

The effects of a heel lift on squat form.

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Introduction:

Low back pain (LBP) costs the United States about 90.7 billion dollars a year, with LBP being the second most common cause of missed work^{1,2}. Squatting is a common task that many workers must do throughout the day, leading to overuse injuries at the workplace. Our purpose is to find the optimal heel lift conditions for squatting and lifting in order to promote good mechanics and thus reduce the risk of low back pain and work-related injury. Our hypothesis is that a heel lift will lead to better mechanics in squatting and lifting compared with no heel lift as seen through a reduction in the forces produced by the erector spinae muscles.

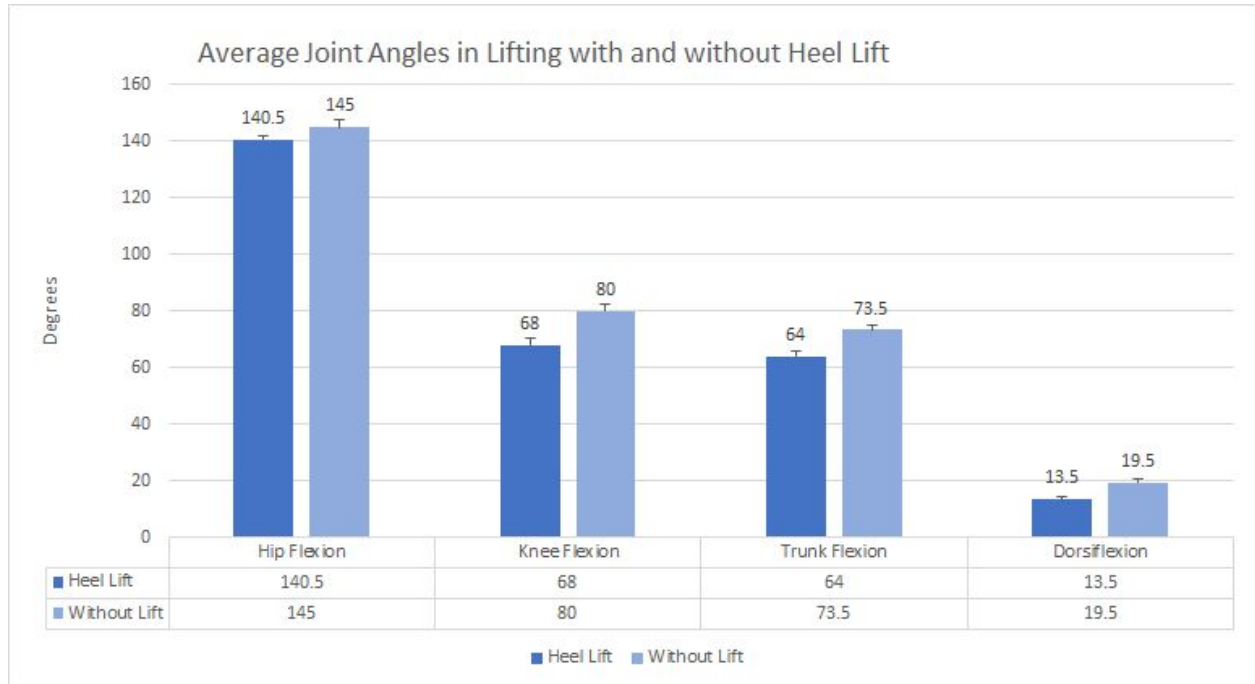
Methods:

To determine the effect of a heel lift on squat mechanics, two subjects of similar demographics participated in a study comparing squat mechanics with and without a heel lift. The subjects included two caucasian 23-year-old females ranging from 65-66 inches height, both demonstrating a lack of ankle dorsiflexion as indicated by goniometric measurement. The experiment was set to simulate an occupational setting in which the subjects had to squat to lift a 5kg box with and without a 0.75 inch heel lift.

Using the 2D Hudl Technique application, peak joint angles of trunk flexion were observed during each trial and used to calculate the torque exerted on the body by the weight of the head-arms-trunk (HAT) segment. The torque exerted by the HAT segment and the box were added together to equal the total torque exerted on the body from the task of squatting to lift the box, and was assumed to be equal to the torque exerted on the lumbar erector spinae musculature. The force exerted by the erector spinae is assumed to be correlated to low back pain in those whose occupational demands include repetitive squatting to lift objects.

Results:

As a result of our investigation, we found that on average with both test subjects, there was a reduction in peak joint angles measured at each joint measured during their squat while utilizing a heel lift. The variation of this data was minimal as indicated by small standard deviations, indicating the value and validity of these findings. We additionally found that the torque of the erector spinae muscles was decreased for both subjects while utilizing a heel lift. Average torque for both subjects without the heel lift was 879 N, and with heel lift was 830 N.



Discussion:

The use of a heel lift yielded more optimal squat mechanics, as evidenced by a few factors. We found that the amount of force generated by the erector spinae and the joint angles were reduced with the addition of a heel lift. As a result, the subjects demonstrated a more upright posture when squatting and their erector spinae needed to generate less force to hold the squat position. Reduced trunk flexion could be beneficial for individuals with lumbar disc pathologies as well as with workers who must repetitively lift. Although the repetition would not be reduced by the heel lift, the amount of torque the erector spinae must produce is decreased.

There are a few major limitations of this study, including a small sample size, no low back pain of the subjects, as well as both subjects having similar demographics, which made this study less generalizable to the target population.

Conclusions:

There may be some benefit to implementing heel lifts in the workplace, especially for individuals with decreased dorsiflexion range of motion (ROM), as it may be an effective preventative strategy for decreasing LBP incidence. We conclude that more research is necessary on multiple populations and demographics to explore whether heel lifts in the workplace is a recommended option.

Clinical Implications:

Many patients in the clinic demonstrate decreased dorsiflexion ROM. A heel lift reduces the need for sufficient dorsiflexion ROM, and appears to lead to decreased joint angles of the trunk

and lower extremities, reduced force generated by the erector spinae, a more upright posture when squatting, and may lessen the extent of repetitive stress on the low back. A heel lift may be useful for preventing or reducing low back pain in individuals who must squat and lift objects as part of their job.

Resources:

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