

## **A SURVEY ON MEAN GLANDULAR DOSE FROM FULL-FIELD DIGITAL MAMMOGRAPHY SYSTEMS, OPERATE USING Mo/Mo AND W/Rh TARGET/FILTER COMBINATIONS**

*KAJIAN MENGENAI DOS PURATA GLANDULAR DARI SISTEM MAMOGRAFI DIGITAL BERBIDANG-PENUH YANG BEROPERASI MENGGUNAKAN KOMBINASI SASARAN/PENURAS Mo/Mo DAN W/Rh*

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### **Abstract**

*We had conducted a survey on Mean Glandular Dose (MGD) from Full-Field Digital Mammography systems (FFDM) operate using Molybdenum/Molybdenum (Mo/Mo) and Tungsten/Rhodium (W/Rh) target/filter combinations. A survey was carried out at two randomly selected mammography centres in Malaysia, namely National Cancer Society and International Islamic University of Malaysia. The first centre operates using a W/Rh, while the second centre operates using an Mo/Mo target/filter combinations. On the basis of recorded information, data on mammographic views, MGD, age and Compressed Breast Thickness (CBT) were recorded for 100 patients, for each mammographic centre respectively. The MGD data were analyzed for variation with age group, with 5 years increment. The MGD data were also analyzed for variation with CBT, with 5 mm increment. We found that for both CC and MLO views, FFDM systems operated using Mo/Mo and W/Rh target/filter combinations present the same trend on MGD. The average MGD decreases as age increases. While average MGD increases with the increasing of CBT. However, FFDM system operates using Mo/Mo gives higher MGD as compared with FFDM system operates using W/Rh.*

### **Abstrak**

*Kami telah menjalankan satu kajian mengenai Dos Purata Glandular (MGD) dari sistem mamografi digital berbidang-penuh (FFDM) yang beroperasi menggunakan kombinasi sasaran/penuras Molybdenum/Molybdenum (Mo/Mo) dan Tungsten/Rhodium (W/Rh). Kajian ini telah dijalankan di dua pusat mamografi di Malaysia yang telah dipilih secara rawak, iaitu Persatuan Kanser Kebangsaan dan Universiti Islam Antarabangsa Malaysia. Pusat mamografi yang pertama beroperasi menggunakan kombinasi W/Rh, sementara pusat yang kedua beroperasi menggunakan Mo/Mo sebagai sasaran/penuras. Berdasarkan maklumat yang telah direkodkan, data mengenai view mamografi, MGD, umur dan ketebalan payudara tertekan (CBT) telah direkodkan untuk setiap pusat mamografi, masing-masingnya untuk 100 pesakit. Data MGD telah dianalisa untuk variasi terhadap kumpulan umur, untuk peningkatan 5 tahun. Data MGD juga telah dianalisa untuk variasi terhadap CBT, untuk peningkatan 5 mm. Kami dapati untuk kedua-dua pandangan, iaitu CC dan MLO, system FFDM yang beroperasi menggunakan kombinasi sasaran/penuras Mo/Mo dan W/Rh memberi corak yang sama mengenai MGD. Purata MGD berkurangan dengan peningkatan umur pesakit. Sementara purata MGD meningkat dengan peningkatan CBT. Walau bagaimanapun, system FFDM yang beroperasi menggunakan Mo/Mo memberikan MGD yang tinggi berbanding dengan system FFDM yang beroperasi menggunakan W/Rh.*

**Keywords:** Mean Glandular Dose, Mo/Mo, W/Rh, Target/filter combination

## INTRODUCTION

Early detection of breast cancer is the key to successful long-term control of disease and good prognosis, while mammography of excellent quality is a fundamental prerequisite (Miller, 2005). The breast is radiosensitive organ and has a tissue-weighting factor of 0.05 (International Commission on Radiological Protection, 1991). The potential risk of radiation-induced carcinogenesis is increased with such a procedure (Fung and Gilboy, 2001).

Mean glandular dose (MGD) is the most appropriate dosimetric quantity to predict the risk of radiation induced carcinogenesis in mammographic practice. There are two main methods for the assessment of MGD from mammography, namely by using a standard breast phantom and patient-based measurement. Standard breast or phantom measurement is utilized to define MGD limits and is well suited for quality control and inter-system comparison to ensure that all units are capable of achieving acceptable doses. Such measurements, however, do not indicate the actual dose received by the individual woman (Jamal et al., 2003).

