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Research Article

COMPARATIVE ANALYSIS OF MAMMOGRAPHIC AND ANTHROPOMETRIC BREAST VOLUME MEASUREMENTS PREOPERATIVELY WITH POST-MASTECTOMY SPECIMEN VOLUME IN CARCINOMA BREAST PATIENTS

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ABSTRACT

Objective: A precise measurement of breast volume is a critical component of preoperative planning for achieving breast symmetry, particularly in women undergoing breast-conserving surgery with oncoplastic reconstruction. Carcinoma breast is the most prevalent form of malignancy in women and its treatment continues to evolve with emphasis to individual care. The aim of this study was to assess the precision of mammographic and anthropometric methods for measuring breast volume, with post-mastectomy specimen volume functioning as the analysis's control.

Methods: Breast volume was measured preoperatively using mammography and anthropometric (anatomic) methods, and specimen volume was measured using the water displacement method (Archimedes) after a total mastectomy. The study enrolled 126 breast cancer patients admitted for total mastectomy for a period of 12 months. The findings obtained were statistically compared with the values acquired using the other two approaches.

Results: The volume of the specimen from a mastectomy was a mean of 791.67 mL (range: 504.6–980.6). The anthropometric approach yielded values of 807.76 mL (493.7–971.2) for breast volume, whereas the mammographic method yielded 786.81 mL (488.6–956.1) values. Paired t-test analysis revealed that the mammographic measurement method of breast volume measurement was more accurate in all volume and age groups compared to the anthropometric method, with a significant $p<0.001$.

Conclusion: Mammography was shown to be the most accurate approach for measuring breast volume before surgical intervention, as evidenced by the current study when compared to the anthropometric method.

Keywords: Breast volume, Mammography, Anthropometry, Mastectomy.

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INTRODUCTION

Breast cancer is the most common form of malignant disease and the second leading cause of mortality among women [1]. In the past, treatment decisions were mostly centered on the anatomic extent of the disease. However, now, the focus is shifting to the underlying biological process. For example, the oncoplastic method permits broad excisions without affecting the natural contour of the breast [2], and breast conservation has become a normal standard of therapy.

Accurate breast volume measurement is a vital component of preoperative preparation when performing reconstructive and cosmetic breast surgeries to attain breast symmetrization and an acceptable outcome [1]. This is a continuing trend in the treatment of breast cancer, which is moving in the direction of more individualized care. Patients diagnosed with breast cancer should have their breast volume evaluated since the ratio of tumor size to breast size is crucial in determining the kind of surgery that will be-breast conserving surgery or modified radical mastectomy.

The breast volume measurement is an important component that must be considered to pick the method that will be utilized during any form of breast surgery (reduction, augmentation, reconstruction, and oncoplastic) to achieve symmetry between both breasts and to select the proper size of implant to be employed [3,4]. Several breast volume measurement techniques have claimed to be accurate but have been unable to obtain widespread acceptance due to high cost, technical difficulties, and patient discomfort [5]. Archimedes (displacement of water), anthropometry (anatomic) measurement, imaging (mammography, magnetic resonance imaging [MRI], and computed tomography, USG), Grossman-Roudner device method, Casting, and Biostereometrics (3D Surface scanning) are examples of these techniques.

This investigation's primary objective was to assess the precision of multiple approaches for measuring breast volume, including mammography, anthropometry, and the Archimedes method for post-mastectomy specimen volume. The Archimedes method served as the control group for this investigation.

METHODS

This is a single-center cross-sectional study conducted for 12 months from January 2022 to December 2022 in Government Medical College, Kottayam, Kerala. A total of 126 patients with carcinoma breast who underwent total mastectomy were included in the study. The study was approved by the Institutional Scientific and Ethical Review committees. All patients with biopsy proven carcinoma breast were included for the study, whereas patients with metastatic breast cancer and those who had previous lumpectomy for a benign breast disease were excluded from the study.

