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Innovation and ergonomics consideration for female footwear design

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Abstract

The intent of this study is to explore the potential of 3D printing female shoes and try to change the manufacturing procedure. High-heel is the target because of the marketing value and the challenge for ergonomics. Therefore, problems of standing balance, comfort and fitness are investigated. This study starts from observation of traditional manufacture and the way shoes are assembled in order to increase the value of innovation. The design and producing procedure would be presented, and participants are also asked to do a pilot study for understanding the preliminary results.

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1. Introduction

Footwear design has been developed for a long time, and researches for footwear always focus on ergonomics or physiology [1, 2]. Recently, more and more kinds of footwear are designed for different functions, such as hiking boots, sports shoes and high-heeled footwear [3]. However, high-heeled footwear is universally considered as a charming design without any consideration of ergonomics, and cause many problems related to our feet [4]. Hence, many researches try to find out the factors of the problems by gait analysis, statistical parametric mapping clinical

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trials, which lead to some new observation. For example, the height of the heel has greater influence to our balance and gait than the thickness. Also the walking experience of people could change the performance of clinical trials. The big difference is observed between ballet dancers and normal students. Although so many theories strongly point out the disadvantages that lacking of ergonomics, high-heeled footwear is not only increasing the sales, but more and more new styles of it continuously pop out, indicating that this kind of female footwear remains popular. In this study, researchers deal with the problem of female footwear from different side; not only consider the ergonomics (size, outline and shape of foot), but also the design thinking.

How do the ergonomics of foot be applied to foot design, and how can the new ideas change the process and concept of shoes are the focal points. Through the design method, such as morphological analysis, this study could bring a new viewpoint to think about footwear design, and also take ergonomics into concern, for creating a new form of female footwear.

This new form of footwear in this study could be deconstructed and combined depends on users' needs, declining the uncomfortability while walking. Most important of all, this study breaks the limit of foot manufacturing with the usage of 3d printing and 3d scan. It means that the whole process and concept of shoes are changed. Users can be their own shoemaker and creator. The final evaluation of the ergonomics and satisfaction would be shown by Likert scale.

2. Related works

2.1. 3D Printing and 3D scanning

Traditional way of producing footwear results in many limitations when combining parts of shoes. In order to create footwear which insole and instep are combined according to difference feet, a new way to combine parts are needed. 3D printing provides the high freedom while producing[5]. 3D printing technology such as fused filament fabrication and stereolithography, make an integral forming or production of parts easier. This technology has actually been imply in industrial design for several years[6].

On the other hand, 3D scan is also helpful with 3D printing and is wildly used for study the relationship between foot and footwear because of the advantages to create accurate models[7, 8]. With the accurate models, people can get shoes which are fitting their feet appropriately.

2.2. Ergonomics consideration

Previous researches have shown that the height of heels and the form of footwear play important roles in standing balance[9]. In the standing tests, 20 participants who were 21 years old with similar weight and height participated in this test. 10 of this participants exercise regularly and another 10 people were ballet dancers with experience more than 14.6 years in average. Kilby observed the performance of Center Of Pressure (COP)[10] by distance, distance velocity and variation. The performance helped to determine how high-heel influence our standing.

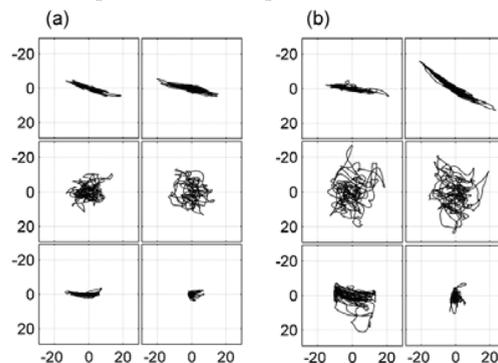


Fig. 1. Results of COP tests (a) Ballet dancers; (b) Students[9]

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