

The Effect of Method of Instruction Given on Muscle Activation and Kinematic During Vertical and Horizontal Based Strength Training



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Abstract: Lunge and squat exercises are two exercises mainly used in strength training due to its multi-joint, structural and free weights nature and benefits. Main aim of this study is to determine the effect of verbal and video-based mode of instructions on both exercises. Joint angles and muscle activation were measured as an indicator or determinants of the effect of the exercises. Thirty male participants were recruited and involved in two testing occasions. Results of the study indicated no significant differences for both exercises in term of all determinants measured. As a conclusion, mode of instructions may give variety to teaching and learning approach for both exercises, but it produces similar effects. Most important is to ensure in any mode of instructions utilized, the technical aspects given are based on correct biomechanical cues for optimal mechanical effect.

Index Terms: Lunge, Squat, Verbal, Video, Biomechanics

I. INTRODUCTION

While types of exercise seem to be the determining factor in specific movement adaptations, the way the technique of the exercise being given to the athletes has been said to also play a vital role. Excellent communications typically being said as one of the indicators of a good sports coach. However, the way the communication being done seems more important when it involves technical instructions, such as exercise technique instructions. Due to this, proper methods of instruction might need to be addressing first prior delivering certain new exercise technique to the athletes. Demonstration and verbal instruction are two methods that can help to provide information to help individuals perform a motor movement effectively [1-5]. Verbal instruction is verbal communications to others on how to perform motor skills. Demonstrations give advantages in conveying information about how to perform a skill with similar act being shown to the receiver.

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Demonstration of a movement can use live model or model that are recorded and shown through a video, in which case, the model will show the proper technique to perform the movement. These two methods of instruction can either be used independently to each other or in combination of both. No matter what, both will have an effect on exercise technique performed by athletes [6, 7]. It is important to be noted that slight changes in exercise technique is known to also change the mechanical properties of the movement [8, 9].

For the purpose of peak sports performance, most of the time the aim is on producing the peak output from each mechanical movement of the performer. Mechanical properties of movement which produce kinetics output is actually influenced by muscle architecture that produces the movement [10, 11]. Muscle architecture have been shown to be correlated with several physical performances [12, 13]. Two types of muscle architecture properties that determine kinetics output are muscle fascicle length and muscle fascicle pennation angle [14-16]. At the same time, activation of the appropriate muscle in order to produce kinetics output for intended movement is determined by appropriate movement technique being executed [17, 18]. Thus, the most accurate ways to determine proper movement execution is by assessing which muscles has been activated and how much [19]. Both muscle architecture and muscle activation rate will then determine kinetics output of the movement [20-22].

In summary, therefore the aim of this study is to investigate the effect of methods of instructions given during training on muscle activation and kinematics. Second to it, the study is also comparing the effect of vertical versus horizontal based strength training on similar parameters.

II. METHODOLOGY

A. Participants

Thirty healthy and recreationally active volunteered male participants (age: 20-25 years old) without prior experience in strength training especially squat and lunges, were recruited for the purpose of this study. Participants recruitment were done in accordance with the ethical standards of the committee responsible for human experimentation and the Declaration of Helsinki of 1975 revised in 2008, as per required in the approval process of the study.



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B. Procedures

Participants had been asked to attend one familiarization session and two testing occasions. Research briefings and informed consent were obtained during the familiarization sessions. During the briefing's participants were also informed on their rights to withdraw at any stages of the study, without the need of reasons whatsoever.

Participants' privacy were ensured throughout the study process, with anonymity of participants ensured with code-number given during the familiarization session.

All participants performed randomly squat and lunges performance in two separate testing occasions. During both testing occasions, all variables of interest were measured. The participants during the testing occasions were asked stand on top of force platform and performed the exercises. At the same time the wireless electromyography (EMG) was used to measure muscle activation at muscles as indicated in Table 3 and 4 with motion analysis camera recording the movement for joint angle assessment later on. For accuracy of joint angle measurement, each joint involved as indicated in Table 1 and 2 for each participant has been marked with specific markers for motion capture. Raw data obtained were then analyzed and transferred for statistical analysis, with results as indicated in the finding section.

C. Statistical Analysis

One way ANCOVA was used to compare the effectiveness of strength training using the vertical (lunge) and horizontal (squat) to the kinematic output and muscle activation between groups that receive verbal instruction and group that receive video instruction. Significant level was set at $p < 0.05$.

III. RESULTS

The results of the study as produced output as indicated below.

Table 1: Results of One-way ANCOVA analysis for joint angle during lunges performance.

Joint Angle (°)	Mode of Instructions		Sig.
	Verbal (Mean ± SD)	Video (Mean ± SD)	
Right Ankle	62.52 ± 10.51	63.93 ± 8.36	0.657
Right Knee	105.34 ± 13.15	103.31 ± 12.80	0.581
Right Hip	92.33 ± 12.21	93.98 ± 12.03	0.675

Table 2: Results of One-way ANCOVA analysis for joint angle during squat performance.

Joint Angle (°)	Mode of Instructions		Sig.
	Verbal (Mean ± SD)	Video (Mean ± SD)	
Right Ankle	58.34 ± 9.06	58.00 ± 6.85	0.162
Right Knee	102.38 ± 19.94	104.90 ± 17.80	0.639
Right Hip	89.56 ± 15.52	92.78 ± 16.29	0.471

Table 3: Results of One-way ANCOVA analysis for muscle activation during lunge performance.

Muscles Involved	Mode of Instructions		Sig.
	Verbal (Mean ± SD)	Video (Mean ± SD)	
Biceps Femoris	241.12 ± 231.78	256.75 ± 117.21	0.698

Gastrocnemius Lateralis	875.55 ± 1366	957.69 ± 1470	0.875
Gastrocnemius Medialis	548.84 ± 627.94	726.87 ± 685.16	0.459
Vastus Lateralis	349.87 ± 428.70	380.04 ± 405.11	0.846

Table 4: Results of One-way ANCOVA analysis for muscle activation during squat performance.

Muscles Involved	Mode of Instructions		Sig.
	Verbal (Mean ± SD)	Video (Mean ± SD)	
Biceps Femoris	66.93 ± 47.10	81.48 ± 93.43	0.451
Gastrocnemius Lateralis	472.00 ± 663.50	472.01 ± 767.71	0.983
Gastrocnemius Medialis	331.05 ± 206.64	346.93 ± 240.24	0.843
Vastus Lateralis	79.66 ± 60.40	62.22 ± 34.93	0.285

IV. DISCUSSIONS

Results obtained indicated that in contrary to perceptions, both lunges and squat performance do not have any significant differences in term of technical aspect changes, when either using typically used verbal instructions or video mode of instructions. Technical aspects assess in this study has covered two main factors that influence stimulus and responses of both exercises. The first mechanical aspect that would determine the mechanical stimulus of both exercises were the joint angle utilized by the performers.

From the joint angle utilized, it will affect the muscles that was activated. In both mechanical aspects, all produced non-significant results. As indicated here, the chain of reactions started with the joint angle selected, and with that others responses produced. Thus, it can be safely said that whatever muscle activation expected or aimed in squat and lunges exercises, it should always start with modifications of joint angle technical modification. Thus, no matter what mode of instructions used, the focus should firstly be on giving technical advice related to joint angle execution during each phases of the exercise. With that, the desired outcome will be obtained.

As a conclusion, squat and lunges exercises has always been considered two main exercises in strength training with higher degrees of difficulty levels for beginners. Utilizing any mode of instructions is only beneficial as long as the technical focus in the instructions is correct (joint angle utilization).

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