The effects of stance width on muscle activation and performance during Romanian deadlift exercise

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Abstract. This study was conducted to determine the effect of different stance-width; i) narrow, ii) shoulder and iii) wide, on muscle activation and performance during Romanian deadlift (RDL) exercise. Thirty recreationally resistance trained men aged of 19-23 years old (22.20±1.13) were involved in this study. The participants need to perform RDL with 80% of their 1RM in three sessions with three difference stances in randomized order. To measure the muscle activation level during performing the exercise, the electromyogram (EMG) marker was placed on vastus lateralis, biceps femoris, gluteus maximus and multifidus muscles. The number of repetitions completed during each sets was recorded as indicator for performance. The mean EMG value during concentric and eccentric movement along with the number of repetitions completed were analysed using one way repeated measure analysis of variances (ANOVA). The result showed no significant differences were found on EMG reading of vastus lateralis and bicep femoris during eccentric and concentric phase of RDL when three different stances were used. However, when wide stances were used, a significant difference was observed on gluteus maximus whilst significant differences on multifidus were obviously seen when narrow stance were used. Higher number of repetition completed was significantly found when wide and shoulder width stances were used compared to narrow stance. The results of this study revealed the importance to choose correct stance width (depending on training objective) while performing RDL due to its effects on the muscle activation and performance.

Keywords: Romanian deadlift, stance width, muscle activation, performance

1. Introduction

Resistance training is one of the variations of physical training that can be defined as the training that exerts force or resistance progressively. Resistance training was traditionally used for developing hypertrophy of muscle especially for those athletes in bodybuilding and power lifting competition [1-3]. In recent decades, resistance training had been known as not only beneficial for increasing strength, power and hypertrophy, but also was adopted as a part of rehabilitation process [4, 5].

Deadlift, bench press and squat are three exercises routine that commonly used by strength and conditioning practitioners in their training program. These exercises had a great impact on improving the strength and power which helps the athlete to improve their performance. Deadlift is a posterior closed-kinetic chain exercise that target on leg and lower back muscle [6]. Besides conventional
deadlift, few variations of deadlift can be performed in a resistance training program such as sumo deadlift, single leg deadlift, hexagonal barbell deadlift, stiff-legged deadlift, and Romanian deadlift (RDL).

RDL is one of the deadlift variations that always been performed to target more on the hamstrings. While conventional deadlift is performed by mimicking picking a load from the floor by bending down, RDL is reverse to the conventional deadlift as the performer hold the load in standing position and lowering the load until the lowest point of flexibility [7]. RDL motion is almost similar with stiff-legged deadlift, but this type of deadlift performed with the knee was slightly bent at 15° while lowering the load to the floor. The performer need to lower the load by maintaining the load closed to body. This variation of deadlift mainly activate muscle on hamstrings and lower back more than conventional deadlift as it is performed with knee slightly bent at starting position [8].

To date, as of authors’ knowledge, no study had yet determine the effect of stance-width on the muscle activation and number of repetitions completed during RDL. It has been previously shown that stance-width resulted in significant effect on range of motion and peak acceleration during deadlift and squat exercises [9]. Unfortunately, there was no effect on muscle activation level possibly due to the used of light weight (10 kg) in that study.

Therefore, this current study was conducted to determine the effect of three different stances which were narrow, shoulder, and wide stance on the number of repetitions completed and the level of muscle activation (vastus lateralis, bicep femoris, gluteus maximus and multifidus) during RDL.

2. Methodology

2.1 Participants
Thirty male participants that met the inclusion criteria were selected. The inclusion criteria of participants involved in this study were: i) aged of 19-23 years old; ii) recreationally resistance trained; iii) able to perform 1 Repetition Maximum (1RM) for RDL with minimal load of 1.5 of their body weight; iii) do not have any history of injuries or any limitation to perform the RDL exercise; and iv) male.

The participants were excluded if; i) incompetent to understand and feel forceful to complete the task along the session; ii) unable to perform the RDL exercise successfully with proper technique; and iii) failed to execute Romanian deadlift at minimum of 1.5 or their body weight in 1RM.

All the participants were briefly explained about the objectives of the study conducted, the procedures that must be followed, the risks and the benefits of being participated in this study. Prior to the data collection, the participants completed the Physical Activity Readiness Questionnaire (PAR-Q) and consent letter. Participants were explained that they can withdraw from this study at any time, without having to give specific reason.

