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Sports Bra Design Based on Dynamic Elder Women Avatar ⋆

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Abstract

Elder women often suffer from chest pain and pressure discomfort due to breast displacement during exercise. To design functional sports bras that will mitigate chest pain and pressure discomfort under dynamic conditions, a survey was completed to find out the bra design special requirements and simulation experiments were carried out to investigate breast displacement rules. A standard sized running woman was selected as a subject to determine the typical breast movement positions, and an elder woman avatar was used to simulate the breast displacement. The results showed that by dividing the bra into different functional areas, the breast movement postures can be generated on the virtual model and this method could be applied to develop ergonomic sports bras that can limit the breast movement for elder females. Approaches involved in this research are also suitable to design sportswear with specific functional requirements for various age women.

Keywords: Sports bra; Breast displacement; Elder women; Avatar; Pattern; Apparel design

1 Introduction

Women, especially elder females, often suffer from bust pressure discomfort or pain caused by breast displacement during exercise. Senior women therefore often place factors related to sports bra functions such as fit well, comfort, deterring breast displacement (BD) at a higher priority for their breast care. By far there have been many studies focusing on bra issues in the general female population. Berger-Dumound [1] reported that the most effective breast motion-limiting bras were often uncomfortable while the bras with a high rating in comfort performed poorly in breast motion controlling. Jutel [2] suggested although the breast motion is restricted most effectively when a bra firmly held the breast tissue close to the body, there is a need for sufficient

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elasticity in the horizontal plane to allow the chest to expand during respiration. Hence, the functional performance of sports bras depends mainly on achieving a balance between reducing BD and improving pressure comfort in specific dynamic conditions [3]. However, only limited attention has been given in the scientific literature to the success or failure of various sports bra design features in reducing breast motion [4].

Typically, aging and menopause affect the anatomy of female breasts [5, 6]. The breasts and body shape of middle-aged women change when they start the menopause phase, and their Cooper's Ligaments elongate, resulting in flaccidity and breast sagging [7]. These changes in breast characteristics cause issues such as breast tightness, uncomfortable, or poor breast support when older females wear a commercial sports bra. It is difficult to find commercial sports bras meeting senior women's special requirements including breast protection, fit, and pressure comfort [8]. Issues such as inadequate breast support can affect wearer health, including low back pain and loss of posture, and even reduce their daily physical activities, etc. The paper aims to design a functional sports bra that will provide breast protection during sports activities. Typical breast movement positions are identified during running of elder women. The protective sports bra is designed by well-fitting on the elder female avatar to minimize BD. Fit simulation is also conducted to evaluate the functional sports bra design on an elder female avatar.

2 Methodology

2.1 Survey

A custom-designed 15-question, self-administered survey on sports bra usage was approved by RMIT University College Human Ethics Advisory Network (CHEAN A&B 22595-11/19). There were 26 participants from an outdoor activity group consisting of women aged 50 and over. The participant age groups are 50-55 years, 30%; 56-60 years, 43%; 61 years and over, 27%. Their bra size is classified into two categories: small [A–B Cup], 35%; large [C Cup +], 65%. The survey asked the participants to describe their level of satisfaction with regarding to sports bra design features and sports bra wearing issues.

2.2 Software

CLO 3D software from CLO Virtual Fashion Inc. was used to complete garment design and evaluation. It was applied not only to complete the sports bra prototype but also to evaluate the designed sports bra in line with a virtual fit assessment Richpeace CAD system from Tianjin Richpeace AI Co. Limited. Richpeace CAD system was mainly applied for two-dimensional (2D) pattern sports bra design. Through digital input or output between CLO 3D and Richpeace CAD system, 2D patterns were converted to a three-dimensional (3D) pattern, or vice versa.

2.3 Avatar

According to Burnett's report, sports bra usage among older women wearing a C+ cup size bra was below 41% due to breast pain caused by vigorous activities and poor breast support [9]. Thus, in this investigation, an elder avatar of C cup bust size was created. The measurement