



***Electromyography Study on Lower Limb Muscle  
Synchronizations Strategies during Walking and Sit-  
to-Stand Tasks on High-Heeled Shoes***

A Dissertation submitted for

The partial fulfillment of

Master of Engineering Research

By

**Manisha Pratihast**

University of Technology Sydney

New South Wales, Australia

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## **CERTIFICATE OF ORIGINAL AUTHORSHIP**

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as part of the collaborative doctoral degree and fully acknowledged within the text.

I also certify that I have written the thesis. Any help that I have received in my research work and the preparation of the dissertation itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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## Abstract

High-heeled shoes as accessories are prominent in today's society. They are worn on special occasions as well as with casual outfits. Specific muscle activation and synchronization changes occur when performing Sit-to-stand and walking tasks in shoes with high heels vs. lower heels. The reformed demands on muscles mostly accompanying the muscle synchronization changes have not been well documented. As walking and sit-to-stand while wearing HHS in the work environment is very common for professional women, it is essential to understand the health implications. Therefore, the main purpose of this study is to identify changes in muscle activation and synchronization patterns when Sit-to-stand and walking are executed in high-heeled vs. low-heeled shoes.

Between 10 and 15 Healthy young women participated in the study. Participants performed two tasks - sit to stand and walking. Both these tasks were performed in different experiment sessions, where each participant was made to wear heeled shoes of different heights (4cm, 6cm, 8cm and 10cm for walking task and 4cm, 6cm and 10cm for STS task). Muscle activities from the dominant leg were recorded. The investigated muscles were: Rectus Femoris (RF), Vastus Lateralis (VL), Vastus Medialis (VM), Semitendinosus (ST), Tibialis Anterior(TA) and Gastrocnemius (GA). RMS analysis of all muscles, Co-contraction analysis of RF – ST, VL – ST and VM – ST and combinations and coherence analysis of RF-VL, RF-VM, and RF-ST combinations were carried out.

When comparing parameters relevant to different heel heights, a significant increase in muscle activity was perceived in all muscles involved in the two tasks. Co-contraction and Coherence parameters were increased in all three muscle pairs in both tasks. An interesting observation made was that irrespective of heel heights, the percentage contribution of muscle activation and percentage contribution of muscle pair synchronization remain same in sit-to-stand and walking task.

These results reflect greater alteration demands for joint stability, balance and avoid from falling during sit-to-stand and walking in shoes with increased heel height.

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