

The Ground Reaction Force Comparison Between Conventional Deadlift And Hacklift

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Abstract: The aim of this study was to determine and compare the ground reaction force (GRF) during conventional deadlift and hacklift. Twenty (n=20) recreationally active, resistance-trained men were recruited to this crossover design study and were instructed to perform both conventional deadlift and hacklift in random order. Participants were needed to lift 85% of their conventional deadlift one repetition maximum (1RM) score. One way repeated measure analysis of variances (ANOVA) was conducted to compare the differences of GRF during concentric and eccentric phase of both exercise. Results showed that the force production during concentric phase was significantly higher during traditional deadlift while no significant differences exist during eccentric phase. Findings of this study suggested that based on force production, performing conventional deadlift imposed better chances of strength adaptation.

Index Terms: position of barbell, types of deadlift, ground reaction force, biomechanics.

1 INTRODUCTION

Resistance training has been proven as one of the main methods to improve muscular strength and power [1], [2]. Various training variables exist that need to be well planned and manipulated in order to obtain better adaptation [3], [4]. One of the training variables is exercise selection. Looking at the movement biomechanics, deadlift is one of the main exercise that is suggested to be performed due to many muscles that been recruited during the movement [5], [6], [7]. Deadlift is a movement that involve a performer to lift weights from the ground. Traditionally, the weight lifted is put in front of the body. This is also known as conventional deadlift. Through a lot of practitioners' experiences and researches been conducted, various types of deadlift has evolved and been suggested to be performed. One of it is hacklift. The movement of hacklift is not so much different from conventional deadlift. While weight is been put in front of body during conventional deadlift, during hacklift, weight is put behind the body. Deadlift is an exercise that involve quadriceps, gluteus maximus, erector spinae, hamstrings, trapezius, rhomboideus, deltoideus and wrist flexors [8]. The amount of muscle activation is believed to be different based on the types of deadlift performed (i.e. conventional, Romanian, sumo, hacklift etc), stance width, types of grips used and many more. The understanding of muscle activation is important as training the correct muscle will induce more specific chances for adaptation to the specific movement to be performed [9], [10], [11], [12]. Study on ground reaction force during a movement provide information on how much force been produced by the body [13], [14], [15]. More force been produced reflect more muscle working and more muscle coordination in the body.

Thus, it can be said here that with more ground reaction force been produced during a movement, it provide more chances of body adaptation especially in terms of muscular strength and hypertrophy. Despite been a major exercise performed in a resistance training program, not much research has been conducted on the response and adaptation comparison between deadlift and its variations. The aim of this study was to determine and compare the ground reaction force during conventional deadlift and hacklift. The comparison will be made according to the concentric and eccentric phase.

2 METHODOLOGY

2.1 Participants

This study involved twenty (n=20) recreationally active, resistance-trained men as participants. Participants need to be healthy, injury free and were currently active performing resistance training at least two times per week. All participants can perform both conventional deadlift and hacklift with correct techniques. Physical Activity Readiness Questionnaire (PAR-Q) and informed consent were given to participants before data collection.

2.2 Data Collection

Figure 1 and Figure 2 showed the techniques of performing conventional deadlift and hacklift. During testing, participants were required to lift 85% of the conventional deadlift one repetition maximum (1RM) value for three repetitions. Participants were required to perform each exercise in three trials. After finished the first exercise, participants were given two days to recover, before performing the other exercise with the same procedure (i.e. three trials, each trial three repetitions). The order of exercise performed were randomly divided among participants to avoid order effects. Both exercise were performed on tri-axial force platform (BP400600HF-2000, AMTI Inc., USA) (width: 400 mm X length: 600 mm X height: 82.5 mm). Data sampling rate were set at 200Hz with filter cut-off frequency rate of 10Hz. The kinetics data that were measured in this study were the peak and mean force during concentric phase and mean force during eccentric phase. During concentric phase, the peak force was defined as the highest force before the takeoff. Mean force was the average of force produces between the beginning of concentric phase and the end of concentric phase. During eccentric phase, mean force was the average

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of force produced between the start of participant step on the force platform until the point where the concentric force begin. As participants need to lift 85% of their 1RM value, they were first tested of their 1RM score. 1RM testing protocol what were conducted in this study has followed the guideline by the National Strength and Conditioning Association [16].