United State Food and Drug Administration has first approved FFDM in market since 2000. Since it was approved, it has rapidly replacing the conventional screen-film mammography system in many countries including Malaysia (Ranganathan et al., 2007). There are two types of mammography namely screening and diagnostic.

The objectives of these study is to undertake a survey on MGD from FFDM systems operate using Mo/Mo and W/Rh target/filter combinations.

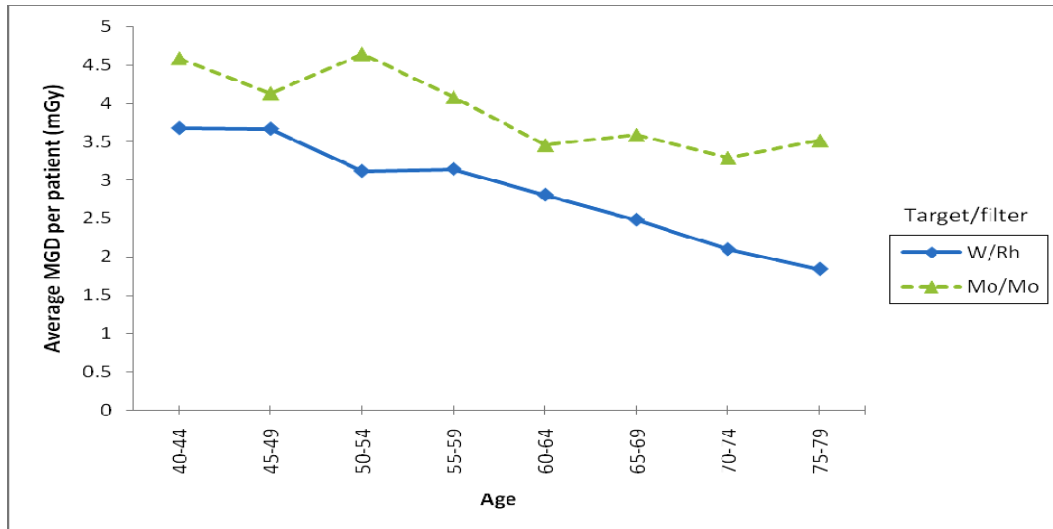
## METHODOLOGY

These survey was conducted on FFDM operated using Mo/Mo and W/Rh target/filter combinations. It was carried out at two randomly selected mammography centres in Malaysia, namely National Cancer Society and International Islamic University of Malaysia. The first centre operates using a W/Rh, while the second centre operates using a Mo/Mo target/filter combinations.

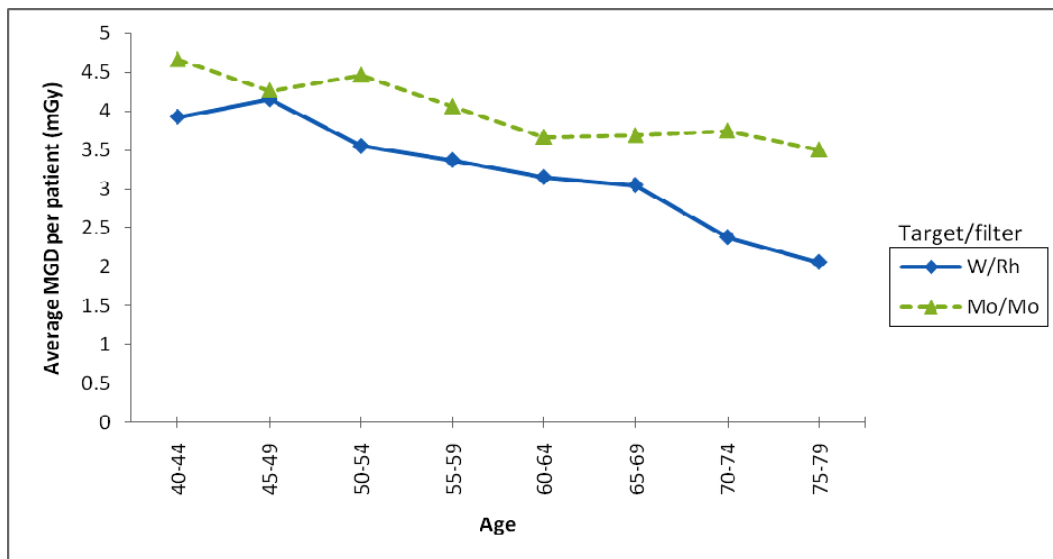
On the basis of recorded information, data on mammographic views namely mediolateral oblique (MLO) and craniocaudal (CC), MGD, age and Compressed Breast Thickness (CBT) were recorded for 100 patients, for each mammographic centre respectively. The MGD data were analyzed for variation with age group, with 5 years increment. The MGD data were also analyzed for variation with CBT, with 5 mm increment.