Sample size

Based on the study by Kayar *et al.* [6], the sample size was calculated by the formula $\mathrm{N} = \dfrac{\left(z_\alpha + z_\beta\right)^2 \left(\dfrac{s_1^2 + s_2^2}{2}\right)}{\left(N_1 - N_2\right)^2}$ and the sample size was found to be 126.

Sampling method

All patients presenting with breast cancer satisfying the inclusion and exclusion criteria were taken consecutively till the desired sample size was achieved within the study period.

Study procedure

Breast volume was measured preoperatively using mammography and anthropometric techniques and postoperatively by Archimedes principle.

Mammographic volume measurement

Following equation is used for volume measurement-Breast volume = $\pi/4(W*H*C)$

Where W = breast width, H = breast height, and C = compression thickness, measured in craniocaudal mammography. A ruler is utilized in the process of taking the measurements. The mammography technician is the one responsible for determining the compression thickness [7].

Anthropometric (Anatomic) measurement

Breast volume was measured using anatomic dimensions and a geometric volume equation. The formula for calculating breast volume is as follows: Breast volume = $\pi/3* MP^2*(MR+LR+IR-MP)$ [8] where MP = mammary projection, MR = medial breast radius, and IR = inferior breast radius. The patient is either asked to sit or stand, whereas the measures are collected and her arms are kept at her sides during the process.

Specimen volume measurement (Archimedes Technique)

The simple mastectomy specimen before being fixed is immediately placed into a graduated cylinder and the volumes are measured using the water displacement method (Archimedes' principle). The volume of the specimen is then measured after that [9].

Data management and statistical analysis

Data were examined with the help of IBM SPSS version 16 software. The volume of the patient's post-mastectomy samples was compared to the breast volume data for each subject. The significance level was determined by a $p<0.05$, whereas a high degree of significance would be equivalent to a $p<0.001$.

RESULTS

The patients in our study were having a mean age of 51.52 (range 39–68) years as well as a mean body mass index of 21.58 (range 18.3–25.8). The volume of the mastectomy specimen was 791.67 mL on average (with a range of 493.7–971.2 mL). The anthropometric approach yielded a mean breast volume of 807.76 mL, with a range of 504.6–980.6 mL; the mammographic method yielded a mean breast volume of 786.81 mL with a range 488.6–956.1 mL.

The mean values of post-mastectomy specimen volume (mL) were larger with a difference of 4.8579365 and are statistically significant with a $p<0.001$. This was determined by comparing the average breast volume values by mammographic technique (mL) and after mastectomy specimen volume (mL).

When compared to average values for breast volume determined by the anthropometric technique (mL) and the post-mastectomy specimen volume (mL), the mean values of breast volume determined by the anthropometric method (mL) were significantly greater, with a difference of 16.0912698 mL. A $p<0.001$ indicates that this difference is statistically significant.

By comparing with the standard-that is post mastectomy specimen volume, it was found that 118 out of 126 cases (93.8%) of

Table 1: Paired t-test to compare the before and after values

Breast volume measurement method	n	Mean±SD	Mean difference±SD	t	p-value
Pair 1					
Breast volume by mammographic method (mL)	126	786.81±98.8	−4.86±9.35	−5.83	<0.001
Post-mastectomy specimen volume (mL)	126	791.67±98.36			
Pair 2					
Breast volume by anthropometric method (mL)	126	807.76±100.06	16.09±13.04	13.85	<0.001
Post-mastectomy specimen volume (mL)	126	791.67±98.36			

SD: Standard deviation

Table 2: Comparison of breast volumes by the three different methods using measures of dispersion-negative value indicates anthropometric measurements are larger than the mastectomy measurements in the last row

Breast volume measurement method	n	Mean±SD	Median(IQR)	Range
Breast volume by mammographic method (mL)	126	786.81±98.8	813.15 (697.05, 860.85)	488.6–956.1
Breast volume by anthropometric method (mL)	126	807.76±100.06	831 (725.35, 880.35)	504.6–980.6
Post mastectomy specimen volume (mL)	126	791.67±98.36	821.15 (701.1, 861.7)	493.7–971.2
Mammographic difference	126	4.86±9.35	5.4 (3.98, 6.93)	−89.7–31
Anthropometric difference	126	−16.09±13.04	−15.65(−21.9, −10.48)	−103.8–16