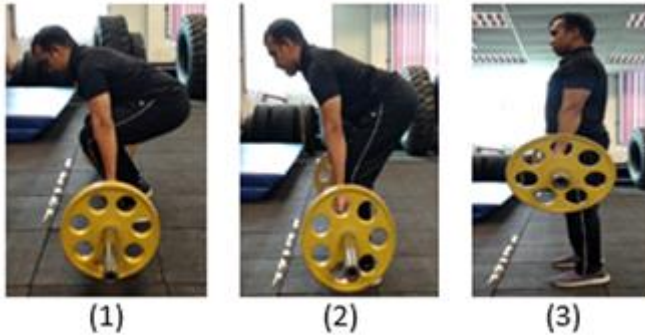


Figure 1. Conventional Deadlift

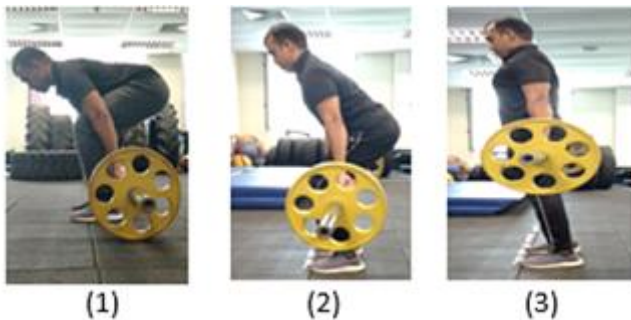


Figure 2. Hacklift

2.3 Statistical analysis

Descriptive statistics was performed to obtain the mean and standard deviation of physical characteristics and data score. One way repeated measure analysis of variances was conducted to compare the GRF of concentric and eccentric phase during both conventional deadlift and hacklift. All statistical analyses were conducted using Statistical Package for Social Science (SPSS) version 23 (IBM, USA).

3 RESULTS

Table 1 showed the physical characteristics of participants involved in this study.

TABLE 1
PHYSICAL CHARACTERISTICS OF PARTICIPANTS

| Variables | Mean \pm SD |
|----------------|-------------------|
| Age (years) | 21.34 \pm 1.82 |
| Body Mass (kg) | 65.34 \pm 4.48 |
| Height (cm) | 170.24 \pm 5.71 |

Analysis showed significant main effect for the following kinetic variables: i) peak concentric force (PCF), $F(1,19) = 19423.12$; $p < 0.05$, ii) mean concentric force (MCF), $F(1,19) = 24312.93$; $p < 0.05$. No significant main effects were found for the mean eccentric force (MEF), $F(1,19) = 634.52$; $p > 0.05$. Table 2 showed the kinetics data during the conventional deadlift and

hacklift. Pairwise comparison showed that peak and mean force were found to be greater during conventional deadlift compared to hacklift.

TABLE 2

KINETICS DATA DURING CONVENTIONAL DEADLIFT AND HACKLIFT

| Kinetics | Conventional Deadlift | Hacklift |
|----------|-----------------------|-----------------------------------|
| PCF (N) | 1823.17 \pm 103.65 | 1492.03 \pm 240.34 ^a |
| MCF (N) | 1391.77 \pm 99.45 | 1139.94 \pm 118.49 ^a |
| MEF (N) | 894.03 \pm 48.54 | 867.93 \pm 64.23 |

Notes, a = significantly difference from conventional deadlift, $p < 0.05$

4 DISCUSSION

This study is among a new study been conducted on comparing the ground reaction force between conventional deadlift and hacklift. Previous studies were only conducted on other types of deadlift such as Romanian and sumo type. Thus, through this study, we would be able to know the effects of placing the barbell in front or behind body on the ground reaction force, which reflect how much force the body produced. Results showed that differences only existed during concentric phase and not during eccentric phase. The force produced during concentric phase in conventional deadlift was found to be higher than hacklift and it is just like being predicted earlier due to the nature of movement of conventional deadlift which need the participant to bend the knee more and push upward harder. In contrast, mean force during eccentric phase was shown to be no difference between both exercises. If the result was been compared between concentric and eccentric, the reading in concentric is higher than eccentric. The result of this study is supported by Fauth et al. [17] that also stated in his study that concentric phase produce greater muscle activation and force than eccentric.

5 CONCLUSION

Findings of this study demonstrated the conventional deadlift produced greater stimuli for muscle strength and hypertrophy adaptation through the greater force that been produced especially during the concentric phase.

6 ACKNOWLEDGMENT

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