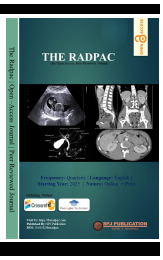
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Original Research

Comparison of Breast Compression Force and Patient Comfort in Mammography: A Pilot Study

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ABSTRACT

Background: Breast compression is an essential component of mammography, as it improves image quality and reduces radiation dose. However, excessive compression may cause discomfort or pain, potentially affecting patient compliance with breast cancer screening programs.
Aim: To evaluate the relationship between breast compression force applied during mammography and patient-reported comfort levels.
Materials and Methods: A prospective pilot study was conducted among 55 women undergoing routine mammography. Compression force values were recorded directly from the mammography unit for standard craniocaudal (CC) and mediolateral oblique (MLO) views. Patient comfort was assessed immediately after the examination using a standardized visual analog scale (VAS). Descriptive and correlation analyses were performed to evaluate the association between compression force and patient comfort.
Results: The mean compression force applied was 11.2 ± 2.4 daN for CC views and 12.6 ± 2.7 daN for MLO views. Most participants reported mild to moderate discomfort. A statistically significant negative correlation was observed between compression force and comfort scores ($p < 0.05$), indicating increased discomfort with higher compression levels. No examination was terminated due to intolerable pain.
Conclusion: Higher breast compression force was associated with reduced patient comfort during mammography. Optimizing compression techniques while maintaining diagnostic image quality may enhance patient experience and improve adherence to breast screening programs.

Keywords: Mammography; Breast compression; Patient comfort; Pain perception; Pilot study

INTRODUCTION

Mammography is widely recognized as the most effective imaging modality for the early detection of breast cancer and plays a central role in population-based screening programs worldwide [1]. The diagnostic accuracy of mammography is influenced by several technical factors, among which adequate breast compression is considered essential. Proper compression reduces breast thickness, improves image contrast and spatial resolution, minimizes motion artifacts, and contributes to a reduction in radiation dose [2]. Despite its technical advantages, breast compression is frequently reported as the most uncomfortable aspect of the mammographic examination. Discomfort or pain experienced during mammography has been identified as a significant factor influencing women's willingness to participate in regular breast cancer screening [3]. Negative experiences during initial examinations may lead to poor adherence to follow-up screening, thereby limiting the effectiveness of early detection strategies [4]. Breast compression force applied during mammography varies depending on breast size, tissue composition, positioning technique, and radiographer practice. While insufficient compression can compromise image quality and increase radiation exposure, excessive compression may not provide additional diagnostic benefit and may instead increase patient discomfort [5]. Achieving an optimal balance between adequate compression and patient comfort remains a clinical challenge. Patient perception of pain during mammography is multifactorial and

influenced by individual pain thresholds, anxiety levels, hormonal status, and previous breast-related experiences. [6] Studies have shown that discomfort is often greater during mediolateral oblique (MLO) views compared to craniocaudal (CC) views, likely due to traction on the pectoral muscle and surrounding tissues.[7] These factors underscore the need for a patient-centered approach to breast compression. Recent advances in mammography technology have focused on dose reduction and image quality optimization; however, patient comfort has received comparatively less attention. Understanding the relationship between applied compression force and patient-reported comfort is essential for developing evidence-based compression practices that maintain diagnostic standards while improving the patient experience [8]. Given the limited data from routine clinical settings, particularly in pilot-scale investigations, this study aims to compare breast compression force and patient comfort during mammography.

AIM AND OBJECTIVE

Aim: To evaluate the relationship between breast compression force applied during mammography and patient-reported comfort levels.

Objectives

1. To measure the breast compression force applied during routine mammographic examinations for craniocaudal (CC) and mediolateral oblique (MLO) views.
2. To assess patient comfort during mammography using a standardized pain/discomfort scale.
3. To compare patient comfort levels between different mammographic views (CC and MLO).
4. To analyze the association between applied compression force and patient-reported discomfort.
5. To generate preliminary evidence to support optimization of breast compression techniques in clinical mammography practice.

MATERIALS AND METHODS

Study Design and Setting: This prospective pilot study was conducted in the Department of Radiology at a tertiary care diagnostic imaging center. The study was carried out over a three-month period.

Study Population: Fifty-five women undergoing routine mammography for screening or diagnostic indications were included in the study.

Inclusion Criteria

- Women aged 40 years and above
- Patients undergoing bilateral mammography
- Willingness to provide informed consent

Exclusion Criteria

- History of breast surgery or breast implants
- Known breast malignancy
- Severe breast pain prior to examination

Mammography Procedure: All examinations were performed using a full-field digital mammography system by experienced female radiologic technologists. Standard craniocaudal (CC) and mediolateral oblique (MLO) views were obtained for each breast. Compression was applied according to routine departmental practice to achieve optimal image quality.

Measurement of Compression Force: Breast compression force (in decaNewtons, daN) was automatically recorded by the mammography unit for each view. The average compression force for CC and MLO views was calculated for analysis.

Assessment of Patient Comfort: Patient comfort was assessed immediately after completion of the examination using a Visual Analog Scale (VAS) ranging from 0 to 10, where:

- 0 = no discomfort
- 10 = worst imaginable discomfort

Comfort levels were categorized as:

- Mild discomfort (VAS 0–3)
- Moderate discomfort (VAS 4–6)
- Severe discomfort (VAS 7–10)

Statistical Analysis: Data were analyzed using SPSS software. Descriptive statistics were used to summarize compression force and comfort scores. Pearson correlation analysis was performed to assess the relationship between compression force and patient comfort. A p-value < 0.05 was considered statistically significant.