SD: Standard Deviation, IQR: Interquartile Range

Table 3: Intraclass correlation for agreement

Breast volume measurement method	Mean	Standard deviation	n	Intraclass correlation	Lower bound	Upper bound	p-value
Comparison of							
Breast volume by mammographic method (ml)	786.8087	98.80123	126	0.995	0.993	0.997	<0.001
Breast volume by anthropometric method (ml)	807.7579	100.0612	126				
Comparison of							
Breast volume by mammographic method (ml)	786.8087	98.80123	126	0.996	0.994	0.997	<0.001
Post mastectomy specimen volume (ml)	791.6667	98.36188	126				
Comparison of							
Breast volume by anthropometric method (ml)	807.7579	100.0612	126	0.991	0.988	0.994	<0.001
Post-mastectomy specimen volume (ml)	791.6667	98.36188	126				

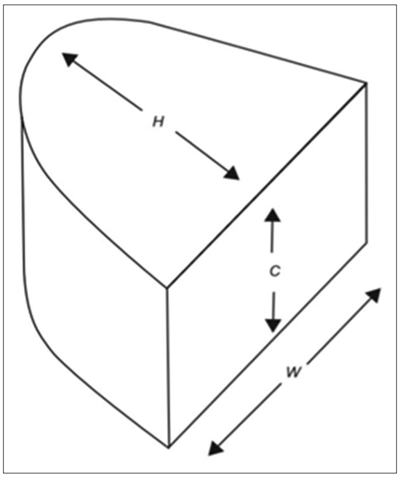

Fig. 1: Mammographic volume measurement

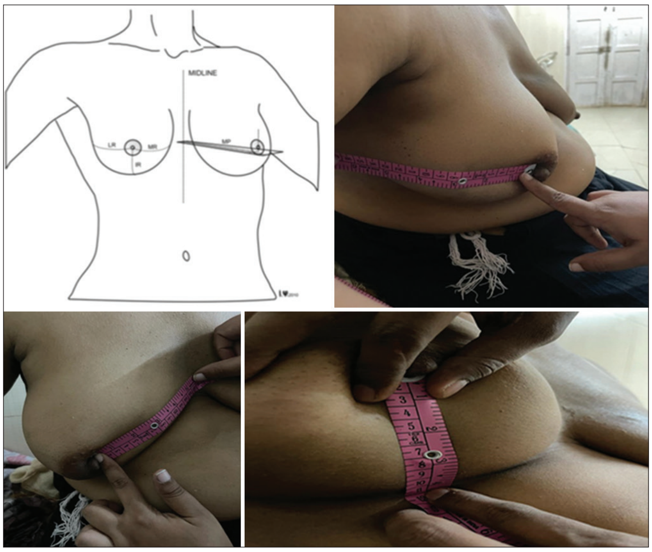

Fig. 2: Anthropometric (Anatomic) measurement

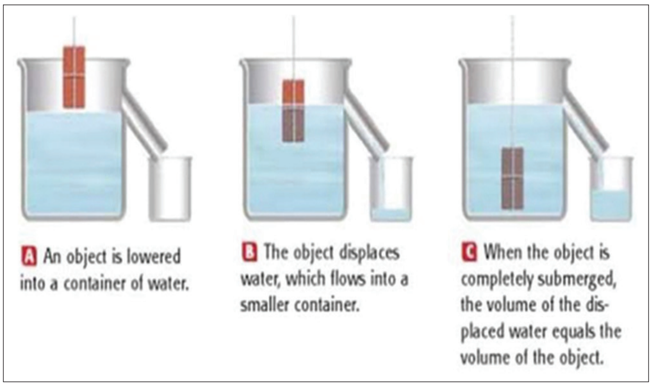

Fig. 3: Tools used for specimen measurement

Fig. 4: Archimedes principle

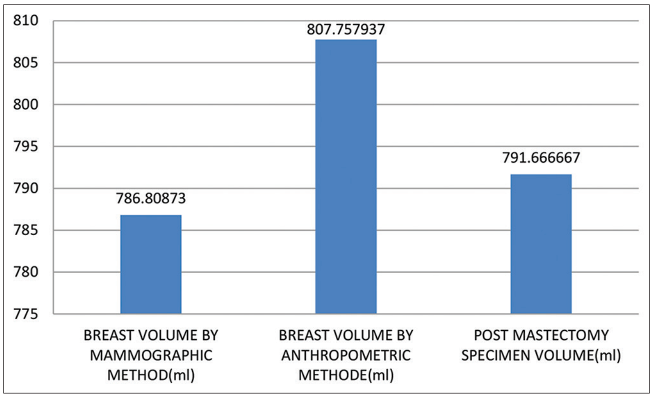