2.2. Procedures
All participants underwent the first session that was conducted to collect the demographic data such as height, age and body mass. Then, the familiarization session was conducted where the participants were briefed and shown the proper execution of RDL until they can execute it correctly. The participants were asked to use pronated handgrip to hold the bar at hip level; lock the back by arched the body and knee was slightly bent. The participants were asked to use any stance that they comfortable with during this session. Next, the participants were needed to lowering the load to the maximum range of motion by maintaining the bar closed to the shin. The maximum range of motion was determined by placing the load just beyond the knee level. After reaching the maximum point of range of motion, the participants need to return to the starting position. After participants were found to have mastered the RDL technique, 1RM test was conducted. The 1RM test was conducted according to the guidelines provided by National Strength and Conditioning Association [10]. The
IRM value was recorded as it will be used as the calculation for the loads needed to be lifted during the data collection of the different stance width effects.

For the second session, the participants were required to lift 80% of their 1RM that was determined during the first session. Participants performed the RDL by using one of the three stance width required at one time. The order of stance width was counterbalanced so that there are no effects of order. During this session, the participants were asked to use self-selected pace to make sure that the participant performed the RDL in a proper execution. The execution was also performed with pronated handgrip by using Olympic barbell. For safety reason during lifting session, few spotters were present to avoid any possibility of failure to lift the load since the submaximal load was used within this study. The mean value of muscle activation level during eccentric and concentric phase were observed during the testing sessions.

2.3. EMG Marker Placement
To measure the muscle activation level during the study, the participants were asked to wear comfortable but minimal clothing (short and close-fitting athletic shorts) due to the used of motion-tracking and EMG electrodes that had been attached the skin to enhance the reliability of the EMG reading. To make sure the conductance of EMG electrode during the testing, participants’ skins were prepared by shaving, abrading and cleaning before attaching the EMG marker. Muscle activation level of the vastus lateralis, biceps femoris, gluteus maximus and multifidus were collected using wireless EMG (TrignoDelsys) based on procedures recommended [11, 12].

2.4. Statistical Analysis
The data of the study was analyzed by using Statistical Package of Social Science (SPSS) version 20. Descriptive statistics were used to obtain the mean and standard deviation of physical characteristics and data score. One-way repeated measure analysis of variances (ANOVA) was used to compare the muscle activation and the number of repetitions completed during the RDL execution with the three different stance width. Significance value for all statistical analyses within this study was set at a p-value of less than 0.05.

3. Results

3.1 Physical characteristics

| Variables       | Mean ± SD |
|-----------------|-----------|
| Age (years)     | 22.20 ± 1.13 |
| Body Mass (kg)  | 70.21 ± 3.64 |
| Height (cm)     | 170.30 ± 3.31 |

Table 1 showed the physical characteristics (age, body mass, height) of participants involved in this study.

3.2 EMG during concentric phase of RDL
Analysis of concentric phase data showed significant main effects were found in the gluteus maximus, F(2, 58) = 338.97; p = 0.000, and multifidus, F(2, 58) = 302.19, p = 0.000. No significant main effects were found in this study for both vastus lateralis, F(2, 58) = 0.46; p = 0.634 and biceps femoris, F(2, 58) = 2.07; p = 0.135. Table 2 showed EMG reading during concentric phase of RDL.
Table 2. EMG reading of muscle activation level during concentric phase of Romanian deadlift.

|        | Wide       | Shoulder   | Narrow      |
|--------|------------|------------|-------------|
| VL mean (% MVIC) | 24.09 ± 0.37 | 23.90 ± 0.33 | 23.73 ± 0.36 |
| BF mean (% MVIC)  | 73.13 ± 0.39  | 73.67 ± 0.37  | 72.55 ± 0.38  |
| GM mean (% MVIC)  | 54.10 ± 0.40bc | 47.28 ± 0.45ac | 46.31 ± 0.41ab |
| MF mean (% MVIC)  | 67.16 ± 0.35bc | 67.43 ± 0.44bc | 74.98 ± 0.36ab |

a = significantly difference from wide shoulder stance width, p < 0.05  
b = significantly difference from shoulder stance width, p < 0.05  
c = significantly difference from narrow stance width, p < 0.05

3.3 EMG during eccentric phase of RDL

Analysis of eccentric phase showed significant main effects were found in the gluteus maximus activation where F(2, 58) = 204.982; \( p = 0.000 \), and erector spinae muscle, F(2, 58) = 215.184, \( p = 0.000 \). No significant main effects found for vastus lateralis, F(2, 58) = 1.604; \( p = 0.210 \) and biceps femoris, F(2, 58) = 0.363; \( p = 0.697 \). Table 3 showed an EMG reading during eccentric phase for RDL.

