JPRAS Open 3 (2015) 22–25

Contents lists available at ScienceDirect

JPRAS Open

journal homepage: http://www.journals.elsevier.com/jpras-open

Original article

Acute changes in clinical breast measurements following bra removal: Implications for surgical practice

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ARTICLE INFO

Article history:
Received 9 January 2015
Accepted 13 January 2015
Available online 28 January 2015

Keywords:
Breast
Biomechanics
Displacement
Strain

ABSTRACT

Background: Stable measurement of breast position is crucial for objective pre-operative planning and post-operative evaluation. In clinical practice, breast measures are often taken immediately following bra removal. However, research shows that restrictive clothing (such as a bra) can cause acute anatomical changes, leading to the hypothesis that clinical breast measures may change over time following bra removal. This cross-sectional observational study aimed to provide simple clinical guidelines for the measurement of breast position which account for any acute changes in breast position following bra removal.

Methods: Thirteen participants of varying breast sizes had markers attached to their thorax and nipples to determine clinical measures of sternal notch to nipple distance, internipple distance, breast projection, and vertical nipple position. The positions of these landmarks were recorded using a motion capture system during 10 min of controlled sitting following bra removal.

Results: Internipple distance and breast projection remained unchanged over 10 min, while the resultant sternal notch to nipple distance extended by 2.8 mm in 299 s (right) and 3.7 mm in 348 s (left). The greatest change occurred in the vertical nipple position, which migrated an average of 4.1 mm in 365 s (right) and 6.6 mm in 272 s (left), however, for one participant vertical migration was up to 20 mm.

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http://dx.doi.org/10.1016/j.jpra.2015.01.002

Conclusions: Internipple distance and breast projection can be measured first following bra removal, followed by sternal notch to nipple distance, any measures associated with the vertical nipple position should be made more than 6 min after bra removal. These guidelines have implications for breast surgery, particularly for unilateral reconstruction based on the residual breast position.

Introduction

Breast surgery has been reported to lack accuracy and reproducibility,[1] highlighting the need for objective breast measurements that are accurate and repeatable. Breast measurement techniques include manual positional measurement such as sternal notch to nipple distance, internipple distance, breast projection, and vertical nipple position.

Whilst patient orientation during breast measurement has been investigated, no research has considered the stability of clinical breast measures. Typically, these measurements occur shortly after patients remove their bra and it is assumed that these measures remain stable over time. This assumption has implications for unilateral breast surgery, when the residual breast position informs the reconstructed breast position. The assumption that breast position remains stable is challenged by previous literature which shows restrictive clothing causing acute anatomical changes. Previous research has reported bras causing chronic shoulder furrows of 3 cm[2], decreased chest girth, decreased vertical nipple position, increased breast circumference and increased internipple distance.[3] While other research has reported that skin takes time to recover from compression.[4] These studies suggest that bras may cause acute changes in breast tissue position, which may affect clinical breast measures. Therefore, this study hypothesized that the following clinical breast measures would significantly change over 10 min after bra removal; sternal notch to nipple distance, internipple distance, nipple projection, and inferior nipple migration.

Materials/patients and methods

Following ethical approval, thirteen females (eligibility criteria: no surgical or clinical breast treatment, nulligravida) provided informed consent and breast sizes were established (Table 1). In a private area, participants removed their upper body clothing and were seated in a control chair. Markers were attached to the sternal notch, left and right anteroinferior tenth rib and nipples.[5] Participants remained as still as possible for 10 min as marker coordinates were recorded using motion capture cameras (50 Hz, Qualisys, Sweden). Markers were identified with 0.6 mm accuracy. Coordinate systems were established and multiplanar nipple coordinates, independent to thorax position, were calculated every sample.[5] Relative nipple position data were filtered with 0.09 Hz cut-off frequency to eliminate breathing artefacts.

The following clinical measures were calculated every sample; 1. resultant distance from sternal notch to nipples, 2. internipple distance; resultant distance between left and right nipple, 3. nipple projection; sagittal plane, perpendicular distance from thorax plane (defined by sternal notch and rib markers) to nipple, 4. inferior or superior migration; vertical change in nipple position (in the local coordinate system, relative to the sternal notch).

To determine changes in measures across the trial, start and end nipple positions were statistically compared. Measures where significant changes occurred ($P < 0.05$) demonstrated exponential change (supporting previous stress/strain literature for skin). Magnitude (c) and rate of change (b), and time (t) at which steady state occurred were investigated (Equation (1)).