ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 6 No. 2 June 2020*

Assessment of the Relationship between Mean Glandular Dose and Compressed Breast Thickness in some Selected Hospitals in Lagos State, Nigeria

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Abstract

The aim of the study was to determine the relationship between compressed breast thicknesses (CBT) and mean glandular dose (MGD) during mammography. The study was a prospective cross-sectional study carried out in four selected hospitals in Lagos state, Nigeria. A total of sixty seven women consented for the study. The entrance surface doses were measured with the use of thermoluminescent dosimeter chips which were calibrated, the following parameters were also recorded on the data capture sheet, Age, kVp, Anode/filter combination, CBT. The mean glandular dose was calculated using Dance formula. TLD chips were placed at the upper inner quadrant of the breast before compression is applied. The CBT is then measured with a meter rule. Ten Percent (10%) of the TLD chips were kept as control, the TLD chips were read by the TLD reader after exposure and the readings are multiplied with the conversion factors by Dance. This is done for both Cranio-caudal and mediolateral oblique view of the breast. The result shows an average MGD of 0.74mGy from all the Centre and a mean CBT of 40.24mm. The range of ESD for CC and MLO were 0.33-6.4mGy and 0.28 – 8.59mGy respectively. The MGD were 0.85, 0.84, 0.57 and 0.50 mGy. The result shows a weak correlation of r=0.228 between the compressed breast thickness and mean glandular dose and there was no statistical significant relationship p >0.05. The Mean Glandular Dose does not depend entirely on CBT, Other factor like breast glandularity specific beam qualities also contribute to dose optimization.

Keywords - Compressed breast thickness, mean glandular dose, Dose optimization, Relationship

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INTRODUCTION

Dose optimization is an important principle in radiation protection most especially in mammography examination. Mammography which is the x-ray examination of the breast tissue has been found to be very helpful in early detection of breast diseases (Olarinoye and Sharifat, 2010; Shrimpton, 1986; National Radiation Protection Board,1992). The goal of mammography which is the detection, characterization and categorization of findings suggestive of breast cancer and other breast disease (Hart *et al* 2002).

The need for radiation dose assessment of patients during diagnostic x-ray examinations has been highlighted by increasing knowledge of the hazard of ionizing radiation. The variation inpatient doses and their causes is a useful tool in investigating areas in need of dose optimization (Shrimpton, 1986; National Radiation Protection Board,1992). Due to the importance of optimisation of dose in radiology a lot of researches have been carried out to measure patient dose during mammography, a few studies has also been carried out in Nigeria. Significant variation in patient doses for the same x-ray examination has been evident from many international, national and regional studies and mammography is not an exception. (NRPB,2002; Hart et al 2005). Patient Dose studies completed has shown large intra and inter radiological centre entrance skin dose variation for the same diagnostic procedure in Nigeria. To facilitate standardization and optimization in Nigeria, there is a need for a national dose survey (Ogundare *et al.*, 2008; Olarinoye and Sharifat, 2010; Oyeleke, 2009). Dose optimization in mammography will help reduce unnecessary exposure of the breast to radiation and further reduce the chances of stochastic effect of radiation.
This study sought to find out the relationship between compressed breast thicknesses and mean glandular Dose as a panacea for dose optimization in mammography examination in the four hospitals studied in Lagos state of Nigeria.

MATERIALSAND METHODS

The study was a prospective cross-sectional study carried out in four selected hospitals in Lagos state of Nigeria, the hospitals include one public hospital, one private hospital and two private diagnostic centres. A total of sixty seven women consented for the study. The entrance surface doses were measured with the use of thermoluminescent dosimeter chips which were calibrated, the following parameters were also recorded on the data capture sheet, Age, kVp, Anode/filter combination, compressed breast thickness (CBT). The mean glandular dose was calculated using the entrance surface dose and conversion factor published by Dance. The Annealed TLD chips were placed at the upper inner quadrant of the breast before compression is applied. The CBT is then measured with a meter rule. Ten Percent (10%) of the TLD chips were kept as control, the TLD chips were read by the TLD reader after exposure and the readings are multiplied with the conversion factors by Dance. This is done for both Cranio-caudal and mediolateral oblique view of the breast.

