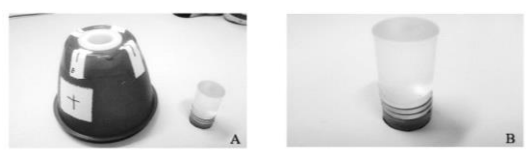

Figure 1: A) Phantom and acrylic disks. B) Rare-earth metal magnet, three acrylic disks of 2.5mm

Table 1: XIO planned dose and irradiated film measured doses.

	6 MV		15 MV	
Film position	XIO dose (±2.0 cGy)	Measured dose (±6.0 cGy)	XIO dose (±0.5 cGy)	Measured dose (±6.0 cGy)
1	204.0	219.4	208.5	230.2
2	204.0	233.4	208.5	230.2
3	---	219.4	---	230.2
4	204.0	219.4	208.5	205.8