Fig. 5: Measurement of breast volume by the three methods-mammographic method was closer to the post mastectomy specimen volume

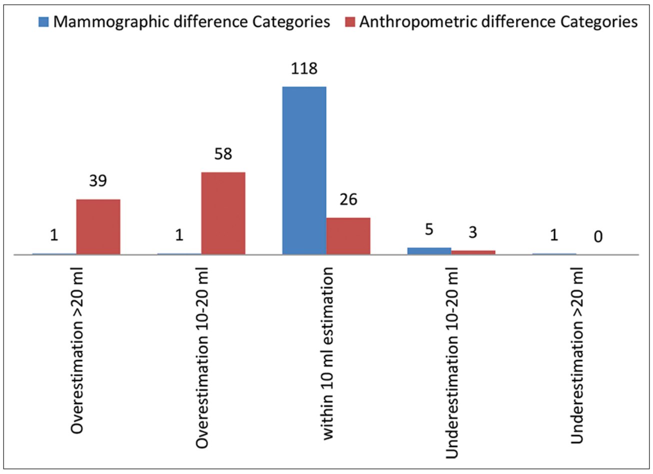

Fig. 6: Mammographic and anthropometric differences in breast volume measurement-categories

Mammographic volume estimation fell within 10 mL of that measured by the specimen method compared to only 26/126 cases (20.6%) of anthropometric measurements.

Values of the intra-class correlation coefficient that are <0.5 points to a level of dependability that is only moderate, values that fall between 0.75 and 0.9 points to a level of reliability that is good, and values that are more than 0.90 points to a level of reliability that is exceptional [10].

DISCUSSION

In our research, the average age of the patients was 51.52 years and their average body mass index was 21.58. The average volume of the specimen removed during a mastectomy was 791.6 mL, whereas

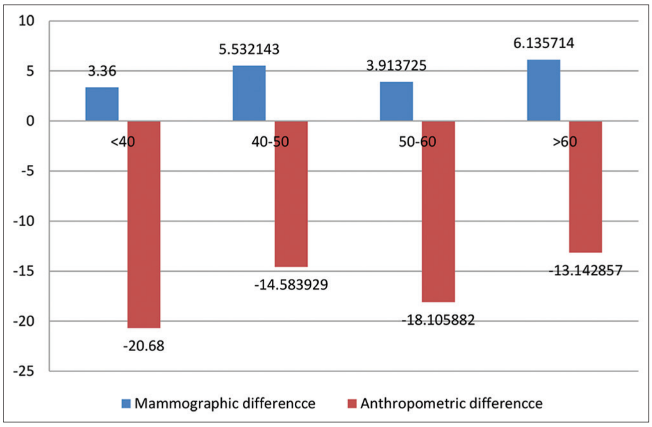

Fig. 7: Mammographic and anthropometric difference in each age group-shows more difference in the anthropometric group when compared with the specimen volume

