



Research article

Mammography image quality and evidence based practice: Analysis of the demonstration of the inframammary angle in the digital setting



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ABSTRACT

Aim: The aim of this study is to determine the clinical rates of the demonstration of the inframammary angle (IMA) on the mediolateral oblique (MLO) view of the breast on digital mammograms and to compare the outcomes with current accreditation standards for compliance. Relationships between the IMA, age, the posterior nipple line (PNL) and compressed breast thickness will be identified and the study outcomes validated using appropriate analyses of inter-reader and inter-rater reliability and variability. Differences in left versus right data were also investigated.

Method: A quantitative retrospective study of 2270 randomly selected paired digital mammograms performed by BreastScreen NSW was undertaken. Data was collected by direct measurement and visual analysis. Intra-class correlation analyses were used to evaluate inter- and intra-rater reliability.

Results: The IMA was demonstrated on 52.4% of individual and 42.6% of paired mammograms. A linear relationship was found between the posterior nipple line (PNL) and age (p-value < 0.001). The PNL was predicted to increase by 0.48 mm for every one year increment in age. The odds of demonstrating the IMA reduced by 2% for every one year increase in age (p-value = 0.001); are 0.4% higher for every 1 mm increase in PNL (p-value = 0.001) and 1.6% lower for every 1 mm increase in compressed breast thickness, (p-value < 0.001). There was high inter- and intra-rater reliability for the PNL while there was 100% agreement for the demonstration of the IMA.

Conclusion: Analysis of the demonstration of the IMA indicates clinically achievable rates (42.6%) well below that required for compliance (50%–75%) to known worldwide accreditation standards for screening mammography. These standards should be aligned to the reported evidence base. Visualisation of the IMA is impacted negatively by increasing age and compressed breast thickness but positively by breast size (PNL).

1. Introduction

Mammographic imaging is used widely throughout the world by screening services for the early detection of breast cancer [1]. Reduction in breast cancer mortality from mammography screening is highly dependent upon the consistent production of high quality mammographic images to enable the early detection and therefore treatment of cancers. To this aim, countries with breast screening programs such as Australia, the European Union and Hong Kong have established minimum image quality standards. Specifically, in these screening programs, mammographic image quality of the two routine views, the craniocaudal (CC) and mediolateral oblique (MLO), and radiographer performance are assessed and monitored through the use of the PGMI

(Perfect, Good, Moderate, Inadequate) image evaluation system (IES).

1.1. The PGMI

The PGMI IES was developed by the UK Mammography Trainers Group in 1994 to facilitate reproducibility, accuracy and consistency in image quality; and has informed National Health Service Breast Screening Program (NHSBP) publications in that country and standards elsewhere from that time [2,3]. Image quality analysis focuses on the inclusion and visualisation of all breast tissue and incorporates the assessment of breast anatomy including the demonstration of the inframammary angle (IMA) (Fig. 1).

The IMA is anatomically defined as the area where the chest wall

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and skin of the lower pole of glandular breast tissue meet and reflect and is formed by a region of adherence of the superficial fascial system to the chest wall below [4]. Although the true incidence of breast cancer in the IMA is not well known, its occasional occurrence demands that this area of the breast is adequately demonstrated on the mammographic image whenever possible [5].

Depending on which criteria are met and to what degree, a grade of P (perfect), G (good), M (moderate) or I (inadequate) is awarded to both the imaging series and the radiographer responsible for performing the mammogram. Both P and G images require the IMA to be “well demonstrated”. Reflective of the known subjectivity of the PGMI IES [6,7], “well demonstrated” has no absolute definition; but is reasoned anecdotally in the clinical setting to mean that there are no skin folds or air gap present over the IMA, that there is a reflection from the inferior breast down to the abdomen with breast tissue visualised between the anterior margin of the IMA and the back of the image receptor (Fig. 2). Images graded M reflect a number of criteria failures which may include not demonstrating the IMA clearly or not including it on the image at all. Anatomical presentation and

the ability of the radiographer to manoeuvre the breast prior and during the application of breast compression is known to attribute to the extent the IMA is included on the image [8] which ultimately influences the final grade awarded. Importantly, demonstrating the IMA on *both* the left and right MLO is mandatory to achieve a P or G grade for a set of paired images (Fig. 1).

The extent to which the demonstration of the IMA specifically contributes to an M grade in the PGMI IES setting has not been adequately determined given that no known published analysis of the Australian situation is evident. International researchers such as Guertin et al. in a German study of 79,115 mammograms, evaluated diagnostic image quality suggesting that of the 1.4% of I graded mammograms, failure to include the IMA was the biggest contributor at 18% [9]. An Indian study by Popli et al. reviewed the demonstration of the IMA on 1369 patients stating the demonstration of the IMA is as low as 2–3% [10]. Without a fundamental audit and training program to achieve consistency across mammograms, this Indian study is unlikely to be reflective of the wider screening experience.

<p align="center">Cranio-caudal view (CC) Specific positioning criteria</p> <ol style="list-style-type: none"> 1. All breast tissue imaged <ul style="list-style-type: none"> o medial border well demonstrated o nipple in profile or skin edge seen transecting nipple (retro-areolar tissue well separated) o nipple in midline of imaged breast o posterior nipple line (PNL) within 1cm of PNL on MLO view) 	<p align="center">Medio-lateral oblique view (MLO) Specific positioning criteria</p> <ol style="list-style-type: none"> 1. All breast tissue imaged <ul style="list-style-type: none"> o pectoral muscle shadow to nipple level o full width of pectoral muscle o nipple in profile or skin edge seen transecting nipple (retro-areolar tissue well separated) o <u>infra-mammary angle well demonstrated</u> o PNL within 1cm of PNL on CC view
<p align="center">Classification of CC images</p>	<p align="center">Classification of MLO images</p>
<p>P = Perfect images Both CC and MLO images meet criteria for image assessment 1–9</p>	
<p align="center">G = Good images</p> <ol style="list-style-type: none"> 1. All breast tissue imaged* <ul style="list-style-type: none"> o all postero-medial tissue visualised (*axillary portion of breast not to be included at expense of medial portion) o nipple in profile or skin edge seen transecting nipple o nipple in midline of imaged breast 	<p align="center">G = Good images</p> <ol style="list-style-type: none"> 1. All breast tissue imaged <ul style="list-style-type: none"> o pectoral muscle well demonstrated o nipple in profile or skin edge seen transecting nipple o <u>infra-mammary angle (IMA) well demonstrated</u>

Fig. 1. PGMI IES [3].

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