Machine Specification

Mammography machines from the four Hospitals include, Alpha RT (mgt101)- Hospital 1, Siemens (Mammomat 3000) – Hospital 2, Allengers (venus) – Hospital 3, Alpha RT – Hospital 4

Ethical Consideration
Ethical consent was approved by the Lagos State government (General Hospital Lagos ethical committee as well as signed, informed consent from volunteers were obtained.

Dosimetric Measurement
Measurements were taken with the breast positioned on the breast support of the TLD chip placed at the upper inner quadrant then compression is applied. The value of compressed breast thickness is then taken for both the cranio-caudal and medio-lateral oblique views .10% of the TLD chips in each centre were kept away from any form of irradiation to serve as control to record background radiation. The TLD chips after exposure were sent for reading at Center for Energy Research and Training Zaria Kaduna State, Nigeria using a TLD reader, Harshaw 4500 thermo electron made in USA model 4500 serial no: 0810238. The result appears as a glow curve and readings were recorded.

The recorded readings are converted to mean glandular dose using the conversion factor (6)

RESULTS
From figure 1, the highest age group were between 41 to 50 years (49.3%) and 51 to 60 years (31.3%). The least were < 30 years of age (1.5%).

Table two shows that sixty Seven (67) volunteers aged between25 –68years participated in the study with mean age and standard deviation as 49.72 ±7.85. The mean and standard deviation of the CBT was 40±10.6mm. The MGD±SD was 0.741±7.85mGy.

Table 2 showed that the Mean glandular Dose (MGD) correlated weakly with CBT(r = 0.228) but show no correlation with age r=0.There was statistical significant relationship between MGD and CBT with p=0.001.