## RESULTS AND DISCUSSION

Figure 1 shows variation of average of MGD per patients with age groups for CC and MLO views. We found that for both CC and MLO views, MGD per patient decreases with increasing age. This is contrary to the results reported earlier (Jamal et al., 2003) on diagnostic screen-film mammography. This could be explained by the fact that our present study is on the mammography screening. However, this trend is similar to that reported by Beckett and Kotre (2000). Where MGD per subject patient declines with increasing age.



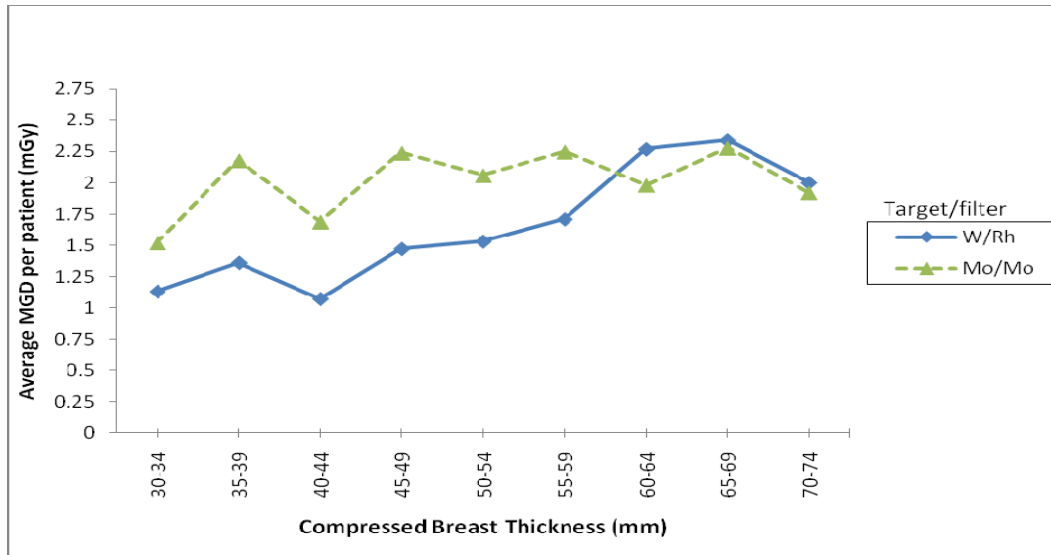
(a) Craniocaudal (CC) view



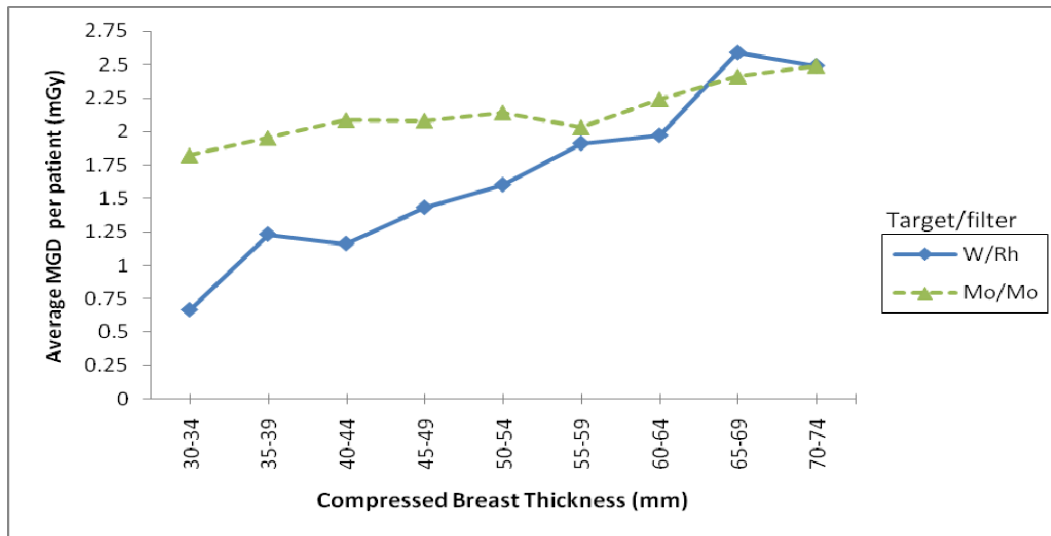
(b) Mediolateral oblique (MLO) view

Figure 1: Variation of average Mean Glandular Dose (MGD) per patient with age groups (a) CC view (b) MLO view

Figure 2 shows variation of average MGD with CBT for CC and MLO views. We found that for both CC and MLO views, FFDM systems operated using Mo/Mo and W/Rh target/filter combinations present the same trend on average MGD per patient increases with increasing of CBT. This increases is due to the fact that increases of CBT indicates increases of the length of X-ray passage through the breast. Consequently there is an increase of energy absorption, and hence MGD.



(a) Craniocaudal (CC) view



(b) Mediolateral oblique (MLO) view

Figure 2. Variation of average Mean Glandular Dose (MGD) with Compress Breast Thickness (CBT) (a) CC view (b) MLO view

Table 1. Average Mean Glandular Dose and Compressed Breast Thickness for each target/filter combination

Parameter	View	Target/filter	
		W/Rh	Mo/Mo
Average Mean Glandular Dose (MGD) (mGy)	Craniocaudal	3.31 ± 1.11	4.11 ± 1.11
	Mediolateral	3.72 ± 1.19	4.16 ± 0.88
Average Compressed Breast Thickness (CBT) (mm)	Craniocaudal	1.66 ± 0.55	2.05 ± 0.55