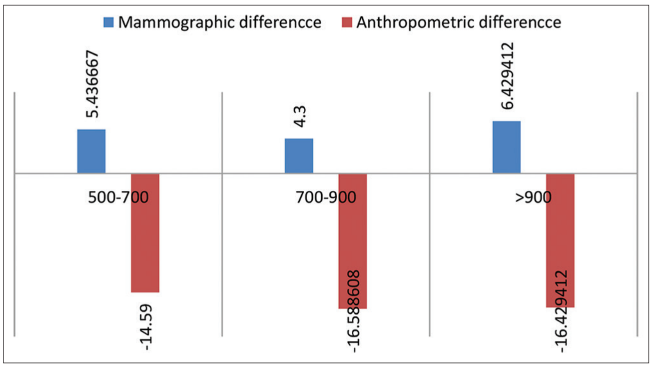

Fig. 8: Mammographic and anthropometric difference in different volume groups-shows more variation compared with the specimen volume group

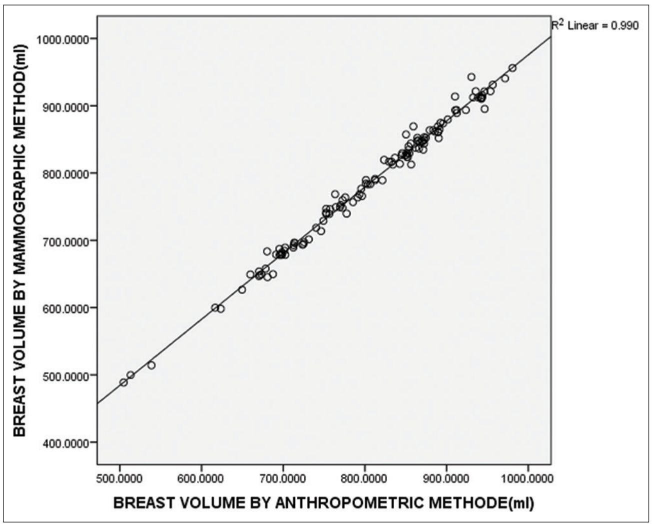

Fig. 9: Intraclass correlation of breast volume by mammography and anthropometry method

the average volume of a breast was assessed to be either 807.76 mL or 786.81 mL using anthropometric or mammographic methods respectively. On comparison of mean breast volume calculated by mammographic and anthropometric methods with post-mastectomy specimen volume, the mammography (lower with a difference of 4.86) was established to be superior to anthropometric (higher with a difference of 16.09) method, statistically significant with a p<0.001.

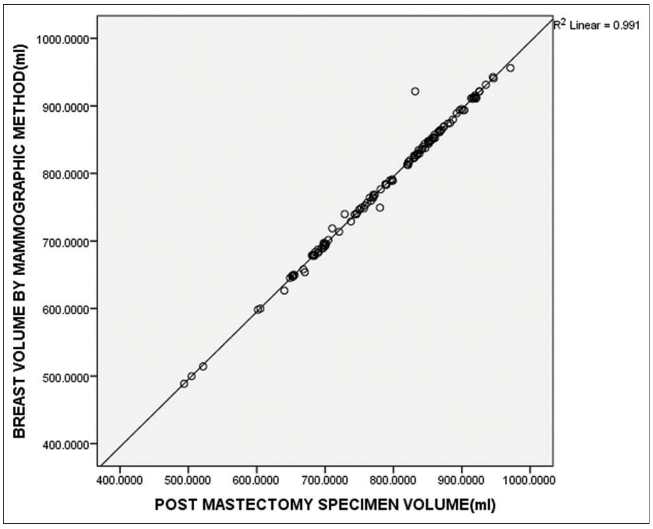

Fig. 10: Intraclass correlation of breast volume by mammography and post-mastectomy method