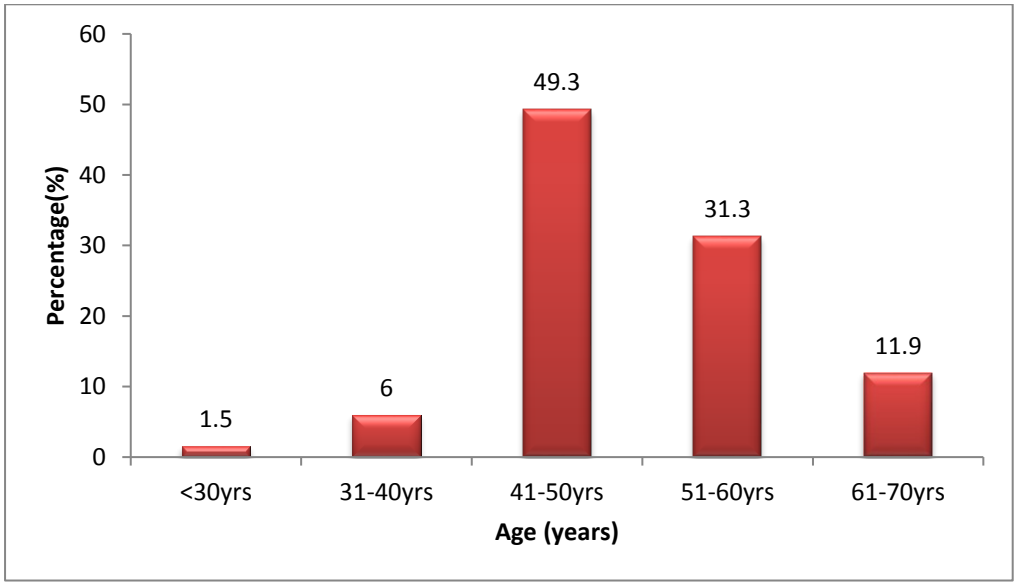

Figure 1: Bar Chart showing age distribution of participants

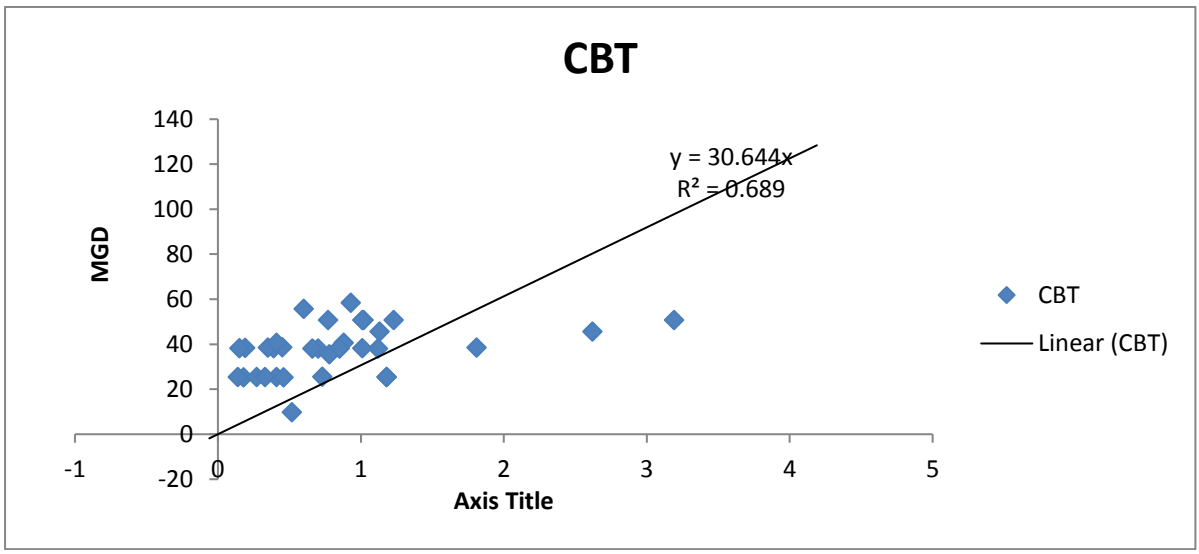

Figure 2: Correlation Showing the relationship between Mean Glandular Dose and Compressed breast thickness

Table 1: MGD distribution for the four facilities studied.

MGD	Hospital A (mGy)	Hospital B (mGy)	Hospital C (mGy)	Hospital D (mGy)
CC(mGy)	0.28+0.23	0.28+0.23	0.22+0.19	0.15+0.10
MLO(mGy)	0.59+0.37	0.59+0.37	0.41+0.55	0.39+0.22

Table 2: Relationship between MGD and CBT

	n = 67			**P<0.05 (p=0.001)**	
	min	**max**	**mean±SD**	**median**	**MGD**
Age (years)	25	68	49± 7.85	49	r = 0
CBT (mm)	35	59	40	39	r = 0.228

DISCUSSION

The results of the MGD estimated from this study shows that dose from mammography in this study is lower than the result from a work done by Ogundare *et al.,* 2009, (5) on the mean glandular doses for woman undergoing mammography breast screening in Oyo State, Nigeria. The difference can be due to difference in tube output and the use of film screen combination of which some centres were using digital mammography. However this study agrees with this study which discovered that over 90 of patients had MGD values less than 2.5 mGy which is below the guidance level of 3 mGy. The value of MGD gotten from the work is also significantly lower than the one gotten from a study that calculates the MGD assessment for phantoms' and patients in which the phantom gave the MGD of 1.9 mGy. When MGD is supplemented by a patient dose survey, the average MGD per image was 2.8 mGy for CC and 4.3 mGy for the MLO. Differences may be due to differences in tube output and breast granularity. (Olivera *et al.,* 2010)

The study objective was to determine the relationship between MGD and CBT. The findings of this study revealed that MGD correlates weakly with compressed thickness with correlation value of r = 0.228. This means there are other factors that contribute to the mean glandular Dose of patients rather the CBT. Factors like breast glandularity and specific mean qualities also contribute.

There was also no correlation between the mean glandular dose and age of the women. There was a weak correlation between MGD and CBT amongst our subjects. This is different from a work done in Malaysia using a multivariate test of two factors namely half value layer of x-ray and CBT has a significant effect on MGD at $p<0.05$ (Jamal, 2003).No significant relationship was seen between MGD per woman with respect to age which agrees with the result of this study, effectively proving that increase in age leads to reduced glandularity. It does not lead to reduced CBT. Other factors like half value layer cannot be ignored. The correlations between MGD and CBT was r = 0.28 this agrees with the finding in another work (Bor *et al*., 2010) to investigate the relationship of mean glandular dose and CBT during mammography which recorded a poor correlation (Bor *et al.,* 2010).

CONCLUSION

The study showed that there is relationship between MGD and CBT. There are other factors like glandularity and specific mean qualities affecting the MGD other than compressed breast thickness. It is recommended that further studies can be carried out based on breast glandularity and half value layer.

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