Journal of Engineering and Science Research 2 (1): 06-10, 2018
e-ISSN: 2289-7127

DOI: 10.26666/rmp.jesr.2018.1.2

Lunge as a Sport-specific Exercise: A Mini Review

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Abstract: As a way to enhance performance in sports, apart from in-field or in court training, athletes are recommended to adopt resistance training into their training routine. As an exercise that needs the performer to split their legs, lunge is suggested to be included as an exercise in a training session. Various researches had been conducted on lunge and several findings showed different methods or protocols of lunge affect the kinematics, kinetics muscle activation and fascicle behaviour response during the exercise. Although not much study conducted on the chronic adaptations, the existing studies suggested that performers should well plan the training protocols as this will cause different training adaptations.

Key words: *Lunge*, *Specificity*, *Biomechanical Response*, *Training Adaptation*, *Physical Abilities*

LUNGE AS A SPORT-SPECIFIC EXERCISE

In parallel to the expansion of body of knowledge, the strength training programs that is planned to be developed can be referred to a lot of sources which has been proven in researches that had been conducted over the years [1-2]. Through various researches, the concept of specificity in training has received considerable mention and attention over the past decade [1]. Thus, it is important to analyse the movements performed in a specific sport as the more similar the training activity is to the actual sport movement, the greater the likelihood of positive transfer to performance [1].

Most movements in sports involve an athlete to split apart their feet so that one foot is in front of the other [3]. Several benefits evolved when performing exercises with one limb such as the ability to reduce bilateral deficit [4], detection of muscular imbalances [5-6] and the greater proprioceptive demand while performing the split position [7]. Looking at the criteria of one limb splitted, lunge exercise seems to be an appropriate exercise to be used in training. Additionally, to better train the body to become functional in various directions, lunge exercise is suggested to be included in the training program [8-10].

One of the most performed lunge technique is the forward lunge. Forward lunge started with a front step followed by a backward push. In order to enhance its effectiveness, the forward lunge should be performed with the lead leg been brought far to the front as in descent phase, the knee should not exceed the toe. There are various types of lunge pattern exercises that have been used as assessment tools for measuring strength, flexibility, and balance [11-13]. Given the relevance of the lunge pattern to sport and the necessity of the strength and conditioning specialist to load the movement pattern to enhance performance, lunge training could be one of the most specific resistance exercises to many athletes. However, in order to achieve desired outcomes, the lunge training could be adjusted as different lunge training has also demonstrated different adaptations [14-16].

Badminton is one of the sports that involved a lot of lunge movement in the game. A video-based pilot study had confirmed the relatively high frequency of lunging, approximately 15% of all movements, in a competitive singles games [17]. The important of lunge in a game could be seen when the player want to retrieve a drop shot where the player need to do a deep lunge to get to the shuttlecock. Sturgess and Newton

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[10] had highlighted the importance of the ability to accelerate from receiving stance to retrieving a drop shot. The usage of lunge as an important movement was not only in badminton, but also in other sports such as during reaching the ball in other racquet sports (tennis and squash), defending or attempting to steal the ball in football and many more. Throughout the consistency of lunge used in sports, lunge exercises should be used widely as training exercises during strength training program. The inclusion of lunge as training exercises should be beneficial as it will allow athletes or individuals to train and improve their ability for the movement and as a way to overload the athletes or individuals, various methods of lunge could be implemented during training sessions [18]. This includes putting some weights and includes ballistic movement during the exercise [15, 19-21].

BIOMECHANICAL ANALYSIS OF LUNGE

Previous studies have shown that different lunge techniques have cause different mechanics during the movement [14, 17, 22-24]. For example, Flanagan, Wang [25] found the lateral lunge targeted the ankle plantar flexors, producing greater dorsiflexion angles, joint moments, impulse and mechanical energy expenditure compared to forward lunge. In contrast, forward lunge was found to target the hip extensors, producing a greater flexion angle, peak joint moment, joint power, and mechanical energy expenditure compared to lateral lunge. In line with Flanagan, Wang [25], Riemann, Congleton [26] also found forward lunge to target the hip extensors while lateral lunge prompted greater ankle flexion and greater ankle and knee extensor kinetic contributions.