	Mediolateral	1.86 ± 0.59	2.08 ± 0.44

Table 1 shows average MGD and CBT for each target/filter combination. The average MGD per film for CC and MLO views for W/Rh target/filter were  $3.31 \pm 1.11$  and  $3.72 \pm 1.19$  mGy, respectively, and average CBTs were  $1.66 \pm 0.55$  and  $1.86 \pm 0.59$  mm, respectively. While the average MGD per film for CC and MLO views for Mo/Mo target/filter were  $4.11 \pm 1.11$  and  $4.16 \pm 0.88$  mGy, respectively, and average CBTs were  $2.05 \pm 0.55$  and  $2.08 \pm 0.44$  mm, respectively. We found that target/filter of W/Rh reduces 15% of MGD as compared to Mo/Mo target/filter. This may be due to the fact that W/Rh target/filter produces a harder beam compared with Mo/Mo target/filter. The difference in CBT between MLO and CC views is larger for W/Rh as compared to Mo/Mo target/filter system. However, the measurement of CBT may vary because there is no standard method for measuring the thickness of the breast (Nsiah-Akato et al., 2011) and the values were obtained by individual practice from the respective centre.

## CONCLUSION

We found that for both CC and MLO views, MGD per patient decreases with increasing age. FFDM systems operated using Mo/Mo and W/Rh target/filter combinations present the same trend on average MGD per patient that increases with increasing CBT. The average MGD per film for CC and MLO views for W/Rh target/filter were  $3.31 \pm 1.11$  and  $3.72 \pm 1.19$  mGy, respectively, and average CBTs were  $1.66 \pm 0.55$  and  $1.86 \pm 0.59$  mm, respectively. While the average MGD per film for CC and MLO views for Mo/Mo target/filter were  $4.11 \pm 1.11$  and  $4.16 \pm 0.88$  mGy, respectively, and average CBTs were  $2.05 \pm 0.55$  and  $2.08 \pm 0.44$  mm, respectively.

## ACKNOWLEDGEMENT

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