

## A PRELIMINARY STUDY OF BREAST MOVEMENT IN DIFFERENT BRA SUPPORT

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To free women involved in physical activities from suffering breast pain due to insufficient breast support, thorough understanding of the breast displacement mechanism is needed. The study is aimed to determine the true movement of the breast in three types of bras, and ultimately, to build a scientific base for bra design improvement. 28 female participants were recruited and the breast movements in four different types of breast support were recorded using the electromagnetic tracking system for further analysis. The results showed that the trajectories of left and right breast in a crop-top bra for the lateral raise showed significant difference ( $p = .039$ ). The effect of sportsbra was obvious in all four movements and the breast displacement decreased as the breast support level increased (from non-sportsbra to sportsbra).

**KEY WORDS:** motion, fashion bra, sportsbra.

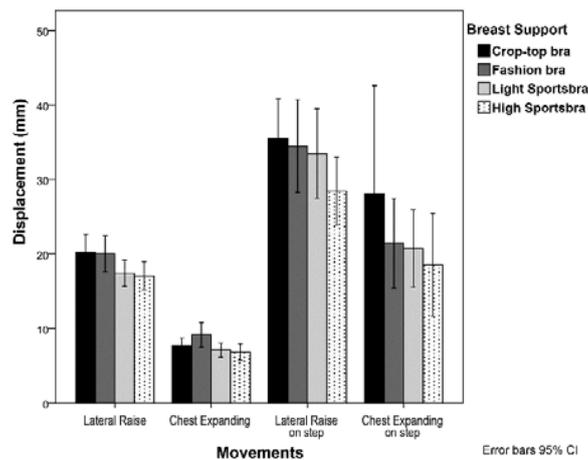
### INTRODUCTION:

Previous researches on bra-breast motion adopted the optical tracking system to capture the motion of the nude breast (no bra) and breast in sportsbra (Mason *et al.*, 1999; Scurr *et al.*, 2011a; White *et al.*, 2009; Zhou *et al.*, 2012). These motion data were collected and further analyzed under the assumption that no bra-breast relative movement occurred within the bra. However, the relative movement under the non-sportsbra conditions cannot be neglected for non-sportsbras usually have lighter support compared to that of sportsbra due to the difference in the material and structure of the two. This study is the first to adopt electromagnetic tracking system to examine the true breast displacement and aims to determine the true displacement of the breast within breast support, which has always been neglected and seldom studied in previous researches.

**METHODS:** 28 female participants ( $21.5 \pm 3.0$  years old) were recruited and the breast movements in four different types of breast support (four support levels totally) were recorded using the electromagnetic tracking system, which were indicated by five passive sensors (0.9 mm) attached to the suprasternal notch, the left and right nipples, and the left and right anterior inferior aspect of the 10th ribs (Haake and Scurr, 2010), respectively. The study protocol was approved by the Human Experiment and Ethics Committee of National Cheng Kung University Medical Center, Tainan, Taiwan (B-ER-103-005). A long-ranged transmitter was connected to the electronic units of the electromagnetic tracking system (3D Guidance trakSTAR™, Ascension Technology Corp., USA) and placed in front of the participants for motion capture. The participants performed two sets of movements wearing a crop top bra, a fashion bra (provided by participants themselves), and a light level sportsbra or an high level sportsbra (Mason *et al.*, 1999; White, 2013). Utilization of one-way ANOVA analysis compared the differences of four breast support conditions in four movements. Significant level was defined as  $p < .05$ .

**RESULTS:** No significant difference was found between the trajectories of left and right breast in all four support conditions except for the lateral raise in a crop-top bra ( $p = .039$ ). In figure 1, the effect of sportsbra was obvious in all four movements and the breast displacement decreased as the breast support level increased (from non-sportsbra to sportsbra). The high sportsbra had displayed least displacement in all movements, while the

greatest displacement was found in crop-top bra and fashion bra. Despite the apparent decrease in breast displacement found in all movements, no significant difference was found between all types of breast support conditions.



**Figure 1: Displacement of each movement under each breast support conditions.**

**DISCUSSION:** The effect of sportsbra decreasing the vertical displacement during exercises is the same as previous results (Mason *et al.*, 1999; Scurr *et al.*, 2011a; 2011b). The less significant vertical breast displacement under the breast support conditions might result from the daily movement involved in this study. The displacement of participants in their own fashion bra doing lateral raise were found to be  $20.04 \pm 6.17$  mm, indicating the bra can be easily pulled away from its best-fit position just by doing simple arm movements. Also, the intensity of the activities involved in this study was way lower than the common exercises, such as running or other ball games, yet the results had shown an approximate vertical displacement of 30 mm wearing a crop-top bra or a fashion bra. The problem is that many females in Taiwan were not aware of the importance of proper protection during exercise, breast support especially. Only 2 in 28 of the participants reported the habits of putting on proper breast support when involved in physical activities.

**CONCLUSION:** Sufficient breast support can help decrease breast displacement. A study comparing the displacement of the breast and the bra is recommended, and activities involved should be more intense. The definition of the relationship between the breast and bra displacement may give tributes, on a scientific base, to the improvement of the bra design.

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