

# Evaluation of the Quality of Screening Mammograms at the Radiology Department of the Douala General Hospital: Analysis of 100 Cases Using the PGMI System

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## Abstract

**Objective:** Use the PGMI (Perfect, Good, Moderately Good, Inadequate) system to evaluate the quality of screening mammograms performed at the Radiology Department of the Douala General Hospital during the Pink October 2024 campaign. **Methods:** A retrospective study analyzed 100 mammograms (craniocaudal [CC] and mediolateral oblique [MLO] views) using data sheets containing 16 criteria (8 for positioning, 8 for photographic quality). **Results:** At CC angle, 80.5% of images showed good visualisation of posterior and medial breast tissue, and 74.5% showed a well-defined nipple, classified as 'P' or 'G'. In MLO, 85% visualised the lower part of the breast and a pectoral angle > 15°, but only 7.5% showed an unobstructed infra-mammary fold, limiting the classification to 'G' or 'M'. Photographic criteria were 100% 'P', except for folds (45.5% 'G' or 'I'). **Conclusion:** Mammograms are globally satisfactory, but the MLO incidence requires technical improvements to optimise diagnostic quality and reliability.

## Keywords

Screening Mammography, Image Quality, PGMI System, Douala General Hospital, Positioning

## 1. Introduction

Mammography, which uses low-dose X-rays, is the reference method for the early detection of breast cancer, the most common cancer in women worldwide [1]. It aims to reduce mortality by detection at an infra-clinical stage [2]. Performed in

two standard views, craniocaudal (CC) and mediolateral oblique (MLO), it requires optimum quality to maximise diagnostic specificity while minimising repeat examinations and radiation exposure [3]. The PGMI system, adopted in Europe, classifies radiographs into four levels (Perfect, Good, Moderately Good, and Inadequate) based on positioning and photographic quality criteria [4].

The PGMI system was designed to standardise the assessment of mammographic image quality, focusing on criteria such as complete visualisation of breast tissue, correct positioning of the nipple and pectoral muscle, and absence of skin folds or artifacts. A study compared the validity and reliability of different assessment systems, highlighting that the PGMI, although subjective to an extent, provides a coherent structure for external audit and continuous improvement of practice [5]. However, inter-observer variability in its application has been noted, suggesting the need for standardised training to optimise its effectiveness [6].

In organised screening programmes, such as those in the UK and Australia, the PGMI is used to monitor the performance of x-rays. For example, BreastScreen Australia's accreditation standards require at least 50% of a radiographer's mammograms to be graded P or G annually [7]. This requirement highlights the importance of optimal image quality to maximise cancer detection and minimise technical callbacks.

In countries with limited resources, such as Cameroon, mammography quality assessment is less well documented due to the absence of systematic screening programmes. A study at Douala General Hospital examined the indications and results of mammography, revealing that the majority of examinations were motivated by clinical symptoms rather than routine screening [8]. This study did not use the PGMI system, but highlighted the challenges of obsolete equipment and lack of training for technologists, factors that can affect image quality.

Another study analysed the quality of mammograms at Port Moresby General Hospital in Papua New Guinea using PGMI [9]. Out of 102 cases, only 14.8% of routine series (four images) were graded P or G, far from international standards. Positioning errors, such as non-visualisation of the inframammary angle (IMA) and an insufficiently long pectoralis muscle, were common. These results suggest that similar challenges may be encountered in Douala, where logistical and educational constraints are comparable.

Technologist training plays a major role in improving the quality of mammograms. Intensive training, combined with the use of tools such as the PGMI, has been shown to significantly increase the percentage of images graded P or G [10]. In Douala, where human and material resources are limited, such an intervention could be beneficial. Furthermore, automation of the assessment, as proposed by a recent technological solution, could reduce the subjectivity of the PGMI, although this technology remains inaccessible in many African contexts [11].

Analysis of 100 cases at Douala General Hospital using the PGMI would enable the quality of local mammography to be benchmarked against international standards. Based on existing studies, a high proportion of images graded M or I can be

expected due to factors such as the lack of organised screening programmes and inadequate training of technologists. However, this analysis could also identify specific areas for improvement, such as breast positioning or artifact management, providing a basis for targeted interventions.

