

Original Article

Inter-observer reliability of clinical measurement of suprasternal notch-nipple distance and breast ptosis

Emma Hansson, Jonas Manjer, Anita Ringberg

Department of Plastic and Reconstructive Surgery, Skåne University Hospital, Malmö, Department of Clinical Sciences, Malmö, Lund University, Sweden

Address for correspondence: Asst. Prof. Emma Hansson, Department of Plastic and Reconstructive Surgery, Skåne University Hospital, Jan Waldenströms gata 18, SE - 205 02 Malmö, Sweden. E-mail: emma.hansson@med.lu.se

ABSTRACT

Context: Suprasternal notch-nipple distance and breast ptosis are two measurements that are often used in everyday plastic surgical clinical practice. Nonetheless, the reliability of standard breast measurements has never been tested. **Aim:** The aim of the present study was to test the inter-observer reliability of clinical measurement of ptosis and suprasternal notch-nipple distance. **Settings and Design:** Six raters measured ptosis and suprasternal notch-nipple distance in 12 breasts on the same day. **Statistical Analysis Used:** Intra-class correlation (ICC) coefficients, the coefficient of variation (CV) and Bland–Altman plots. **Results and Conclusions:** The results show that there is certain variation between different raters. The ICC of average measures between raters is 0.92 for the ptosis and 0.94 for the suprasternal notch-nipple distance, that is, the agreement between different raters is high. According to the Bland — Altman plots, the overall assessment of the comparisons of measurements between the different raters shows that the direction of the mean differences is close to zero. This study shows that there is a good reliability for measurements of suprasternal notch-nipple distance and ptosis. Nonetheless, there is a slight inter-rater variability in the measurements. Even though standardised, measurement of breasts is not an exact science and care has to be taken when the measurements are performed. The surgeon should have this in mind when measurements are used in clinical practice to evaluate breasts and to choose the right surgical method, as well as when guidelines for indications for surgery are set up.

KEY WORDS

Breast measurements; breast ptosis; breast surgery; suprasternal notch-nipple distance

INTRODUCTION

Suprasternal notch-nipple distance and breast ptosis are two measurements that are often used in everyday plastic surgical clinical practice to evaluate breasts preoperatively,^[1-9] to choose the right surgical technique^[10,11] and to predict surgical outcome.^[11] Nonetheless, the reliability of standard breast measurements, such as ptosis and suprasternal notch-nipple distance, has ‘to our knowledge’ never been tested. The aim of the present study was to test

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the inter-observer reliability of clinical measurement of ptosis and suprasternal notch-nipple distance.

MATERIALS AND METHODS

Subjects and raters

Six women (12 breasts) were recruited as subjects from the staff of the Department of Plastic and Reconstructive Surgery at Skåne University Hospital. Six raters assessed the subjects' breasts. The assessors were plastic (rater B-C) or breast (rater A) surgeons or nurses (rater E-F) in our hospital. All the raters, the surgeons as well as the nurses, received the same instructions on how to perform the measurements.

The procedures followed were in accordance with the Helsinki Declaration of 1964, as revised, and the Good Clinical Practice (GCP) guidelines. The subjects gave their informed consent to participate in the study.

Measurements

All measurements were performed by all raters on the same day. The patient was placed in an upright relaxed position with her arms hanging down. The distance from the submammary fold and the lower pole of the breast (the ptosis) and the distance from the suprasternal notch to the nipple were measured using a tape measure and recorded with an accuracy of 0.5 centimetres (cm).

Statistics

Statistical tests were performed using the IBM SPSS 21 for Mac (SPSS Inc, Chicago, IL) and Microsoft Excel for Mac 2011 14.0 (Microsoft Corporation, Redmond, WA). To assess agreement between different raters Intraclass correlation (ICC) coefficients^[13] were calculated. The

ICC does not take the order of the observations into account and can be used when there are more than two observations per subject. ICC can range from 0 to 1, with the maximum of 1 corresponding to complete reliability, that is, no measurement error. The coefficient of variation (CV) was calculated as $(1SD/mean) \times 100$. The overall CV was calculated as $\sqrt{((CV1^2 + CV2^2 + CV3^2 + \dots + CV12^2)/12)}$.

Bland-Altman plots^[14] were drawn between the measurements of the two nurses (rater E and F) to visualise any systematic variation over the range of measurements. These two raters were chosen as they were both taught how to perform these measurements at the same time in 2009, and have since then been measuring breasts, in conjunction with reduction mammoplasties, equally long and equally frequently.

RESULTS

The diagrams of measurements [Figures 1 and 2] show that there is a certain variation between different raters and that a certain rater seems to consistently measure slightly longer or shorter distances than the other raters.