Previous studies had been conducted on comparing the muscle activity during lunge with different methods [14, 27, 28] and equipment [24, 29]. Research on lunge has examined the muscle activation on different legs [30], in fatigue conditions [31], ratio of muscle activation [32, 33], different muscle activation across genders [34], and how this compared to other exercises [35, 36]. As such, Kim and Yoo [24] compared the use of variety of foot wedge boards on vastus medialis (VM) and vastus lateralis (VL) muscle activities and the VM/VL ratios among 20 asymptomatic males. Result demonstrated the use of medial and posterior wedge boards during the lunge exercise can selectively strengthen the VM muscle. All these studies showed that performing different protocols of lunge exercise will provide different acute biomechanical response.

Several studies had also been conducted on the biomechanics of lunge specific to sport. Williams and Kuitunen [37] conducted a study aimed to determine and compare the ground reaction forces produced during simulated forehand and backhand lunge shot among experienced juniors and developing juniors in squash. Results demonstrated no significant differences between any variables tested when comparing forehand and backhand, thus showed similar force magnitude and kinematics were produced although participants were using alternate legs during the lunge movement. Due to slightly straighter leg with a more flat-footed strike during landing among developing junior group, it was found that this group produced higher impact loading forces and lower initial impact forces. The development junior group has been shown tended to begin knee flexion later, after the foot was completely flat on the ground, suggesting the inexperienced players had not yet developed the appropriate coordination and movement skills, or strength, to reduce this aspect of the impact force [38].

Recent studies conducted by Nadzalan et al [5, 6, 19-21, 39] found that biomechanical responses were difference across variations of lunge protocols. The greater loads were found to cause more effects on the forces production when compared to the speed of movement. Jumping movement on the other hand adding more forces production compared to step lunge. Besides kinetics, jumping and loadings were also found to induce more muscle activation, which is one of the variables for chronic muscle hypertrophy. However, looking in the sport settings, it seems that performing step lunge is more preferable for badminton players for its ability to be faster compared to jump movement.

CHRONIC EFFECTS OF LUNGE TRAINING

Researches on the chronic effects of lunge were not well established. Not many researches have been conducted on determining the effects of lunge as a single training exercise [15, 16, 40, 41]. Bloomfield [40] in his study examined the effectiveness of six weeks lunge training on balance control among elderly women. Results demonstrated that the exercise group managed to perform lunge with lower forward trunk

velocities, lower forward pelvis velocities, lower medial-lateral trunk velocities, and shorter step lengths compared to control group after training. The authors concluded that lunge training would benefit elderly women in terms of improving medial-lateral trunk stability during a lunge by decreasing peak medial-lateral trunk velocity.

Training different kind of lunge might provide different adaptations. For example, study by Jönhagen, Halvorsen [14] have found that a six weeks period of training with walk forward lunge improved hamstring strength, whereas training with jump forward lunge improved sprint running performance. The different of adaptations could be attributed to several factors such as different structural adaptations [15, 42] imposed by the different stimuli that was caused by the different methods of training.

Recent studies on the chronic adaptations were also conducted by Nadzalan et al. [15, 16]. These studies found that the both step and jump forward lunge treatment groups (SFL and JFL) had improved significantly in all tests. JFL was shown to have significantly greater improvement in lunge 1RM, lunge relative 1RM, vertical jump, and standing broad jump compared to SFL. Results demonstrated the superiority of JFL training compared to SFL in enhancing badminton specific physical abilities. Additionally, JFL was also found to be superior in altering muscle architectures of the lower body compared to SFL training.

CONCLUSION

As a sport-specific movement, the information on the kinematics, kinetics, muscle activity and fascicle behaviour during different protocols of lunge is very crucial. The mechanical differences shown by differences of exercises has raised the importance to understand the mechanics of both the movement used in sport and the exercises that to be included in the training program as this could potentially allow for better neuromuscular adaptations. The effects of using lunge as a single exercise in training programs would demonstrate how this movement specific lunge training will benefit the movement efficiency itself and how it can affected other physical performances such as jumping and agility performances. The information obtained would be useful for coaches, athletes and/or individuals in order for them to select the exercise to be performed in training to maximize the potential benefits [43, 44].

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