QUALITATIVE ANALYSIS OF 3D BREAST DISPLACEMENT DURING TREADMILL ACTIVITY.

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The movement of the breast during physical activity has been underestimated during previous research as only the vertical component has been considered. Understanding 3D displacement of the breast may help in the design of effective interventions to minimise exercise related mastalgia, reduce the risk of breast ptosis and inform bra design. Only one study has reported coronal plane displacement trajectory of the breast during running (Gehlsen & Albohm, 1980). Therefore, the aim was to analyse multiplanar displacement of the breast during an increment treadmill test and to assess the subsequent change in breast displacement after normalising to the movement of the body.

Following ethical approval, 8 females with D cup breasts (mean ±SD; age 22 ±1.2yrs, mass 64.1 ±9.4kg) had retroreflective markers positioned on the left and right nipples, clavicles (directly superior to the nipple), anterior superior iliac spines (ASIS) and acromiales. 3D displacement of the markers was recorded during a ramped speed treadmill test using 5 calibrated ProReflex cameras (100Hz, Qualisys, Sweden). The treadmill test began with 5 strides at 5kph; speed was then increased by 1kph for another 5 strides; this was repeated until the subject requested termination of the test. To establish independent resultant 3D displacement of the right nipple and eliminate the 6 degrees of freedom of movement of the body, a reference grid of left and right clavicles and ASIS’ markers converted the global to a local coordinate system (LCS) with the origin at the right clavicle.

Treadmill activity produced a figure-of-8 trajectory for unnormalised breast motion in the coronal plane. During one gait cycle, 4 phases of breast motion occurred, these corresponded to loading and flight of the left and right stride. LCS produced normalised coordinates for the breast, these demonstrated less uniformity and a considerable reduction in mediolateral (m/l) displacement, moderate change in vertical displacement and minimal change in anteroposterior (a/p) displacement. A double peak during left and right mid-stance/flight (walking/running) was observed in temporal vertical displacement, with m/l and a/p displaying a single peak. The breast reached its most lateral and most posterior position during mid-stance/flight of the ipsilateral limb. Normalising produced a delay in peak vertical breast displacement due to the inertia properties of the breast. At maximum treadmill speed, mean total 3D breast displacement was 47.04 ±16.12cm, throughout one gait cycle; this incorporates the 4 gait phases with 2 peaks in activity. A better representation of 3D breast displacement might be achieved by averaging across the 4 gait phases. During gait considerable m/l breast motion results from m/l body motion, to normalise only the vertical movement of the body would result in an overestimation of breast displacement during activity.


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