The intra class correlation (ICC) coefficient of average measures of ptosis between raters A-F is 0.92, 95% confidence interval 0.91-0.99 and of suprasternal notch-nipple distance 0.94, 95% confidence interval 0.80-0.98. The ICC coefficients imply that 92% of the variation in ptosis, and 94% of that in suprasternal notch-nipple distance, are between patients rather than within patients, which is a sign of low intra-rater variance, that is, the agreement between different raters is high.

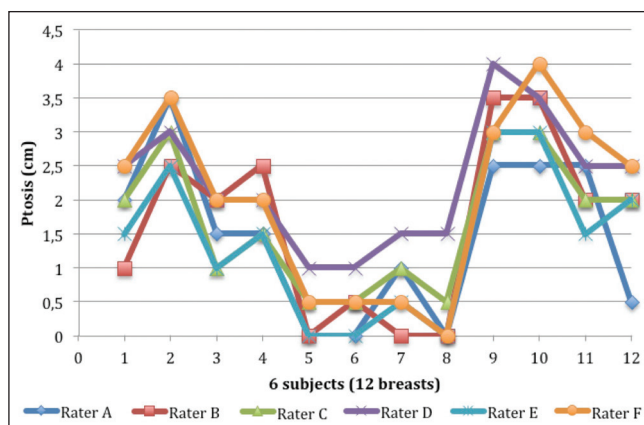


Figure 1: Different raters' measurements of the ptosis of the 12 breasts

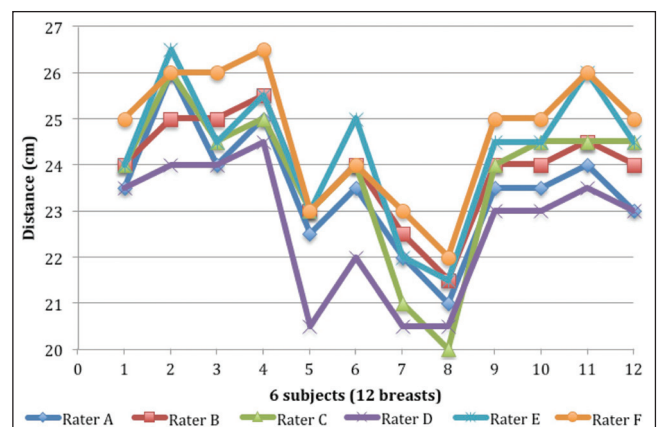


Figure 2: Different raters' measurements of the distance from the suprasternal notch to the nipple of the 12 breasts

The median absolute difference in ptosis between the biggest and smallest measured ptosis for each breast was 1.5 cm (mean 1.3 cm, min 1 cm, max 2 cm) and in suprasternal notch-nipple distance 2 cm (mean 2.2 cm, min 1.5 cm, max 3 cm). The coefficient of variation for the ptosis was 72% and 14% for the suprasternal notch-nipple distance.

According to the Bland-Altman plots [Figures 3 and 4], the overall assessment of the comparisons of measurements between the different raters show that the direction of the mean differences is close to zero. The limits of agreements of the differences were within ± 1 cm for the ptosis [Figure 3] and ± 1 cm for the suprasternal notch-nipple distance [Figure 4].

DISCUSSION

Standard breast measurements, such as ptosis and suprasternal notch-nipple distance, are often used in clinical practice to evaluate breasts, make decisions about treatment, for preoperative planning,^[10,11] and to discriminate between functional and cosmetic operations.^[12] Even-though we base clinical decisions on these variables, this study is the first that evaluates the reliability of such measurements. In most of the previous studies where morphometry of the female breast has been described, the reliability of measuring methods used to measure upper sternal-notch to nipple distance and ptosis is not tested.^[1-7,10,15] In most of the studies all measurements were performed by one rater, measuring each subject one time. In Brown *et al*'s^[8] study, the reproducibility of the measurements is tested by letting one rater measure 10 subjects on two occasions. Nonetheless, previous research does not reveal anything about the inter-rater reliability of measurement of suprasternal notch to-nipple distance and ptosis.

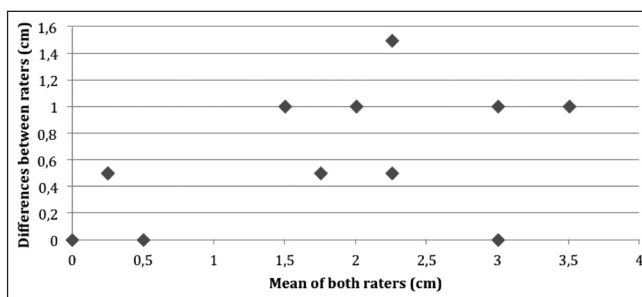


Figure 3: Bland-Altman plot of measurement of ptosis made by rater E and rater F. The lower dashed line indicates the mean difference. The upper dashed line shows "limits of agreement" (mean ± 2 standard deviations (SD)).

