The effects of arms and countermovement on vertical jumping

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Introduction

Sports have become popular throughout all parts of the world and are played by people of all ages. The rise in adolescent participation in sports brings the need for additional studies on this age group. One component required for proficient athletes in their respective sports is the ability to jump. The purpose of this study is two-fold. The first purpose is to quantify and analyze the height difference between different jump techniques. One technique is known as a countermovement which is “a quick bend of the knees during which the body’s center of mass drops somewhat before being accelerated upwards” (Harman, Rosenstein, Frykman & Rosenstein, 1990). This quick movement allows for the athlete to push into the ground and rapidly switch directions to move upward. Muscle spindles allow for this to happen by triggering the stretch reflex. The stretch reflex resists the uncomfortable stretching by contracting the muscles and increasing their length (Wilmore, Costill, & Kenney, 2008). The other technique being used was arm swing which was used to add mechanical drive by throwing the arms back and driving them forward. The second purpose of this study was to observe and analyze whether there was a difference in jump height between athletes and non-athletes, using a single camera video analysis. This project could potentially influence how coaches train athletes.

Methods and Materials

All participants were recruited on a volunteer basis and were between ages 14 through 18. Subjects were required to have verified parental consent (in the form of a signed waiver) and complete a demographic questionnaire. Subjects were recruited from the Aberdeen High School student body. Prior to testing, each subject was to fill out a pre-test survey to gauge previous experience with sports. Two subjects jumped at the same time while being recorded by a video camera. First a picture was taken of the subjects with arms raised to determine the standing reach height (STR). Then each subject was required to complete four different jump techniques and a jump technique of his/her choice (OC), repeating all jump techniques three times (see Figure 1). The location where the subject touched the wall was known as the Peak Jump Height (PJH), and the was measured in inches. VideoLAN Client® (VLC), a media player, was used to go frame by frame to screenshot where the PJH occurred. ImageJ was then used to scale the screenshot to a preset distance, allowing for accurate measurements. To calculate the Vertical Jump Height (VJH), the STR was subtracted from the PJH. Afterwards a post-test survey about the testing experience was completed by each subject.

Graph 1 (above): Schematics of the four different jump techniques from starting position to end position.

The paired t-test was used to compare the SJ+J technique to the CM+A technique to see if there was a significant difference in jump height by using a countermovement. A p-value of 0.000, there was conclusive evidence of a difference. For the influence of arm swing a paired t-test was also used with the CM technique and CM+A technique, a p-value of 0.000 showed that there was conclusive evidence to demonstrate a significant difference (Graph 1). The p-value of 0.00 indicates there is a significant, positive relationship between the CM+A and CM.

Results

For all five jumps completed by the subjects, athletes had a greater VJH than the non-athletes. A two-sample t-test was used to compare athletes vs. non-athletes for all five jumps. The p-values were all greater than 0.2. This shows that there is no significant difference in athletes and non-athlete jump heights.

Conclusions

The standing jump was significantly different from all the jumps, giving the lowest vertical jump height. To see the effects of countermovement the squat jump with arms was compared to the countermovement with arms. There was evidence to conclude that there was a difference between the two jumps. Also, the comparison of the countermovement to the countermovement with arms showed a significant difference in the jump height when adding arms. The regression analysis showed that by using the CM+A technique, a student would jump approximately 25% higher than using the CM technique (Graph 3). Similar results were found about the CM+A technique having a higher vertical jump height than the SJ+A technique (Graph 2 & 4). This study supports the results seen in previous studies with adults. Previous studies resulted in significant differences in vertical jump height by jump type. This allows for us to use adults as subjects to provide accurate data for adolescents. An increase of non-athletes and students from different schools would improve this study. Results of this study can be used by coaches who are trying to improve athletes’ jump heights. The squat jump and countermovement both provided significantly higher vertical jump height than a regular jump, so by using one of these techniques, athletes can further excel in his/her sport of choice.

Works Cited


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Materials