Table 3. EMG reading during eccentric phase for RDL

|        | Wide       | Shoulder   | Narrow      |
|--------|------------|------------|-------------|
| VL mean (% MVIC) | 24.09 ± 0.37 | 23.90 ± 0.33 | 23.73 ± 0.36 |
| BF mean (% MVIC)  | 73.13 ± 0.39  | 73.67 ± 0.37  | 72.55 ± 0.38  |
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a = significantly difference from wide shoulder stance width, p < 0.05  
b = significantly difference from shoulder stance width, p < 0.05  
c = significantly difference from narrow stance width, p < 0.05

3.4 Number of repetitions

Analysis of number of repetitions that were completed by the participants showed a significant main effects; F(2,28) = 37.152; \( p = 0.000 \). The data collected on the number of repetitions completed were found to be significantly greater during wide stance compared to both shoulder width stance \( (p = 0.032) \) and narrow stance \( (p = 0.000) \). On the other hand, shoulder width stance showed a significantly greater number of repetitions completed during RDL compared to narrow stance \( (p = 0.000) \). Table 4 showed the mean (SD) value of number of repetitions completed by the participants during RDL at 80% of 1RM.

Table 4. Number of repetitions completed during eccentric phase for RDL

|        | Wide       | Shoulder   | Narrow      |
|--------|------------|------------|-------------|
| Number of reps | 8.17 ± 0.99bc | 7.80 ± 0.66bc | 6.97 ± 0.72ab |

a = significantly difference from wide shoulder stance width, p < 0.05  
b = significantly difference from shoulder stance width, p < 0.05  
c = significantly difference from narrow stance width, p < 0.05

4. Discussions

The objective of this study was to compare the activation of muscles and performance during RDL exercise. The number of repetitions that can be completed by participant was observed as indicator of
performance during RDL exercise. Previous study claimed that difference stance does not affect muscle activation level might be due to the light loads used [9]. Thus, by concerning the limitation from previous finding, the present study was conducted by increasing the loads up to 80% of 1 RM.

EMG reading revealed that gluteus maximus significantly activated more during wide stance width compared to the other two stance. On the other hand, multifidus was most activated during narrow stance compared to shoulder-width and wide stance. No statistical differences on vastus lateralis and bicep femoris were found when comparing the three stance width. Wide-stance and shoulder-width stance showed a greater numbers of repetition completed compared to narrow stance.

By looking at the muscle activation as per MVC data, it can be seen that biceps femoris recorded the greatest percentages of activation followed by multifidus, gluteus maximus and lastly vastus lateralis.

This result was compatible with the early study that revealed the great activation of hamstring muscle during execution of RDL, which involve external knee rotation movement [13]. It was also reported that the remarkable activation of bicep femoris was due to its pennate structure of muscle that lead to a great production of torque which play an important role during hip extension [14]. The present study showed no significant differences of EMG reading on bicep femoris between three types of stance-width used. The activation of hamstring during RDL could be caused by the movement of knee where it was slightly bent while the hip joint was extending and the movement of trunk that lean forward during the exercise [15]. Knee joint angle also play an important role in the activation of quadriceps. The larger degree of knee joint angle lead to the smaller activation of vastus lateralis [16].

Another variable measured within this study was the number of repetitions completed by the participants. The wide and shoulder width stance showed higher number of repetitions completed as compared to narrow stance. The possible reason was the lower back muscle seem to be less stressful when wider stance were used thus the performer can resist the training with more repetition.

Besides that, the position of bar during narrow stance was further as compared to other stances. Thus it takes a longer time to complete the repetition. Shoulder-width stance also helps the lifters by having a smaller distance of center of gravity thus, increase the stability during the lifting phase [17, 18]. The result of the present study that showed smaller number of repetitions done by the participants also aligned with the previous study which is due to the increasing of knee angle as the squat performed with narrow stance [19]. Besides, another possible reason of higher numbers of repetition was the wider stances help the performer to reduce the motion sickness while performing the exercise [20]. In the aspect of postural control strategies, the wider stance helps the body to have a center-of-mass control with the present of active and passive mechanism to maintain the posture [21]. Thus this finding might be a reason why the wide and shoulder width stance had greater numbers of repetition compared to narrow stance.

5. Conclusion
The findings of this study revealed that changing the stance width have affected the muscle activation and performance during RDL exercise. It can be seen here if the individuals want to increase the activation and performance during the training, performing with wider or shoulder width stance are more beneficial compared to narrow stance. Performing RDL with narrow stance increase the activation of the lower back, which something that need to be further investigated, considering the risks it might cause. It is hoped that the findings of this study could be used as the guidelines for coaches, athletes, trainers and practitioners to choose the right stance width to be adopted during resistance training particularly during RDL in order to achieve the individuals’ objective.
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