The literature shows that the PGMI system is a valuable tool for assessing mammography quality, although it requires rigorous training to minimise inter-observer variability. In a setting such as Douala, structural and logistical challenges may limit image quality, but comparative studies in similar settings suggest that improvements are possible through education and the adoption of clear standards. Analysis of 100 cases at Douala General Hospital may provide essential data to guide future breast screening efforts in Cameroon.

## 2. Materials and Methods

A retrospective study was conducted of screening mammograms performed at the radiology department of the Douala General Hospital during the Pink October 2024 campaign. Diagnostic mammograms (performed on patients with clinical symptoms) were excluded in order to limit the analysis to asymptomatic cases typical of screening [2]. A total of 100 cases were selected, each case includes the two standard incidences: craniocaudal (CC) and mediolateral oblique (MLO), giving a total of 200 images. This number was chosen to ensure sufficient representativeness while remaining manageable for detailed analysis, in accordance with the recommendations for mammographic quality assessment studies [3].

### 2.1. Data Collection

A standardised data collection form, adapted from the PGMI (Perfect, Good, Moderately Good, Inadequate) system, was used to assess the quality of mammograms [4]. The form contained 16 criteria divided into two main categories: 8 criteria relating to patient positioning and 8 criteria relating to the photographic quality of the image. Data were extracted from the radiology department's digital and physical archives, including raw images and associated metadata (date, anonymised patient identification, technical parameters).

### 2.2. Positioning Criteria

The 8 positioning criteria were selected to reflect the anatomical and technical requirements necessary for optimal radiological interpretation in accordance with the recommendations of the PGMI system [4]. These criteria are:

- visualisation of posterior breast tissue (CC): ensures complete coverage of the deep areas of the breast, which is critical for detecting retromammary lesions [12].
- visualisation of medial breast tissue (CC): assesses the inclusion of internal regions, which are often underestimated in poorly positioned views [12].
- nipple free and in profile (CC and MLO): guarantees a clear anatomical reference and makes it easier to identify abnormalities around the nipple [13].

- presence and length of the pectoralis muscle (CC and MLO): indicates sufficient extension of the field to include axillary and deep tissues (length deemed appropriate if visible over at least 50% of the MLO image height) [4].
- pectoral muscle angle  $> 15^\circ$  (MLO): measures the appropriate inclination for optimal visualisation of the upper and outer quadrants [12].
- exposed infra-mammary fold (CC and MLO): avoids superimpositions that could mask lesions in the lower part of the breast [13].
- visualisation of the lower part of the breast (MLO): ensures coverage of low-lying areas, which are often difficult to position [12].
- absence of excessive overlapping: reduces artifacts due to misalignment [4].

These criteria were chosen because they correspond to the international PGMI standards, widely validated for their ability to identify positioning errors affecting diagnostic sensitivity [3] [4]. Their relevance in the context of Douala General Hospital lies in their universal applicability, regardless of local constraints (equipment or training).

### 2.3. Photographic Quality Criteria

The 8 photographic quality criteria have been selected to assess the technical aspects of imaging, which are essential for clear and accurate reading [3]. These criteria are:

- spread of breast tissue: verifies adequate compression to reduce overlap [13].
- contrast: assesses the correct exposure to distinguish tissue densities [3].
- sharpness: ensures the definition of fine structures (microcalcifications, lesion contours) [4].
- absence of artifacts: excludes interference due to technical errors or movement [3].
- presence of folds: identifies skin folds that may interfere with interpretation (classified as interfering if they mask  $>10\%$  of the image) [13].
- correct identification: confirms the systematic presence of metadata (anonymised name, date, incidence) [4].
- uniform exposure: checks the homogeneity of optical density across the image [3].
- absence of excessive noise: assesses signal quality for the digital systems used [4].

These criteria were chosen because of their importance for diagnostic reliability and their compatibility with the equipment available at the Douala General Hospital (digital mammography). They also allow comparison with international studies using PGMI [3] [4].

