The overlying skin and the Cooper’s ligament provide limited support to the breast, resulting in breast motion during activity. Excessive breast motion has 2 negative implications; breast pain and breast ptosis (Page & Steele, 1999). Limited research has investigated the effect of different bras on kinematics, focusing solely on the vertical displacement of the breast during 1 or 2 strides of treadmill running, up to a maximum of 13kph (Mason, et al, 1999). Currently there is no universally accepted method for measuring breast motion; therefore, the aim is to present a procedure for monitoring 3D breast displacement during treadmill activity.

Following ethical approval, 8 females with D cup breasts (mean ±SD; age 22 ±1.2yrs, mass 64.1 ±9.4kg, sum of 8 skinfolds 133.4, ±29.6mm, chest size 34) had retro-reflective 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, the 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 movement of the body, a reference grid of left and right clavicles and ASIS’ markers converted the global to a local coordinate system, with the origin at the right clavicle.

Kinematic variables fell within normal ranges (during walking right ASIS vertical displacement of 5 ±0.6cm, mean net angular trunk flexion and lateral flexion of 5.6° and 4.4°, pelvic rotation of 10.5° and cadence ranged from 118.3-175.4 steps/min over the treadmill test). 3D breast displacement displayed an acceptable typical error as a coefficient of variance (%CV) of 16.7%CV (95% confidence interval, +1.8 -1.5%CV) for test/retest. Within each stage, strides 1 to 5 showed no significant difference (P>0.05) and a mean of 9.9%CV (95% confidence interval, +2.8, – 1.6%CV). There was a significant Pearsons correlation between breast displacement and speed of the test (r=0.658, P<0.001). Displacement was not significantly different between the clavicles, acromiales and ASIS’ or between the left and right side reference markers (P=0.705), which adds validity to their use as reference markers. Acceptable test/retest and within stride reliability further demonstrates the validity of this procedure which improves upon any previously reported methodology for the measurement of 3D breast displacement during dynamic activities.


Keywords: Running, 3D Analysis

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