RESULTS

Study Population: A total of 55 women undergoing routine mammography were included in the analysis. The mean age of the participants was 51.6 ± 8.1 years (range: 40–68 years). All participants successfully completed bilateral mammographic examinations with standard craniocaudal (CC) and mediolateral oblique (MLO) views. The compression force applied during mammography was automatically recorded by the mammography unit for each view. The mean compression force applied for the CC view was 11.1 ± 2.3 daN, while the MLO view required a slightly higher mean compression force of 12.5 ± 2.6 daN. Overall, MLO views consistently demonstrated higher compression force compared to CC views.

Table 1: Breast Compression Force Applied During Mammography (n = 55)

Mammographic View	Mean Compression Force (daN)	Standard Deviation

CC view	11.1	± 2.3
MLO view	12.5	± 2.6

Patient comfort was assessed immediately after the examination using a standardized visual analog scale (VAS). Based on reported scores, discomfort levels were categorized as mild, moderate, or severe. Most participants reported mild to moderate discomfort during mammography. Severe discomfort was reported by a smaller proportion of women.

Table 2: Patient-Reported Comfort Levels During Mammography (n = 55)

Comfort Level	VAS Score Range	Frequency (n)	Percentage (%)
Mild	0–3	22	40.0
Moderate	4–6	25	45.5
Severe	7–10	8	14.5

No examination was discontinued due to pain or discomfort. When comfort scores were analyzed by mammographic view, MLO views were associated with higher discomfort scores compared to CC views. Participants commonly reported greater discomfort during MLO positioning, likely due to increased tissue traction and inclusion of the pectoral muscle. The mean discomfort score for the CC view was 3.8 ± 1.6, whereas the MLO view demonstrated a higher mean score of 4.9 ± 1.8, indicating significantly greater discomfort during MLO imaging ($p < 0.05$). Correlation analysis revealed a significant positive association between breast compression force and patient-reported discomfort. Higher compression force values were associated with higher VAS scores, indicating reduced comfort.
The association was more pronounced for MLO views than CC views. Pearson correlation analysis demonstrated a moderate correlation between compression force and discomfort ($r = 0.41$, $p = 0.004$).

Table 3: Correlation Between Compression Force and Comfort Score

Parameter Compared	Correlation Coefficient (r)	p-value
Compression force vs comfort score	0.41	0.004

DISCUSSION

This pilot study investigated the relationship between breast compression force and patient comfort during routine mammography in a sample of 55 women. The findings revealed that MLO views required slightly higher compression force compared to CC views, and higher compression force was significantly associated with increased discomfort. These results emphasize the need for a balanced approach to breast compression, aiming to optimize image quality while minimizing patient discomfort. The mean compression forces observed in this study (11.1 daN for CC and 12.5 daN for MLO) are comparable to previously reported values in clinical practice, suggesting that the compression applied was within commonly accepted ranges. The higher compression force required for MLO views may be attributed to the anatomical positioning and the need to include the pectoral muscle and axillary tail, which often requires additional compression to achieve adequate tissue spread and image quality.

Patient discomfort during mammography remains a widely reported concern and is known to influence screening compliance. In this study, most participants reported mild to moderate discomfort, with only 14.5% experiencing severe discomfort. Although discomfort levels were generally manageable, the significant correlation between compression force and discomfort indicates that even small increases in compression can affect patient experience. This finding is consistent with existing literature, where higher compression force and longer compression duration are commonly associated with greater pain and reduced comfort.

The difference in discomfort between CC and MLO views is also noteworthy. MLO views were associated with higher mean discomfort scores, which may be related to the more complex positioning and additional tissue stretching required for this projection. Previous studies have similarly reported higher discomfort during MLO views, attributing this to increased pressure on the upper outer quadrant and the inclusion of the pectoral muscle. These findings suggest that radiologic technologists should be particularly attentive to patient comfort during MLO positioning and consider strategies such as gradual compression and improved communication.

The results of this pilot study highlight the potential for optimizing breast compression techniques. While sufficient compression is necessary to reduce breast thickness and improve image quality, excessive force may not offer additional diagnostic benefit and may instead contribute to patient discomfort. Patient-centered compression protocols that consider individual breast characteristics, pain tolerance, and patient feedback could enhance comfort without compromising diagnostic outcomes. However, this study has limitations inherent to pilot research. The small sample size and single-center setting limit the generalizability of the findings. Additionally, patient comfort was measured using a subjective visual analog scale, which may be influenced by individual pain thresholds and psychological factors.

Future studies should incorporate larger, multi-center samples and consider objective measures such as breast thickness, compression duration, and image quality assessment to establish comprehensive compression guidelines.

CONCLUSION

In this pilot study, higher breast compression force during mammography was associated with increased patient discomfort, particularly during MLO views. Although compression is essential for obtaining high-quality diagnostic images, attention to patient comfort is crucial to enhance the overall screening experience and encourage regular participation in mammography programs. These preliminary findings support the need for optimized compression protocols that balance image quality and patient comfort, and further research with larger samples is recommended to establish evidence-based guidelines.

DECLARATION

Ethics Approval and Consent to Participate: The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the department prior to commencement of the study. Written informed consent was obtained from all participants before enrollment in the study.

Availability of Data and Materials: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests: The authors declare that they have no competing interests.

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Authors' Contributions: All authors contributed to the study design, data collection, analysis, and interpretation of the results. All authors participated in drafting the manuscript and approved the final version for submission.

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