### 2.4. Analysis

Each image was independently assessed by a radiologist trained in the use of the PGMI system. Criteria were graded according to the four PGMI levels: 'P' (perfect, no defects), 'G' (good, minor defects not affecting diagnosis), 'M' (moderately good, defects partially limiting interpretation), and 'I' (inadequate, defects ren-

dering the image non-diagnostic) [4]. An image was globally classified according to the most unfavourable criterion in accordance with PGMI guidelines [4]. The results were expressed as percentages for each criterion and incidence (CC and MLO), then summarised in tables to facilitate interpretation.

## 2.5. Ethics

The study used anonymised data extracted from the archives of the Douala General Hospital and did not require individual patient consent. The study was approved by the internal committee of the Douala General Hospital, which verified its compliance with local and international ethical standards for secondary data research [1].

## 3. Results

Analysis of the 100 screening mammograms was used to assess the quality of the images from the two standard incidences (craniocaudal [CC] and mediolateral oblique [MLO]) using the PGMI system. The results, detailed below, distinguish between patient positioning and the photographic quality of the image, with a classification into four levels: Perfect (P), Good (G), Moderately Good (M), and Inadequate (I).

### 3.1. Positioning Quality

The positioning criteria revealed significant differences between the CC and MLO incidences, as summarised in **Table 1**.

For CC, the majority of images reached a satisfactory level ('P' or 'G'). Good visualisation of the posterior and medial breast tissue was achieved in 80.5% of cases, reflecting an effective positioning technique for these areas. The nipple was well exposed in 74.5% of images, a key indicator for radiological interpretation. However, the presence of the pectoralis muscle was only observed in 6% of cases, suggesting a limitation in field extension.

On the other hand, MLO incidence showed more heterogeneous results. The lower part of the breast was clearly visible in 85% of cases, and the angle of the pectoral muscle exceeded 15° in 85% of images, which are strong points for this type of approach. However, the length of the pectoralis muscle was appropriate in only 60.5% of cases (56% 'G', 4.5% 'P'), and the infra-mammary fold remained poorly visualised in 92.5% of images (only 7.5% 'P' or 'G'), highlighting the technical challenges involved in optimal positioning.

**Table 1.** Assessment of positioning using the PGMI system (n = 100 images per incidence).

Criterion	Incidence CC (% P or G)	Incidence MLO (% P or G)
Posterior breast tissue	80.5	-
Medial breast tissue	80.5	-
Nipple free	74.5	-

**Continued**

Pectoral muscle visible	<b>6.0</b>	<b>60.5 (longueur)</b>
Pectoral angle > 15°	-	85.0
Inframammary fold free	3.0	7.5
Lower part visible	-	85.0

**3.2. Photographic Quality**

The photographic criteria, assessed independently of incidence, showed an overall high performance (see **Table 2**). All images (100%) were judged ‘P’ for the spread of the mammary gland, contrast, sharpness, and absence of artifacts, indicating reliable equipment and careful technical execution. The identification of the images was also 100% correct. However, the presence of folds was noted in 45.5% of cases, 22% of which were likely to interfere with reading, resulting in a ‘G’ or ‘I’ classification for this specific criterion.

**Table 2.** Assessment of photographic quality (n = 200 shots, CC + MLO).

<b>Criterion</b>	<b>% P</b>	<b>% G or I</b>	<b>Notes</b>
Spread of the gland	100	0	Adequate compression
Contrast	100	0	Optimum exposure
Sharpness	100	0	Well-defined structures
Absence of artifacts	100	0	No interference
Folds	54.5	45.5	22% disturbing for reading
Identification	100	0	Systematic labelling

**3.3. Summary**

In general, mammograms in CC incidence were of higher quality (mostly ‘P’ or ‘G’) than MLO mammograms, where poor positioning (particularly in the inframammary fold) limited the scores. The photographic quality remains an asset, although the folds require particular attention to avoid misinterpretation. It should be noted that this study did not consider correlating image quality with diagnostic results (presence or absence of lesions), which limits interpretation of the direct impact of these defects on clinical performance.

**4. Discussion****4.1. Quality by Incidence**

The CC images achieved ‘P’ and ‘G’ levels for most positioning criteria (80.5% for posterior/medial breast tissue), close to the results of Richli Meystre and Bulliard (75% and 88%, respectively) [13]. Nipple clearance (74.5%) exceeded their 51%, suggesting a technique adapted to the local context. On the other hand, MLO incidence shows shortcomings: poor visualisation of the infra-mammary fold (7.5% compared with 37% in some cases) and insufficient length of the pectoral muscle in 39.5% of cases limit the quality to ‘G’ or ‘M’. These defects may reduce the detection of lesions in the axillary or inferior regions, which are critical for diagnosis [6].