In the present study, the Bland-Altman plots [Figures 3 and 4] showed acceptable accordance for both the measurements and the differences in measurements between different raters were within acceptable clinical ranges for both ptosis (± 1 cm) [Figure 3] and suprasternal notch-nipple distance (± 1 cm) [Figure 4]. Furthermore, the intra class correlation (ICC) coefficient of 0.92 and 0.94, respectively, indicated that the agreement between different raters was high. The coefficient of variation (CV) for the ptosis was 72% and 14% for the suprasternal notch-nipple distance. A CV of 72% might sounds like a bad performance of the method. However, the CV has to be judge in the light of the mean value. In other words, one of the main disadvantages of CV is that it is very sensitive to small variation of the mean when the latter is close to zero. As regards measurement of ptosis, the mean value is close to zero and CV can thus not be used as a reliable measure of dispersion for the measurement of ptosis. Nonetheless, the clinical range of the measurement of ptosis was greater than that of the suprasternal notch-nipple distance, considering that they both were ± 1 cm even-though the suprasternal notch-nipple distance is a much greater distance than the ptosis. This might illustrate that it is more difficult to anatomically define the ptosis. If the rater pressures upwards he or she displaces the inframmary fold and hence changes the measurement of the ptosis. Similarly, the lower border of the breast can be defined differently. Certain definitions of anatomical landmarks have to be made when the suprasternal notch-nipple distance is measured as well, such as the exact location of the suprasternal notch and the center of the nipple. In fact, even though the points of reference are exactly specified there might be a minor variability of how the rater defines them. However, this seems to create smaller variation than displacement of the inframmary fold. Indeed, it is known that anatomical definition of the breast is a factor that complicates breast volume measurement.^[7] Variability in breast measurements due

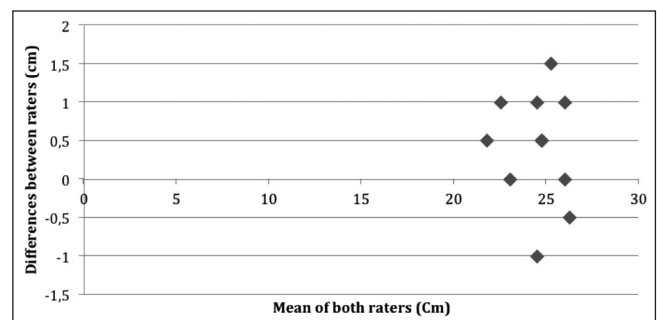


Figure 4: Bland-Altman plot of measurements of suprasternal notch-nipple distance made by rater E and rater F

to definitions of the borders of the breast have also been seen for breast measurements on photographs and with biostereometric analysis.^[16] In addition to the difficulty in defining the borders of the breasts, the female breast is an organ with varying volume, width, height, projection, tissue density, composition, shape, and position on the chest wall,^[5] which further complicates the standardised of measurements. In short, even though the definition of the borders of the breast and of anatomical landmarks is specific, it is always somewhat arbitrary and might create variation in the measurements. In addition, the position of the patient, even though standardisation, could contribute to slight variations in the measurements.

Some of the studies discuss which accuracy should be used when the measurements are performed.^[4,5,15] Smith^[4] reported his results in cm taken to the second decimal, Penn^[15] to the nearest $\frac{1}{4}$ inch (0.68 cm) and Westreich^[5] to the nearest 0.5 cm. Westreich^[5] argued that normal respiration or minor position changes causes changes in the measurements, hence making measurements in millimetres inappropriate. The present study supports that measurements should be performed with an accuracy of no more than 0.5 cm. A higher accuracy might give a false sense of correctness of the measurement. Indeed, even when an accuracy of 0.5 cm is used, our study shows that there is variability between different raters. In this context, as the measurements are only estimations of the true distances, an increase in accuracy does not make the measurements more accurate.

CONCLUSIONS

Even though several studies have tried to create protocols to objectively evaluate breasts measurements,^[4,5,15] such measurements remain a difficult task. This study shows that there is a good reliability for measurements of suprasternal notch-nipple distance and ptosis. Nonetheless, there is a slight inter-rater variability in the measurements. Even-though standardised, measurement of breasts is not an exact science and care has to be taken when the measurements are performed. The surgeon should have this in mind when measurements are used in clinical practice to evaluate breasts and to choose the right surgical method, as well as when guidelines for indications for surgery and for discrimination between functional and cosmetic operations are set up.

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