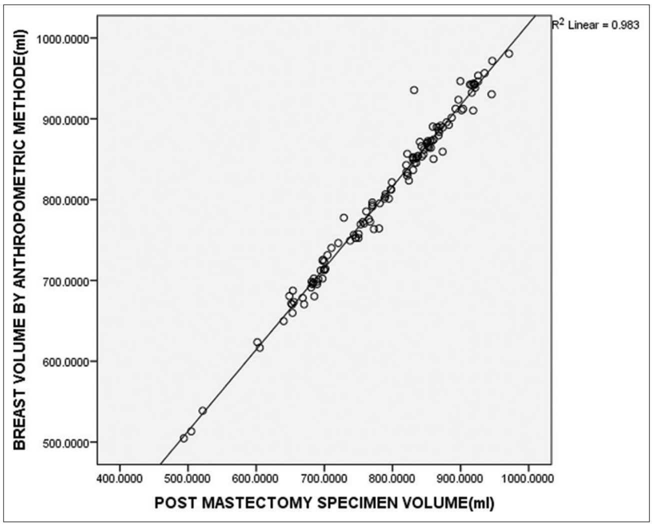

Fig. 11: Intraclass correlation of breast volume by anthropometry and post-mastectomy method

To comprehensively analyze the correlation between the measured volume and the amount of tissue removed after a mastectomy, the specimen volumes were separated into three subgroups: 500–700, 700–900, and >900 mL. The anthropometric approach was less accurate than mammography across the board for volume ranges. In addition, the mammographic approach was shown to be more accurate in determining breast volume than the anthropometric method in a variety of age groups, including those under the age of 40, between the ages of 40 and 50, between 50 and 60, and over the age of 60.

Our findings were similar to what Kayar *et al.* [6] found in their study. In this investigation, the breast volumes of 30 patients scheduled for mastectomy were measured preoperatively by 5 different methods (mammography, anatomic [anthropometric], thermoplastic casting, the Archimedes procedure, and the Grossman-Roudner device) and postoperatively using the Archimedes principle. Mammography was found to be the most accurate followed by the Archimedes method.

It was deemed the most precise approach to the breast volume by Kalbhen *et al.* [7], who evaluated the volume of 32 breasts preoperatively using mammography. These results were comparable to those we discovered in our investigation. In one of the earlier studies, Katariya *et al.* [1] used mammography to compare the breast volumes of 42 patients with breast cancer with 42 age-matched normal controls. They discovered that there was no change in breast volume between the two groups.

In a study done by Caruso *et al.* [6,11], different methods were used to compare breast volumes, and mammography was found to be the most accurate which was similar to what we found in our study, although we compared only 3 methods. In a study carried out by Bulstrode *et al.* [2], the researchers looked at the acceptance of 5 different approaches by patients and doctors and gave each one a score. MRI, the Archimedes process, and casting methods were comfortable for patients, whereas patients claimed that the mammographic technique created discomfort. The anthropometric measurement was the most appropriate approach for patients in their study.

The majority of the research that has been done in the past either did not have a control group or utilized another approach as a control group, whereas the control group in the current study was the postoperative mastectomy specimen volume (excluding the axilla). Mammography is notoriously difficult for patients to tolerate, despite it great degree of precision and the capacity to reproduce results.

It was determined that the easiest procedures were anthropometric and casting by the medical professionals, while mammography was described as moderately tough, and MRI and the Archimedes process were described as challenging. Although many of the earlier research came to the conclusion that MRI is the most reliable method for measuring breast volume, the fact that it requires a data analysis program, is expensive, and can cause claustrophobia are all issues that restrict its usage. In comparison, the mammographic approach requires a straight-forward equation, is more cost-effective, and provides satisfactory accuracy. However, further trials with bigger sample sizes are required to determine the optimal way to quantify the breast volumes preoperatively. This is necessary since breast conservation surgery, and oncoplasty has become essential to modern breast cancer treatment.

CONCLUSION

Even though determining breast volume is essential for both the diagnosis and management of breast disease, many medical professionals have not yet fully comprehended its value. The lack of a reliable, straightforward, low–cost, and accurate procedure has been the primary factor contributing to the fact that such a crucial computation has not been used routinely.

In this investigation, we examined the precision of mammographic and anthropometric techniques of measuring breast volume pre-operatively in comparison with post-mastectomy specimen volume, which served as the control group. Compared to the anthropometric method, we discovered that the mammographic methodology for estimating breast volume before surgery had more accurate results.

FUNDING SOURCES AND CONFLICT OF INTEREST

No funding sources or conflict of interest were reported for this study.

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