## 4.2. Photographic Quality

Optimal performance (100% 'P') for contrast, sharpness, and absence of artifacts reflects functional equipment, surpassing the 81% - 98% of Richli Meystre and Bulliard [13]. Creases (45.5%), although less of a problem than the 22% that were troublesome, indicate a need for improvement in compression or positioning.

## 4.3. Factors Contributing to Sub-Optimal MLO Positioning

Analysis of the results reveals that sub-optimal positioning in MLO is mainly related to two criteria: poor visualisation of the infra-mammary fold (7.5% 'P' or 'G') and insufficient length of the pectoralis muscle (60.5% 'P' or 'G'). Several specific factors may explain these shortcomings. Firstly, inadequate mobilisation of the breast during positioning could prevent full exposure of the inframammary fold, often due to insufficient breast lifting technique by the technologist or patient reluctance due to discomfort [8]. Secondly, the reduced length of the pectoralis muscle could be the result of a positioning angle that is too shallow or a misaligned compression, limiting the extension of the field towards the axillary tissues [6]. Thirdly, the lack of standardised training for technologists, combined with a high workload, may lead to variations in the application of MLO protocols. Finally, the physical characteristics of patients (e.g., small breasts or obesity) could complicate positioning, a factor little documented in African contexts but relevant at Douala General Hospital [10].

## 4.4. Implications

These results confirm an overall satisfactory quality, supporting diagnostic reliability at Douala General Hospital. However, weaknesses in MLO highlight the need for targeted interventions. Compared with European contexts [6], these results reveal potential for optimisation despite limited resources.

## 4.5. Impact on Resources and Potential Obstacles

Implementing improvement initiatives would have an impact on human, material, and financial resources. Training would require time and qualified trainers, potentially disrupting busy schedules. Technical adjustments would involve costs for maintenance or updating of mammograms, which would be difficult to meet within a constrained hospital budget [8]. Obstacles also include the weak culture of systematic screening in Cameroon [2] and the lack of inter-observer data in our study.

## 4.6. Detailed Recommendations for Technical Improvements

To address the identified gaps in MLO, the following recommendations are proposed:

- organise practical workshops focusing on MLO positioning, with emphasis on correct breast lift to clear the infra-mammary fold and on adjusting the angle of the mammograph (ideally between 45° and 60°) to optimise the length of

the pectoralis muscle [6]. These sessions could be scheduled during periods of low activity and led by an experienced radiologist on the team.

- install illustrated checklists near the mammography machines detailing the key steps in MLO positioning (e.g., pectoral muscle alignment, exposure of the inframammary fold) to standardise practices despite variations in experience.
- check and recalibrate compression systems to ensure uniform and sufficient pressure, reducing folds and improving breast tissue spread. If possible, consider adding anti-diffraction grids for patients with high breast density, although this will depend on the budget available [3].
- carry out a complementary sub-group study to identify patient-related factors (e.g., morphology, cooperation) affecting MLO positioning in order to adapt protocols to local characteristics.
- introduce a system of monthly evaluation of MLO mammograms by a panel of radiologists, with direct feedback to technologists to correct errors in real-time, inspired by European quality control programmes [3].

#### 4.7. Limitations

The small sample (100 cases) and the absence of inter-observer data could influence the generalisation of the results. The study of patient-related factors remains exploratory in the absence of specific data. In addition, this study did not consider correlating image quality with diagnostic results (presence or absence of lesions detected), which limits our ability to assess the direct impact of positioning errors or folds on the clinical performance of screening. This omission restricts the conclusions to a technical assessment with no established link to diagnostic efficacy.

#### 5. Conclusion

Mammograms at Douala General Hospital are of satisfactory quality, with CC images predominantly 'P' or 'G' and optimal photographic quality. However, sub-optimal positioning in MLO, linked to technical and human factors, requires targeted improvements. These recommendations (training, protocols, audits) aim to improve the reliability of screening and reduce breast cancer mortality in Cameroon.

#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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