

Research on Heel Height of Women's Shoes Based on Walking Analysis

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Abstract

The purpose of this study is to investigate how the different heel heights of women's shoes influence walking according to walking analysis findings. Identifying heel heights that do not impair walking comfort were also investigated. Ten female university students were chosen as subjects and asked to wear sample pumps with heel heights of 1.5, 3.5, 5.5, and 8.5 cm. The walking experiments focused on walking movements, muscular activities of the lower limbs, and ground reaction at the point of impact. A questionnaire was then used to determine comfort levels while walking. The analysis discovered that the height of the heel was positively correlated with vertical movement, and that the subsequent change in walking movements resulted in an increase in muscular activities and ground reaction, and a corresponding increase walking discomfort. It was also found that poor ratings were given for each measurement item when a heel height of 8.5 cm was used, leading us to conclude that comfort during walking is compromised when the heel height increases beyond 6 cm.

Keywords: High-heeled Shoes; Heel Height; Walking Analysis; Electromyogram

1 Introduction

High-heeled shoes are popular among young women, since they can make their legs appear longer and more slender. For women, shoes are one of the many ways in which they style themselves and express their *kansei*, and it is nearly unthinkable to select a pair of shoes without any regard to their design. Placing priority on design when selecting shoes, however, can be said to result in an increase in foot problems, such as hallux valgus and hammertoe. In recent years, much attention has been paid to the harmful influence that high-heeled shoes can have on the human body, giving rise to a consumer preference for shoes that are relatively high-heeled but as comfortable as possible to walk in. Several studies have clearly shown that wearing high-heeled shoes can

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cause muscle fatigue, repetitive strain injuries, low back disorder, and muscle imbalance [1-3]. There is a real tension in trying to reconcile the desire for fashion with these health concerns. Therefore, this paper seeks to go deeper into the issue by investigating and discussing the unique approach of measuring varying heel heights with qualitative comfort data in order to determine optimal maximum heel heights with minimal discomfort. In general, the characteristics of shoes not only directly influence the foot, but also exercise some influence on other parts of the body when walking. For example, it is assumed that a higher heel can change the way one walks and influence the sensation of walking. It is hoped that this research will contribute to the design of fashionable opera pump shoe design while negating adverse effects, through a deeper understanding of good heel design. In this study, walking movements, the muscular activities of the legs, ground reaction, and comfort during walking were measured in order to investigate how the heel height of women's shoes can influence walking. If a heel height was determined not to significantly impair the ease of walking and other comfort parameters for wearers, it would then be possible to select shoes with better comfort. Because of this, the maximum heel height that does not impair comfort during walking was also examined.

2 Methods

2.1 Subjects and Experiment Samples

The subjects of this study were ten healthy university students (age: 21.7 ± 0.9 , height: 156.7 ± 4.3 cm, weight: 47.2 ± 2.1 kg, shoe size: 23.5 ± 0.4 cm). After the subjects were informed of the risks that might be associated with the experiment, safety considerations, and the control of personal information, they expressed their consent. For the purposes of this experiment, pumps of four different heel heights – 1.5, 3.5, 5.5, and 8.5 cm – were used (Fig. 1).

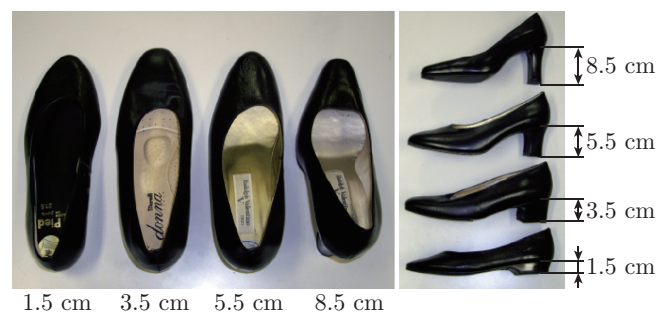


Fig. 1: Experiment samples

2.2 Experimental Methods and Measurement Items

In the experiment, the subjects were asked to walk along a 10m path ten times for each sample (Fig. 2). The experiment was performed in order of heel height 1.5, 3.5, 5.5, 8.5 cm. To measure their walking movements, a CCD camera was set up on the right side of the subjects to film the walking cycle. While they were walking, a surface electromyogram (EMG) measured the vastus lateralis, biceps femoris, tibialis anterior, and gastrocnemius of the right leg. The EMG used the surface bipolar detection technique and a surface electrode with a leader part of 2 mm